

**EVALUATION OF CURRENT PRACTICE OF ONLINE TINNITUS  
MANAGEMENT STRATEGIES AMONG AUDIOLOGISTS IN INDIA: A  
QUESTIONNAIRE-BASED STUDY**

**NAYANA T Y**

**20AUD019**

**A Dissertation Submitted in Part of Fulfilment of the Degree of**

**Master of Science**

**(Audiology)**

**University of Mysore**



**All India Institute of Speech and Hearing,**

**Manasagangothri, Mysuru-570006**

**August 2022**

## **CERTIFICATE**

This is to certify that this dissertation entitled “**Evaluation of Current Practice of Online Tinnitus Management Strategies Among Audiologists in India: A Questionnaire-Based Study**” is a bonafide work submitted in part fulfillment for the degree of Master of Science (Audiology) of the student with Registration Number 20AUD019. This has been carried out under the guidance of the faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru

August, 2022

**Dr. M. Pushpavathi**

**Director**

All India Institute of Speech and Hearing,

Manasagangothri, Mysuru- 570006

## **CERTIFICATE**

This is to certify that this dissertation entitled “**Evaluation of Current Practice of Online Tinnitus Management Strategies Among Audiologists in India: A Questionnaire-Based Study**” has been prepared under my supervision and guidance. It is also certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru

August, 2022

**Dr. Mamatha N.M.**

**Assistant Professor**

Department of Audiology

All India Institute of Speech and Hearing

Manasagangothri, Mysuru- 570006

## **DECLARATION**

This is to certify that this dissertation entitled “**Evaluation of Current Practice of Online Tinnitus Management Strategies Among Audiologists in India: A Questionnaire-Based Study**” is the result of my own study under the guidance of Dr.Mamatha N.M, Assistant Professor, Department of Audiology, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru  
August, 2022

**Registration No:**  
**20AUD019**

## ACKNOWLEDGEMENT

“The fear of the **LORD** is the beginning of wisdom”

(Proverbs 9:10)

It is not a fair task to acknowledge all the people who made this dissertation possible with a few words. However, I will try to do my best to extend my great appreciation to everyone who helped me scientifically and emotionally throughout this study.

I shall begin with God almighty to have bestowed upon me good health, courage, inspiration, zeal and the light.

I am truly indebted to my dissertation guide, Dr. Mamatha N. M, for giving me the wonderful opportunity to complete my dissertation under her supervision, it is truly an honor and also, thank you for giving me your valuable time and support to accomplish my study.

*Rony Roy* - Your support and motivation towards me will not fit with a word, thank you so much for being with me, without you I wouldn't have come to AIISH itself. I don't want to end all these help with a word of thanks.

*Sujisha, Audrey, Trupti, Swathi, and Sneha* you guys are the best in my PG life. Your companionship has helped make this endeavor enjoyable and rewarding.

I would like to thank all the *JRFs*, who help to complete this dissertation and you guys never hesitated to help us. I sincerely admire their contributions during the course of the study. Special thanks to *Syamettan and Durga chechi*.

With great appreciation, I shall acknowledge all my dear fellow batch mates and my dissertation partners *Akshay and Subham*, especially the *MAAN* group (*Monishakaa, Aishuu and Nethra*) for their support and caring through these two years of AIISH life.

I am grateful and express thanks to the honorable members of the Ethical Review Committee for giving kind approval to my research protocol. Special thanks to our beloved director *Dr. Pushpavathi* for allowing me to undertake this study

Finally, but by no means least, thanks go to my *Pappa, Amma and Achoo* for their prayers and unbelievable support. They are the most important people in my world and I dedicate this dissertation to them.

**TABLE OF CONTENT**

<b>CHAPTER</b>	<b>TITLE</b>	<b>PAGES</b>
	List of Tables	ii
	List of Figures	iii
	Abstract	iv
1	Introduction	1
2	Review of Literature	8
3	Methods	34
4	Results and Discussion	39
5	Summary and Conclusions	67
	References	70
	Appendix	I

**LISTS OF TABLES**

<b>TABLE NUMBER</b>	<b>TITLE</b>	<b>PAGE NUMBER</b>
1	The summary of etiologies affecting the tinnitus	16
2	Demographic details of the participants	42

## LISTS OF FIGURES

FIGURE NUMBER	TITLE	PAGE NUMBER
1	Flowchart depicting the entire method of the present study	38
2	Online Tinnitus management program offered by audiologists who are currently working in India at various setups	40
3	Overall percentage of the Tinnitus management program among the participants	44
4	Tinnitus management program offered by audiologists who are currently working in various setups in India	44
5	Overall percentage of the online Tinnitus management program among the audiologists who are currently working in India	46
6	Online tinnitus treatments offered by audiologists who are currently working in India	48
7	Online tinnitus apps for sound therapy offered or known by different audiologists	50
8	Responses of audiologists towards the need for providing psychologically focused online tinnitus therapy	55
9	Audiologists responses on Online tinnitus treatment options for tinnitus-associated psychologically related issues	56
10	Participants' response on Online tinnitus treatment options for tinnitus-associated cognitive issues	58
11	Participant's responses on the Challenges affecting online tinnitus management	59



## ABSTRACT

**Introduction:** Numerous smartphone apps and web-based software choices are available for online tinnitus management. Even though these online management options have been the subject of numerous research, their clinical utility has not yet been established.

**Aim:** The present study aimed to identify the most effective online tinnitus therapy strategy currently offered by audiologists in India.

**Method:** The study was carried out in three distinct phases: questionnaire preparation, validation, and administration. The developed questionnaire had six domains with a total of 37 questions that covered different areas, such as online and offline tinnitus assessment, management and outcome measures, strategies for managing tinnitus-related issues, and challenges, and was taken into account for validation. The final questionnaire which included 37 questions was circulated among more than 400 audiologists.

**Result:** 52 audiologists responded to the questionnaire, out of which 20 audiologists are doing online tinnitus management in India. The findings show that counselling, TRT, hearing aids, or a combination of any of these are the most preferred online tinnitus management options recommended by various audiologists. The majority of audiologists opted white noise and resound tinnitus reduction apps for sound therapy and they identified that patient computer illiteracy and lack of trained clinicians as the pivotal and prime obstacles to implement a structured online tinnitus management program.

**Conclusion:** The findings concluded a consensus opinion that the management of tinnitus through online mode should be tailored, moreover there is little standardized

practice on online assessment and management of tinnitus and hence there is a need for a well-explained protocol for implementing online tinnitus intervention program for individuals with tinnitus.

***Keywords:*** *Tinnitus, Online management, Audiologists*

## Chapter 1

### INTRODUCTION

Tinnitus is not a disease but a symptom of something wrong in the auditory system, including the ear, the auditory nerve that connects the inner ear to the brain, and the parts of the brain that process sound (National Institute on Deafness and Other Communication Disorders [NIDCD], 2021). Tinnitus has been defined as a phantom auditory perception more precisely, it is a sound perception without an actual correspondence of mechanical or acoustic cochlear correlates (Jasterboff, 1990). De Ridder et al. (2021) recommend that tinnitus without and with accompanying suffering be labelled differently: "Tinnitus" for the former and "Tinnitus Disorder" for the latter. The proposed definition is "Tinnitus is the conscious awareness of a tonal or composite noise for which there is no identifiable corresponding external acoustic source, which becomes Tinnitus Disorder "when associated with emotional distress, cognitive dysfunction, and autonomic arousal, leading to behavioural changes and functional disability." In other words, "Tinnitus" refers to the auditory or sensory component, but "Tinnitus Disorder" refers to the auditory component and the associated suffering.

Most of the people who were found to have experienced tinnitus have a neutral attitude to the sensation; however, this becomes an issue only for some individuals. Bothersome tinnitus (distressing) is typically an unpleasant emotional and auditory experience linked to or expressed in actual or probable bodily or psychological damage (Cima et al., 2019). For some people, tinnitus might be a problem, and it can be highly irritating during the hearing, sleep, mental processing, and other functions that are found to have negatively impacted one's quality of life (Jastreboff & Hazell, 1998).

A study was conducted by Manche et al. (2016) to determine the relationship between hearing loss and tinnitus in a population from South India with various otological disorders. Tinnitus was found in 29.3 % (956) of 3255 subjects with various otological diseases, with an increased prevalence in people older than 40 years. Diseases of the middle and inner ear significantly increased the risk of developing tinnitus. It was discovered that hearing loss affected 96.9% of the tinnitus subjects (Manche et al., 2016). Thirunavukkarasu and Geetha (2013) in a retrospective study investigated the prevalence and risk factors of tinnitus in older persons in India (60 years & older) who complained of ear and hearing-related symptoms for one year. The prevalence of ringing ears was found to be 16.81%.

Tinnitus is found to affect around 10–15% of the general population, but tinnitus affects 70–90% of patients who visit an otology clinic, either as a symptom or the primary complaint. Hearing loss is the most critical factor influencing the prevalence of tinnitus, and the risk associated with it is proportional to the degree of the loss (KochKin, Tyler & Born, 2011; Nondahl et al., 2011, 2002; Shargorodsky, Curhan, & Farwell, 2010).

The severity and impact of tinnitus on an individual are found to vary greatly depending on the kind of tinnitus and also from person to person. It may frequently change its pitch and loudness characteristics leading to varying psychological attitudes and confusion among individuals. Tinnitus is prevalent, although only a tiny percentage of people experience discomfort or other issues. Many persons who do not have tinnitus in their typical surroundings were found to have developed tinnitus when placed in a quiet room, such as an audiological test booth (Makar et al., 2012).

Tinnitus has been linked to the discomfort of affective (emotional) symptoms in certain people and it becomes an issue when limbic structures (the emotional brain)

get aroused. Tinnitus is divided into subjective, objective, primary, or secondary categories, and it is further divided into categories based on how long it has been present. Objective and subjective tinnitus are the two basic types of tinnitus. Sounds created in the body and transmitted to the ear cause objective tinnitus, and it could be produced by blood flow turbulence or muscle spasms. Subjective tinnitus is found to have minimal physical correlations, and there are no apparent indicators of sickness. Subjective tinnitus can take several forms, including high-frequency sounds like crickets, high- or low-frequency tones, and persistent or pulsatile tinnitus (Møller & Møller, 1993).

The most difficult of the typical hearing impairments is the subjective type of tinnitus. So far, the existing treatments have had varying degrees of effectiveness and several therapies are in use, and even more, have been attempted and abandoned. The objective of therapy for individuals with severe tinnitus is to remove the symptoms; however, this is seldom achieved. However, it is feasible to minimize some of the consequences of tinnitus such that a patient's quality of life improves and they may be able to work despite the disorder's residual effects. This implies that by managing tinnitus, the patient's quality of life may frequently be improved. It is clear that intervention is unnecessary for many people with chronic tinnitus; nonetheless, the severity of symptoms may be bearable. Medical therapy was the most often suggested option for tinnitus management, even though it is not indicated. The recommendation against medical therapy is based on a lack of data from experimental trials and meta-analyses that shows a decrease in tinnitus perception (Tunkel et al., 2014)

However, the type of therapeutic intervention used to treat people with tinnitus focuses on reducing the burden of tinnitus on daily living rather than eliminating the experience. The four psychosocial repercussions of devastating tinnitus are

employment status, somatic diseases, psychic disturbances, and psychosomatic disturbances. These outcomes form a vicious feedback cycle by compounding the discomfort produced by tinnitus. Tinnitus has been linked to several medical and mental illnesses (Jastreboff et al., 1998). As a result, it has various implications on human existence, including psychological aspects and life quality. Makar, Biswas, Shatapathy (2014) investigated the audiological and psychological correlates of tinnitus in an Indian community and found that 60% of patients had no idea what was causing their tinnitus. 74 % of the participants said their tinnitus pitch did not change. However, 68 % of respondents said that the volume fluctuates. There was a link between the impact of tinnitus and sleep disturbances and an increase in despair and irritability. However, no significant association was found between tinnitus-related suffering and tinnitus duration (Makar et al., 2014).

The majority of empirical data on tinnitus management is based on behavioral interventions, including sound therapy, counseling, education, stress reduction, and coping strategies. Sound amplification/sound generators, tinnitus retraining therapy, and cognitive behavioral therapy are some of the most regularly utilized treatments for individuals with tinnitus (Tunkel et al., 2014; Henry et al., 2008). Tinnitus may be treated using various methods, including experimental studies and commercial products that have been noted in the literature. They include questionnaires, auditory treatments, internet-based cognitive behavioral therapy (iCBT), and tinnitus monitoring and management games on many operating systems, including web/android/iOS (Beukes et al., 2018; Kalle et al., 2011).

In recent years, there has been a surge in interest in using the internet and smartphone-based technology for managing tinnitus. A study on available literature on online tinnitus management conducted between 2017 and 2018, concluded that

mobile applications can provide an effective and user-friendly platform for individualized therapy and tinnitus treatment planning. Patients with tinnitus may benefit from a combination of cognitive-behavioral therapy (CBT) and sound therapy provided through a smartphone app (Abouzari et al., 2021).

To investigate the efficacy of internet-based CBT, an internet-based audiologist-guided CBT was conducted on a tinnitus population speaking English and Spanish. The findings suggest that when compared to weekly monitoring using an intention-to-treat analysis, Internet-based CBT resulted in a greater reduction in tinnitus distress. Secondary outcomes included a greater reduction in tinnitus-related conditions such as cognition and insomnia (Beukes et al., 2022). A review of 200 tinnitus therapy apps found that the development of tinnitus treatment apps and web-based platforms will have a significant impact on people's daily lives with tinnitus (Nagaraj & Prabhu, 2020).

### **1.1 Need for the study**

Online tinnitus treatment is increasing day by day and offline therapy is becoming more complex since owing to the Covid 19 scenario. Due to Covid 19, not only tinnitus sufferers but also other disordered populations were not receiving adequate care and treatment. As a result, online therapy is found to be most excellent alternative for providing behavioral rehabilitation services for the disordered populations (Polinski et al., 2016). Based on a survey it has also been noted that around 95% of patients among 1734 got benefit from their telehealth visits for an online treatment since the treatment received was from the comfort of their homes (Polinski et al., 2016). Taking appointments and visiting the clinic for treatment may necessitates in taking time off from work. Online treatment will be effective particularly if the patient is hesitant to visit a health clinic, hospital, or other

institution and can obtain treatment discreetly and anonymously, without the knowledge of family, friends, or colleagues. It has been observed that patients preferred synchronous telehealth therapy for behavioral health and it was found to be convenient and reduced treatment barriers (Lin et al., 2020).

Numerous smartphone applications and web-based software alternatives are the tools used in tele audiology services, even though the effectiveness of these management systems is still questionable (Nagaraj & Prabhu, 2020). A lot of limitations exists in delivering these contemporary technology-based services such as computer literacy, network issues, lack of trained professionals, etc. especially in the Indian context. Lack of literature and research in these stream of online tinnitus management is another barrier (Ramkumar, 2020; Ramkumar et al., 2016). Also, there exists nonuniformity, no well-known published protocol for online management of individuals with tinnitus and therapeutic approaches for treating the associated conditions related to tinnitus such as cognition and psychological aspects. Hence, it is important to assemble such information into a questionnaire to establish the current practice in online tinnitus care and practice across diverse audiologists in India. The information obtained will give an idea about the various structured methods used to deliver online management of individuals with tinnitus, psychological and/or cognitive perspective of tinnitus management and various challenges faced by audiologists and individuals with tinnitus while choosing and carrying out online tinnitus management options.

There are many western studies on online tinnitus management, but there is a dearth of literature in the Indian context (Nagaraj & Prabhu, 2020). Hence, there is a need to investigate different online tinnitus management strategies that are used in Indian context, as well as treatment options for tinnitus-related conditions such as



cognition and psychological issues.

## **1.2 Aim**

To determine the currently available efficient online tinnitus management options among audiologists in India.

## **1.3 Objectives**

- To determine which smartphone app and tinnitus management option is more widely used by audiologists for tinnitus management.
- To determine the online tinnitus management options available for patients with tinnitus associated with psychological issues.
- To determine the alternative treatment options available for patients with tinnitus associated with cognitive difficulties.
- To identify the difficulties faced by the audiologists while managing individuals with tinnitus through online mode.

## Chapter 2

### REVIEW OF LITERATURE

Tinnitus is one of the most prevalent chronic otological conditions in individuals, that causes a wide range of emotional and psychological repercussions. Tinnitus is found to affect around 10 to 30% of the elderly population worldwide as reported by epidemiologic studies (Oosterloo et al., 2021; Manche et al., 2016; Konadath et al., 2013). The effect of tinnitus varies among the population; most people have a relatively mild form of tinnitus, but some people have chronic impacts on their quality of life due to the ringing sensation (Vernon & Sanders, 2001).

Subjective and objective tinnitus are the two standard types into which tinnitus can be properly categorized which can be caused by various organic factors such as hair cell and neuronal degeneration and non-organic causes such as stress, anxiety, etc. Assessment of tinnitus is reported to be carried out by obtaining a detailed case history along with various subjective and objective measures to find the possible etiologies, severity, and type of tinnitus. These assessment data are found to be helpful in selecting appropriate treatment options and documenting prognosis (Cima et al., 2019). And hence, more people are seeking tinnitus treatments and these therapies have been proven to be effective. Also, tele audiology has a significant impact on Audiological management in the present scenario, and this technological advancement has been utilised in dealing with individuals with tinnitus (Ramkumar, 2016). Many audiologists worldwide have been now employing online tinnitus management, including in India. However, the literature supporting this is relatively scarce in our country. Even though many audiologists use it, there are no specific standards or protocols used in online tinnitus therapy.

## 2.1 Incidence and prevalence of Tinnitus

The prevalence of tinnitus was evaluated in the general elderly population (n=6098) across age strata and hearing status from the city of Rotterdam, Netherlands. Tinnitus was found to be prevalent in 21.4 % of the participants (n = 1304) and was prevalent in all age groups over the course of the study between 2011 and 2016. Participants with hearing loss were more probable to have tinnitus than those without hearing loss (Oosterloo et al., 2021).

Research on tinnitus with hearing loss in the south Indian population reported that 29.3% (956) of patients were over 40 years and also there was a significant rise in the risk of tinnitus with middle ear problems. According to Manche et al. (2016), tinnitus is linked with hearing loss in 96.9% (n = 927) of the participants. In epidemiological research, tinnitus is a widespread condition for many individuals, ranging from 8 to 25.3 % in the United States (KochKin, Tyler & Born, 2011). Several small population-based surveys in other countries have shown similar findings, with prevalence ranging from 4.6 to 30%. Tinnitus is found to affect around 10% - 15% of the general population, but it also affects 70 – 90% of patients who visit an otology clinic, either as a symptom or the primary complaint.

The most critical factor that determines the prevalence of tinnitus is hearing loss, and the risk associated with it is proportionate to the degree of the loss (Nondahl et al., 2002, 2012; Shargorodsky, Curhan & Farwell, 2010). A survey was conducted on 15,441 people using a high-risk register to determine the prevalence of communication disorders in 15 villages in the Mandya district of Karnataka state in India. According to their findings, 9.6% of the overall population suffered from tinnitus. Tinnitus is also found to be more common in females than males in people aged 15 to 50 years (Konadath et al., 2013).

A systemic review from January 1980 to July 2015 on the adult population reported the prevalence of tinnitus in sixteen represented countries and most of the reflections came from Europe (38.5%). Each study's overall prevalence ranged from 5.1% to 42.7%. Twenty-six studies (66.7%) looked into the prevalence of tinnitus in various age groups and it was noted that it increased with age (McCormack et al., 2016). Thirunavukkarasu and Geetha (2013) investigated the prevalence and risk factors of tinnitus in older persons (60 years & older) in India who complained of ear and hearing-related symptoms in a retrospective study of one-year data. The results indicated that the prevalence of ringing ears was 81% and males comprised 60.9% of those experiencing tinnitus. Furthermore, 97.5% of those with tinnitus are accompanied by hearing loss. Similarly, 28.53% of tinnitus sufferers indicated they had a moderate hearing loss, followed by a moderately severe hearing loss, and the majority of them had sensorineural impairment.

According to an unpublished dissertation by Jose (2021), the prevalence of tinnitus in normal hearing people was 21% in people who visited the Department of Audiology at All India Institute of Speech and Hearing between January 2019 and December 2019. The prevalence of tinnitus in people with normal hearing was found to be highest in geriatrics (37.12%), followed by adults (26.86%), adolescents (13%), and children (1.27%). Their study results also indicated that tinnitus was found to be more common in females (24%) than in males (19%).

## **2.2 Pathophysiology of Tinnitus**

According to Henry, Dennis, and Schechter (2005), long-term exposure to noise (22%), head/neck traumas (17%), and infections (10%) have all been linked to tinnitus. Also, the most recent pathophysiologic hypothesis, tinnitus is reported to be driven by the central nervous system. According to several PET scanning and

functional magnetic resonance imaging (fMRI) studies, a loss of peripheral input to neurons in the central auditory system can result in altered neuronal activity in the auditory cortex (Fortune, Haynes & Hall, 1999), and ringing perception is linked to this activity. In addition, the neuronal feedback loops in the central auditory cortex that assist tune and strengthening auditory memory can lose their suppression (Lockwood, Salvi & Burkard, 2002). Normal synapse disinhibition occurs when this feedback loop disruption leads to uncontrolled alternative neural synapses, resulting in the abnormal auditory perception, literally known as tinnitus (Møller & Roberson, 1997). The intricate pathophysiologic mechanisms that generate tinnitus have been proven by recent breakthroughs in neuro-otometry, which have shown the locations where these processes occur (Hendry et al., 2014). Presently, it is recognized that anomalies cause around 24% of cases in the otoacoustic periphery, 35% by auditory pathways, and 41% by supratentorial structures. A reduction in inhibition and increased excitation may cause an excitatory-inhibitory imbalance in these areas, resulting in neuronal hyperexcitability and tinnitus perception (Landgrebe et al., 2009).

Makar (2021) conducted a systematic analysis of studies from 2004 to 2018 to identify multiple pathophysiologies of tinnitus, including inner ear disease, auditory nerve synchronization, central nervous system abnormalities, and limbic autonomous nervous system problems. Several objective investigations have found that cochlear dysfunction is followed by a slight imbalance of neuronal activity in the central route; this is recognized at low signal levels in the auditory systems, and since it is a novel signal, it is amplified by sub-cortical centres, conveyed to the auditory cortex, and interpreted as aberrant sound tinnitus. The auditory system's long-term involvement affects tinnitus sufferers' limbic and autonomic nervous systems. This research

supports the theory that tinnitus affects the entire brainstem and that multiple-feature tinnitus is produced by abnormal activity in the central auditory system (Henry et al., 2014; Hobson, Chisholm & el Refaie, 2012).

### **2.3 Etiology of tinnitus**

Tinnitus can be caused by pathological abnormalities anywhere along the auditory system. Tinnitus is most commonly caused by early cochlear lesions such as rapid hearing loss, loud trauma, presbycusis, or the use of ototoxic medications. These injuries can cause aberrant neuronal excitability in central auditory circuits, subsequently interpreted as tinnitus. Tinnitus can also be caused by abnormal auditory nerve alterations (Langguth et al., 2013).

Tinnitus can be subjective, objective, primary, or secondary categories and has subcategories based on how long it has been present. Objective and subjective tinnitus are the two basic types of tinnitus. Sounds produced in the body are sent to the ear, causing objective tinnitus. In objective tinnitus, a different reason is at work when an internal sound source can be recognized. Heartbeat synchronous pulsatile tinnitus is a common type of objective tinnitus induced by vascular anomalies such as arteriovenous malformations, carotid stenosis, dissections, or dilation of blood vessels such as in anemia (Makar, 2021).

Tinnitus is found to be frequently associated with sensorineural hearing loss. A comprehensive analysis of research articles from 2004 to 2018 indicated that hearing loss among individuals with tinnitus could be caused by noise exposure, age, and ototoxic medicines (Makar, 2021). According to some studies, it has been found that subjective tinnitus is impossible without hearing loss (American Tinnitus Association, 2019). Even those individuals with tinnitus and normal hearing exhibit considerable hearing loss at 10,000 to 20,000 Hz (Kaltenbach et al., 2002). According

to American Speech-Language-Hearing Association (2019) hearing loss is the sole recognized cause of subjective tinnitus, although loud noise exposure may also produce tinnitus.

According to population-based data, exposure to noise is the second most prevalent cause of tinnitus (Lockwood et al., 2002). Noise trauma is the most prevalent cause of tinnitus (18%), followed by head and neck injury (8%), and pharmaceuticals (most often salicylate) which is known to account just for 2% of known tinnitus occurrences, according to review study by Nuttall, Meikle & Trune (2004). Ototoxicity has been associated with bilateral subjective tinnitus in patients using salicylates, non-steroidal anti-inflammatory medications, aminoglycoside drugs, loop diuretics, and chemotherapy medications (American Tinnitus Association, 2019).

Age-related hearing loss, presbycusis is found to have directly linked to bilateral subjective tinnitus. This vital link between tinnitus and advanced age (60 to 69 years) points to cardiovascular disorders (Reyes et al., 2002). Emotional trauma is also found to have associated with the cause of tinnitus in around a quarter of cases that were reported to tinnitus clinics. A population-based study conducted to explore the etiology of tinnitus concluded that ringing ear can have a deleterious effect on an individual's psychological wellbeing. They also discovered a clear link between the psychological state and tinnitus, particularly in patients having depression (Yang et al., 2007).

Apart from psychological perspective of tinnitus etiology, organic causes are also reported by many authors. Neurologic causes include head traumas, multiple sclerosis, vestibular schwannoma, and cerebellopontine-angle tumors, whereas infectious groups include otitis media, meningitis, syphilis, and other hearing-related disorders. Tinnitus is a significant symptom of various medical conditions, including

metabolic disorders, hypothyroidism, anemia, autoimmune disorders, Lyme disease, fibromyalgia, vascular disorders, high blood pressure, and atherosclerosis; concussion can damage the central auditory processing landmarks such as superior olivary complex, medial geniculate body (MGB), thalamus etc., culminating tinnitus symptoms (Makar et al., 2021).

Organic causes not only limited to auditory-related dysfunction but also vestibular hyper or hypo functioning, eventually triggering to tinnitus perception. Tinnitus is linked to vestibular illnesses such as acoustic neuroma, vestibular schwannoma, and other tumorous growths (American Tinnitus Association, 2019). Ménière's disease, migraines, head injuries, and toxic chemicals or treatments have been noted to have related to tinnitus (ASHA, 2019).

Several researches examined the correlation between the auditory and somatosensory pathways, documenting changes in tinnitus loudness and pitch due to somatic activities such as jaw clenching or neck tensing. Trigeminal stimulation followed by auditory stimulation can influence both firing rates and temporal responses to sound. The inferior colliculus (IC) neurons, which receive converging signals from the dorsal cochlear nucleus (DCN) and somatosensory nuclei, recreate this bimodal integration (Makar et al., 2021).

Spontaneous otoacoustic emissions and middle-ear myoclonus are two more sources of objective tinnitus (Langguth et al., 2013). An observer may identify objective tinnitus through auscultation, although the individual suffering can only observe subjective tinnitus (Møller & Roberson, 1997).

Subjective tinnitus is found to have minimal physical correlations, and there are no apparent indicators of sickness. Subjective tinnitus is reported to have taken several forms, including high-frequency sounds like crickets, high- or low-frequency



tones, and persistent or pulsatile tinnitus. It is sometimes associated with hearing loss, which might develop after exposure to loud noises or after taking certain medicines, although the reason is frequently unknown. There is also evidence that tinnitus becomes fundamentally different from acute tinnitus after a while (chronic tinnitus) and this shift in time is noted to be crucial for tinnitus therapy, as data suggests that treatments are less successful when tinnitus has been present for more than five years (Møller & Roberson ,1997). Table 1 depicts the summary of etiologies affecting the tinnitus.

**Table 1***Table depicting the summary of etiologies affecting the tinnitus*

	<b>TYPES</b>		<b>SUBJECTIVE TINNITUS</b>			<b>OBJECTIVE TINNITUS</b>		
	Otologic	Neurologic	Infections	Drug-related	Other	Pulsatile	Muscular	Spontaneous
<b>CAUSES</b>	Noise-induced hearing loss, presbycusis, otosclerosis, otitis, impacted wax, sudden deafness, Meniere's disease, and other causes of hearing loss	Head injury, whiplash multiple sclerosis, vestibular schwannoma or other cerebellar-pontine angle tumors	Otitis media and sequence of Lyme disease. meningitis, syphilis, and other infectious or inflammatory processes that affect hearing	Common side effects of many drugs, Such as salicylates. Nonsteroidal anti-inflammatory drugs, aminoglycoside antibiotics, loop diuretics, and chemotherapy agent	Temporo-mandibular joint dysfunction and other dental disorders	Carotid stenosis, arteriovenous malfunctions, and other vascular anomalies. Vascular tumours, Vascular heart disease status of high cardiac output, and other conditions causing turbulent blood flow	Palatal myoclonus. Spasms of stapedius or tensor tympani muscle, patulous Eustachian tube	Spontaneous OAE

*(Lockwood AH, Salvi RJ, Burkard RF. Tinnitus. N Engl J Med. 2002 Sep 19;347(12):904-10. doi: 10.1056/NEJMra013395. PMID: 12239260).*

## **2.4 Associated problems of tinnitus**

The severity and impact of tinnitus on an individual varies greatly depending on type of tinnitus and from person to person. It frequently changes throughout time and in response to changing conditions. Tinnitus is prevalent, although only a small percentage of people experience discomfort or other issues. Many persons who do not have tinnitus in their typical surroundings will develop tinnitus when placed in a quiet room, such as audiological test rooms. According to a study on the Indian population, tinnitus sufferers have reported feeling uncomfortable, anxious, irritated, depressed, annoyed, distressed, and frustrated due to the multi-faceted effects. It has disrupted their enjoyment, relaxation, and sleep and forced them to avoid calm environments and social events (Makar et al., 2014).

Tinnitus has been linked to the discomfort of affective (emotional) symptoms in certain people. Tinnitus becomes an issue when limbic structures (the emotional brain) get aroused. The most difficult of the typical hearing impairments is subjective tinnitus. So far, the existing treatments have had varying degrees of effectiveness. Several therapies are in use, and even more, have been attempted and abandoned. The objective of severe tinnitus therapy is frequently to remove the symptoms; however, this is seldom achieved. However, it is frequently feasible to minimize tinnitus consequences such that a patient's quality of life improves and may work despite the disorder's residual effects. This implies that managing tinnitus may frequently improve patients' quality of life (Han et al., 2009).

Tinnitus sufferers' burden varies depending on both their auditory and mental health conditions, including but not limited to any combined effect of decreased sensation

of control, sleep disturbance, interference with relaxation, emotional distress, sadness, distress, annoyance, depression, anxiety and worry (Meikle et al., 2012). Pinto et al. (2014) observed a considerable incidence of mental health issues among tinnitus patients in a comprehensive study. The first psychological model of tinnitus-related misery was developed by Coles and Hallam (1987). The tinnitus perception is found to enhance autonomic arousal, inhibiting the ability to disregard the tinnitus perception, which raises autonomic arousal in a self-perpetuating loop. The model has been updated to incorporate avoidance behaviours in order to avoid habituation. McKenna et al. (2014) proposed a psychological model in which tinnitus-related distress is induced and perpetuated by negative thought patterns about tinnitus and inadequate safety responses. Anxiety and melancholy appear to be common among tinnitus patients (Rizzardio et al., 1998) and having an impact on their cognitive functioning.

Previous research has found that tinnitus patients had greater levels of anxiety and sadness than non-tinnitus patients (Stevens et al., 2007). Tinnitus discomfort may substantially influence the extent to which tinnitus affects cognitive performance. The prevailing notion is that "tinnitus may generate worry and emotional discomfort, which disturbs cognitive processes" (Stevens et al., 2007), and that "a higher allocation of scarce resources to the tinnitus experience" (Jackson, Coyne & Clough, 2014).

According to Beukes et al. (2021) in an exploratory cross-sectional study where 1,522 individuals with tinnitus were taken to analyze tinnitus help-seeking behaviour, which resources individuals utilized to manage during the pandemic, and how much more help is required. During the COVID-19 epidemic, this study looked into the various coping strategies that were used by persons with tinnitus and the medical and nonmedical

help needed for treating tinnitus. When comparing assistance seeking for tinnitus during the pandemic to before the pandemic, the amount of support aimed during the epidemic was much lower. Professional health care providers (8%), self-help resources (7 percent), the American Tinnitus Association (ATA) (3 %), and Internet treatments were all sought during the epidemic (2%). This decline in help behaviour during the epidemic was partly due to individuals being unable to receive or unaware that help was available.

It is self-evident that people with tinnitus have difficulty comprehending degraded speech and hence evaluation of temporal processing in these populations is necessary. Such a study is critical in identifying the relationship between peripheral and central processes in tinnitus formation and how they may affect auditory processing (Gilani et al., 2013). It was expected that when tinnitus patients were compared to non-tinnitus people using the Gap In Noise (GIN) and Duration Pattern Test (DPT), brain activity in tinnitus patients would induce irregularities in temporal processing (Gilani et al., 2013). The GIN test findings indicated auditory temporal resolution deficits in tinnitus patients; hence the author concluded the possibility of affected auditory processing abilities despite having normal hearing.

Some literatures describe that, differences exist between the study and control groups in gap in noise test (GIN), control group both in extended high-frequency auditory threshold and outcomes on the gap-in-noise (GIN) test. Hence, despite their normal hearing sensitivity in standard pure tone audiometry, they ascribed tinnitus patients' poor performance to minor cochlear damage (Sanches et al., 2010). Gilani et al. (2013) discovered problems in auditory temporal resolution in tinnitus patients and indicated that, despite normal auditory thresholds, these individuals might have some possible

aberration in central auditory processing (Gilani et al., 2013).

Fournier and Hebert (2013) found that the tinnitus group had poor gap perception for high and low background noise levels. They discovered that tinnitus masks the gap, resulting in poor gap recognition (Fournier et al., 2013). The Frequency Pattern Test (FPT), Duration Pattern Test (DPT), Dichotic Listening Test (DLT), and Gap Detection Threshold (GDT) tests were performed to evaluate possible auditory processing abnormalities in tinnitus patients with normal hearing sensitivity. In the gap detection and dichotic listening tests, tinnitus patients scored considerably lower than controls. As a result, tinnitus in persons who are normally hearing may be linked to auditory processing deficits (Raj-Koziak et al., 2021).

## **2.5 Assessment of tinnitus**

A clear and thorough patient history is the key for accurate diagnosis of severity of tinnitus and comorbidities associated with the same. The description of tinnitus should include the types (subjective or objective) perception characteristics (tonal qualities, pitch & loudness) and temporal characteristics (pulsatile, continuous, or intermittent). Such a detailed description may exclude any medical treatable conditions such as otitis media, otosclerosis or ear wax obstruction of the outer ear canal. There are two types of diagnostic assessment for tinnitus: one is causal and other is severity-oriented (Cima et al., 2019). Despite efforts to standardize, there is no globally approved tinnitus evaluation procedure for clinical or research contexts (Henry, 2016; Langguth et al., 2006).

### ***2.5.1 Case History***

The tinnitus profile relies on several components of a patient's medical history, including demographic data, co-existing disorders, and tinnitus perceptual characteristics

(Pattyn et al., 2016). Such information is preferably obtained through standardized interviews, clinical examinations, diagnostic testing, and health record review. For practical reasons, they are typically self-reported since they can be tested with standardized questionnaires (Genitsaridi et al., 2019; Langguth et al., 2017). Evaluating severity of tinnitus and, more widely, the consequence of tinnitus on the affected population, which can vary significantly from person to person, is a crucial component of tinnitus assessment (Haider et al., 2018). This type of evaluation is also necessary for determining the efficacy of tinnitus treatment. Two multi-item self-report surveys have been devised for this purpose: the Tinnitus Handicap Inventory (THI) (Newman, Jacobson & Spitzer, 1996) and also the Tinnitus Functional Index (TFI) (Haider et al., 2018, Meikle & colleagues, 2012). Visual analog scales and numeric rating scales such as clinical global impressions scale and German version of the Tinnitus Questionnaire are commonly used to assess tinnitus loudness and discomfort (Adamchic et al., 2012).

### ***2.5.2 Audiological Evaluation***

Without an evaluation of the auditory system, tinnitus profiling is incomplete. Tinnitus and hearing loss can coexist, and some tinnitus sufferers are unaware that they are also suffering from hearing loss. This recommendation should be read in conjunction with the National Institute for Health and Care Excellence (NICE) guiding principle on hearing loss in individuals if you have tinnitus and hearing loss. Tinnitus sufferers should get an audiological assessment (NICE guideline 98, 2018). Hearing and tinnitus psychoacoustic evaluations are common in auditory assessment.

### **2.5.2.1 Hearing Evaluation**

Conventional PTA is frequently used in hearing evaluations. A complete hearing test, including increased frequency resolution and extended high frequencies, might help a tinnitus profile by enhancing sensitivity to auditory system impairments (Xiong et al., 2019). Aside from PTA, a variety of other audiological tests, such as speech in noise audiometry, immittance tympanometry, acoustic reflex assessment, auditory brainstem responses (ABR), otoacoustic emissions (primarily distortion product otoacoustic emissions [DPOAE]), and loudness discomfort levels are used to characterize hearing function in greater depth (Schlittenlacher, Turner & Moore, 2018).

### **2.5.2.2 Tinnitus-Specific Psychoacoustics**

Subjective character of tinnitus necessitates further tinnitus-specific psychoacoustic evaluation. Appropriate pitch and loudness matching is found to help investigators better understand the mechanics of tinnitus perception and ensure that sound-based treatments that are delivered correctly on an individual basis (Schaette et al., 2010). Pitch matching has been researched using a variety of approaches. In prior research, procedures such as the "2AFC" (Penner & Bilger, 1992), the "likeness rating", and the "method of adjustment" (Wier, Jesteadt & Green 1976) were widely utilized. Loudness matching and loudness rating are the most prevalent ways of assessment when it comes to loudness (Hoare et al., 2014).

Some tinnitus sufferers reported that external noise cannot cover their individual ringing perception while others claim that even low-pitched noise can mask their tinnitus (Henry & Meikle, 2000). A basic strategy for evaluating tinnitus maskability is to use the minimal masking level (MML), the minimum level of noise required to mask tinnitus. It's



a valuable tool for determining how bothersome tinnitus is and how well masking works (Vernon, Griest, & Press, 1990)

Residual inhibition is (RI) another psychoacoustic measure commonly tested in clinics. It is the temporary reduction of tinnitus that occurs after 30 seconds or 1 minute of exposure to noise at a level of 10 dB over the tinnitus masking level (the lowest level necessary to conceal tinnitus or minimum masking level) (Roberts, 2007). Around 60–80 percent of tinnitus sufferers are found to experience this phenomenon. Individual suppression patterns tend to differ, and stimulus strength, duration, and frequency appear to impact individuals with tinnitus (Schäette et al., 2010).

Fournier et al. (2018) suggested a new method in which the RI duration is replaced by estimating the minimum sound intensity, enabling RI for a short and determined time interval (1 s). The stimulus utilized for the tests comprised of three-second pulsed narrowband sounds separated by one-second silent periods. The MML was acquired by raising the stimulus intensity once the tinnitus was suppressed within the quiet time between the acoustic pulses, and the minimum residual inhibition level (MRIL) was produced by raising the stimulus intensity until the tinnitus was masked throughout the 3-s noise presentation (Schoisswohl et al., 2019).

### ***2.5.3 Imaging***

In a small proportion of people, tinnitus has a definite cause which may be observed on imaging. Pulsatile tinnitus, unilateral auditory or neurological complaints, otoscopy indication of a glomus tumor, or suspicion of intracranial hypertension on fundoscopy will be considered when deciding whether or not to scan (Lewis et al., 2020).

## **2.6 Offline management options for individuals with tinnitus**

Over the last few decades, researchers have worked to thoroughly understand tinnitus's pathogenesis and give patients targeted treatments (Langguth et al., 2013). The most difficult of the typical hearing impairments is subjective tinnitus. So far, the existing treatments have had varying degrees of effectiveness. Several therapies are in use, and even more have been attempted and abandoned. The objective of severe tinnitus therapy is frequently to remove the symptoms; however, this is seldom achieved. However, it is frequently feasible to minimize some of the consequences of tinnitus such that a patient's quality of life improves and they may be able to work despite the disorder's residual effects. This implies that managing tinnitus in patient's quality of life may frequently be improved (Langguth et al., 2013).

### ***2.6.1 Non-audiological management***

#### **2.6.1.1 Drugs/pharmacologic**

Various medications are now being used to treat tinnitus, but none has yet been approved. Furthermore, determining which therapies are most effective is difficult due to variances in the characteristics and symptoms of tinnitus patients. Anticonvulsants, antianxiety drugs, antidepressants, antihistamines, antiarrhythmic agents, local anesthetics, vasodilators, benzodiazepines, vitamin tablets, and ginkgo Biloba extracts have all been demonstrated to be beneficial in the treatment of individuals with tinnitus. Because no one drug is effective, researchers must work to create therapies or combinations of pharmaceuticals that can effectively treat tinnitus while minimizing adverse effects (Kim et al., 2021).

According to the German guidelines of the Association of Scientific Medical

Societies (2015), it is usual to treat acute tinnitus in the same way that acute sudden hearing loss is treated. However, the evidence foundation for treatment in both circumstances is limited. As a result, typical corticosteroid therapy is not indicated if tinnitus starts suddenly without hearing loss. Treatments for tinnitus, such as intratympanic steroid injections is found to have no impact (Topak et al., 2009).

It is clear that intervention is unnecessary for many people with chronic tinnitus; nonetheless, the severity of symptoms may be bearable. Medical therapy was the most often suggested option for tinnitus management, even though it is not indicated. The paucity of evidence from experimental trials and meta-analyses which show a decrease in tinnitus perception underpins the recommendation against medical therapy (Bhatt, Lin & Bhattacharyya, 2016).

#### **2.6.1.2 Neuromodulation**

As a result of the previously established models for tinnitus etiology, it appears fair to assume a change in neuronal activity in the brain locations implicated in the neuronal circuits that cause tinnitus. This method allows access to both auditory and non-auditory areas. In general, invasive and non-invasive neuromodulation are differentiated. Tinnitus-related brain activity should be normalized. Increased structural improvement in functional neuroimaging techniques has made it feasible to precisely address the disease. The brain regions are primarily responsible for tinnitus perception or the distress caused by the tinnitus (Langguth et al., 2013).

In other methods such as invasive neuromodulation techniques, the electrodes are implanted extradurally (epidural), cortically (subdural), or for deep brain stimulation.

These treatments were tested in tinnitus patients or affected patients with deep brain stimulation for movement problems (Langguth et al., 2006).

### ***2.6.2 Audiological management***

A precise and comprehensive methodology for audiologic tinnitus management (ATM) was published by Henry, Dennis and Schechter (2005). The ATM approach has now been improved and includes a more extensive teaching program to help patients learn how to control their tinnitus independently. The methodology was also incorporated into a hierarchical framework, providing that therapeutic intervention is constrained to the amount necessary. Progressive ATM (PATM) is a sound-based approach that has been expanded and upgraded. It varies from other sound-based treatments for tinnitus in that it may be tailored to each patient's needs (Henry et al., 2008).

However, rather than removing tinnitus, the therapeutic method employed to treat persons focuses on minimizing the burden of the condition on everyday life. Sound therapy, counseling, education, stress reduction, and coping strategies make up the majority of empirical research on tinnitus management. Some of the most often used treatments for tinnitus are sound amplification/sound generators, tinnitus retraining therapy, and cognitive behavioral therapy (Tunkel et al., 2014).

#### **2.6.2.1 Hearing aids**

According to Schad et al. (2018) standardized tinnitus services propose an effective clinical protocol for audiologists. According to studies conducted at the National Center for Rehabilitative Auditory Research during the previous two decades, both hearing aids and "combination devices" (hearing aids with a built-in sound

generator) revealed significant decreases in functional tinnitus effects, with a focus on two randomized trials (Schad et al., 2018).

Shekhawat, Searchfield & Stinear (2013) conducted a review study to examine the use of hearing aids in treating subjects with hearing loss along with tinnitus. The Tinnitus Handicap Inventory (THI), Tinnitus Handicap Questionnaire (THQ), Tinnitus Severity Index (TSI), Tinnitus Reaction Questionnaire (TRQ), the German version of Tinnitus Questionnaire (TQ), Beck Depression Inventory (BDI), and visual analog scale (VAS) of tinnitus severity were among the tinnitus assessment methods utilized in the study. From 18 research studies and 11 reviews they found that 17 research studies for and 1 against the benefits of hearing aids, suggests merit in using hearing aids for tinnitus management. They concluded that majority of research evaluated and supports hearing aids for treating tinnitus.

#### **2.6.2.2 Tinnitus retraining therapy**

Tinnitus retraining therapy (TRT), which focuses solely on Jastreboff's neurophysiological model of tinnitus, is a widely used treatment. Tinnitus retraining treatment is a type of tinnitus habituation therapy that combines directive counseling with sound to decrease tinnitus signal strength. TRT's primary purpose is to create tinnitus habituation via brain retraining (Jastreboff, 2011).

Effectiveness of TRT in people with tinnitus has been studied extensively. In three-year follow-up research, Seydel et al. (2014) discovered that patients treated with TRT established a favourable physio-psychological condition associated with the severity of the psychological issue and age before treatment rather than the length of tinnitus and the degree of hearing problems. According to a review published by Jastreboff (2015),

TRT is far more than 80% effective in treating tinnitus. A follow-up data of 18 months post therapy completion, TRT's therapeutic impact was better than during the treatment period. Patients experienced a higher quality of life over the 18-month TRT therapy period, including sleep, work, and sociability than before treatment. Hence, they concluded that TRT has an excellent long-term prognosis (Forti et al., 2009).

### **2.6.2.3 Sound therapy**

Sound therapy is possibly the oldest method of tinnitus treatment. It is, at the very least, the most "natural" one, as tinnitus patients can see how an external sound source might disguise their tinnitus daily. This practical and easy method has been widely employed. This technique does not try to treat the causes of tinnitus; instead, it focuses on assisting with managing the symptoms (Cima et al., 2019). A systematic study investigated sound treatment (using amplification devices, sound generators, or both) for individuals with tinnitus. This review covered a total of eight papers (with 590 participants). Hearing aids were investigated in seven studies, four of which were integrated hearing aids, while three were sound generators. Seven of the investigations were randomized controlled trials with parallel groups, and one was a crossover study. One research investigated the effect of sound generators vs. hearing aids as the primary outcome, the severity of tinnitus symptoms as measured by the Tinnitus Handicap Inventory (THI) at 3, 6, and 12 months. Both devices were associated with a clinically substantial decrement in severity of tinnitus symptoms (Tutaj, Hoare & Sereda, 2018)

### **2.6.2.4 Cognitive-behavioral therapy (CBT)**

CBT has been shown to have various favourable benefits in individuals with tinnitus which has been shown in several randomized controlled studies. Henry and

Wilson (1996) discovered that a combined cognitive/educational treatment approach significantly decreased the suffering and impairment related to tinnitus and the inclination to engage in dysfunctional thought compared with individuals who just received an education. Meta-analytic findings have revealed that CBT is useful for lowering tinnitus annoyance while also having positive effects on other emotional symptoms. However, they discovered no influence on tinnitus loudness.

To establish treatment effectiveness, Li et al. (2019) studied one hundred patients with persistent subjective tinnitus who underwent masking therapy, sound therapy, masking therapy, and sound therapies with CBT. After treatment, the treatment group's Symptom Checklist-90 ratings for psychotic somatization, interpersonal sensitivity, depression, anxiousness, rage, terror, and phobic anxiety and the Tinnitus Handicap Inventory score were significantly lower than the control group. According to the study, CBT can substantially reduce the symptoms of severe subjective tinnitus by removing mood problems and decreasing stress.

A three-round Delphi survey conducted to determine which aspects of psychological treatments are the most relevant and acceptable for audiologists to consider when treating persons with tinnitus. The data was collected from audiologists, hearing therapists, psychologists and 39-member patient panel to achieve consensus on essential components of psychologic tinnitus therapy delivered by an audiologist. The findings provide a means for audiologists to construct a standard tinnitus therapy program based on both patients and clinicians' preference (Thompson et al., 2017).

## **2.7 Online tinnitus management**

There has been a growth in interest in utilizing the internet and smartphone-based technologies for the management of individuals with tinnitus in recent years. Tinnitus can be treated with various approaches, including experimental trials and commercial products documented in literature. Numerous operating systems, including web/android/iOS, contain questionnaires, auditory treatments, internet-based cognitive behavioral therapy (iCBT) and tinnitus management games (Beukes et al., 2018).

According to a recent search, over 200 applications for tinnitus sound therapy are available for downloading on the most popular platforms, including Android and iOS. Five papers exploring the effectiveness of Internet/app-delivered tinnitus interventions were discovered in this systematic review. The development of tinnitus treatment apps and web-based platforms is found to substantially influence people's everyday lives with tinnitus (Nagaraj & Prabhu, 2020).

Abouzari et al. (2021) conducted a pilot study to evaluate the efficacy of a smartphone app that delivers sound therapy and cognitive-behavioral therapy (CBT) for the treatment of individuals with tinnitus. Between 2017 and 2018, an immersive smartphone application for iOS and Android platforms was developed, which provided patients with an 8-week tinnitus-specific CBT program and personalized and frequency-matched sound therapy, while those on the waitlist for getting therapy acted as controls. They concluded that mobile apps can provide an effective and user-friendly platform for personalized therapy and tinnitus treatment. Patients with tinnitus may benefit from a combination of cognitive-behavioral therapy (CBT) and sound therapy provided through a smartphone app.



A research on tinnitus tele therapy by Aazh, Swanepoel & Moore (2021), 90 (80 %) of 113 patients consented to continue or begin their audiologist-delivered CBT for tinnitus via telehealth video consultations, whereas 23 only sought face-to-face consultations. Patients cited a lack of understanding of the technique and a lack of adequate equipment as major drawback. Even though four out of five patients opted for CBT telehealth therapy during COVID-19 lockdown, one out of every five patients preferred face-to-face consultations due to a lack of adequate equipment or a conviction that telehealth sessions would be ineffective. It was also noted that patients who did not use telemedicine had a worse hearing in their better ears and increased Visual Analog Scale scores for tinnitus annoyance. According to Paul et al. (2021), a substantial reduction in tinnitus intensity occurs before and after TRT utilizes the Re Sound Relief app to give individualized sound therapy in conjunction with online counselling sessions. Nine of the 15 individuals reported better and more peaceful sleep after TRT, while five said a change in perceived tinnitus frequency. The findings show that App-based TRT regimens can give enough relief from unpleasant and severe tinnitus if the other variables that exacerbate tinnitus symptoms are managed.

From the above review, it can be noted that the clinical evaluation of tinnitus and management varies across audiologists. The expanding use of the internet as a platform for receiving treatment necessitates creating healthcare-related applications (Nagaraj & Prabhu, 2020). However, treatment solutions and teletherapy facilities, such as mobile applications and internet-based therapy, have recently become available and conquer into tinnitus rehabilitation and its associated conditions. As a result, the management choices available audiologists for tinnitus management may be changed. According to recent

research, online tinnitus care, smartphone applications, and patient preference for online mode in tele audiology are more satisfying than conventional mode of tinnitus therapy (Kutyba et al., 2021; Mehdi et al., 2020). Hence, it is critical to identify the current clinical practice among audiologists and to determine whether the new management solutions are beneficial.

From the review it can be observed that tinnitus is a representation of the most distressing, at the same time, otological pathology and causes various psychological and somatic issues that can interfere with the quality of life. Literature on tinnitus prevalence from Western and Asian countries reported higher occurrence rate of tinnitus and reported a significant impact on quality of life. The prevalence of tinnitus shows a trend of rising as a function of age. Most people with hearing loss due to various organic and nonorganic etiologies accompanied by these ringing symptoms escalate the impact on individuals' day today daily life. Moreover, tinnitus-related conditions may vary from individual to individual; creating emotional or psychological problems. A detailed assessment, including subjective and objective measures, would aid in determining cause, type, severity, and impact on individuals quality of life. This information would be useful in the treatment of individuals with tinnitus and can be used as a baseline to measure the prognosis. There are various approaches available when it comes to the management of tinnitus, not just in the field of audiology but also in other non-audiological professionals.

Numerous studies are available in the literature that supports the benefits of each management options; however, more recently, it has been discovered that patients with chronic tinnitus can benefit more from cognitive-behavioural therapy. Online mode of tinnitus therapy is getting its attention in the current technological era and can be wisely

used for managing individuals with tinnitus. Many western works reported in the literature has indicated that online mode of tinnitus management has got its own merits and demerits (Ramkumar, 2020), especially in cases having comorbid conditions. However, there is very little literature that has been reported with regard to online tinnitus management in Indian context. Hence, it is important to gather information and develop a clinical protocol to carry out online tinnitus management producers in Indian context.

## **Chapter 3**

### **METHODS**

The aim of the present questionnaire-based study was to determine the currently available efficient online tinnitus management options utilized among audiologists in India. Hence gathering all the data regarding the assessment, treatment and outcome measures from audiologists who were currently offering an online mode of tinnitus therapy in India is the goal of the study. The results from the questionnaire based study provide information about the current online treatment choices and the challenges that audiologists and patients experience during the implementation of the online tinnitus management program.

#### **3.1 Research design**

The study employed a descriptive design to analyse current practices in online tinnitus management among audiologists. The study was carried out entirely through online mode.

#### **3.2 Participants**

A total of 52 self-identified professionally qualified practising audiologists participated in the study, and from the total 20 audiologists were selected based on the inclusion criteria.

##### ***3.2.1 Inclusion criteria***

- Participants were professionally qualified audiologists working in India.
- Participants have at least 1 year of working experience in their respective fields.

- Participants have experience with tinnitus patients and knowledge regarding online tinnitus management.

### **3.3 Procedure**

#### ***3.3.1 PHASE 1- Preparation and development of the questionnaire***

A literature search was conducted before constructing the questionnaire. The questionnaire was developed by reviewing Google Scholar and PubMed literature studies from both International and Indian journals that are related to tinnitus assessment, management, and outcome measures published between 2011-2021. The questions were constructed with consideration of currently available literature on tinnitus therapy, questionnaires, surveys, and clinical research articles (Husain et al., 2018; Hoare et al., 2012; Makar et al., 2012). Based on the literature search, a total of 37 questions were constructed under 6 main sections that comprised the entire developed questionnaire. All the questions were developed from the aforementioned articles in such a way that every aspect of online tinnitus practice among audiologists, including assessment, management, outcome measures, associated conditions of tinnitus and challenges was addressed.

First domain contained six questions on the demographic information. The second domain comprised three questions focusing on the tinnitus management facilities provided at their workplace. The third domain consisted of two questions regarding the online tinnitus management services, and the fourth domain contained ten questions about the online tinnitus management program. The final two domains consisted of sixteen questions regarding the online tinnitus care associated with other conditions and the challenges that audiologists confront, respectively. The entire questionnaire comprised of multiple-choice, closed type, open type and likert scale type questions.

After the content and face validation the questionnaire was distributed to the participants.

### ***3.3.2 PHASE 2- Validation of the Questionnaire***

After the development of the questionnaire, a group of four professional audiologists having more than ten years of experience, specifically in tinnitus management, and academics assessed the content validity response options, as well as the face validity of the questionnaire. After the completion of the validation, the developed questionnaire was finalized.

Face-to-face and content validations methods were conducted for the validation of the questionnaire. The face-to-face expert validation was conducted to determine how simple it is for readers to understand the questionnaire's domains and questions, taking into account factors like readability, style, and language clarity etc. The content expert panel validation evaluated the questionnaire items' appropriateness for measuring the constructs and determined whether the selected items are sufficient to assess the variables in the domain (Aithal & Aithal, 2020). For the questionnaire validation, the professional audiologists was requested to rate the question on a three-point (1 to 3) Likert rating scale, where rating one indicated inappropriate statement, rating two indicated somewhat appropriate statement and rating three indicated more appropriate statements.

The questions that received one and two ratings during the validation were revised and included in the final questionnaire. The comments mentioned by the validators were taken into consideration for the final questionnaire developed. The final questionnaire consisted of 6 domains and 37 questions consisting of closed-ended, open-ended, and Likert-ended type questions. Target six sections /domains comprised the viewpoint of audiologists regarding the online tinnitus management program being implemented at the

institutions/clinics/hospitals. The final questionnaire was designed for audiologists and all the participants were instructed to carefully read and answer all the questions. The final questionnaire that was prepared using the inputs obtained from the content validation and face to face validation can be found in Appendix 1.

### ***3.3.3 PHASE 3- Administration of the Questionnaire***

After validation, the questionnaire was randomly distributed to the various audiologists through Gmail, WhatsApp, and other social media through Google form. This questionnaire was designed exclusively for the active Audiology Practitioners who are dealing with tinnitus assessment and management. The audiologists were selected through personal contacts and from various professional society of audiologists who were working at institutes, private clinics, and hospital setups. E-mail and Google form included a consent statement, study objectives, and a link to the questionnaire survey. The goal of the study, the type of questions, and the time needed to complete the questionnaire were explained to the participants in advance. Each participant was instructed to review an informed consent letter and agree to the survey's terms and conditions. Responses were gathered for duration of two to three months and kept completely confidential. The responses were collected from all the participants and based on the inclusion criteria, the sample participants were selected. Figure 1 depicts the Flowchart of the entire method of the present study.

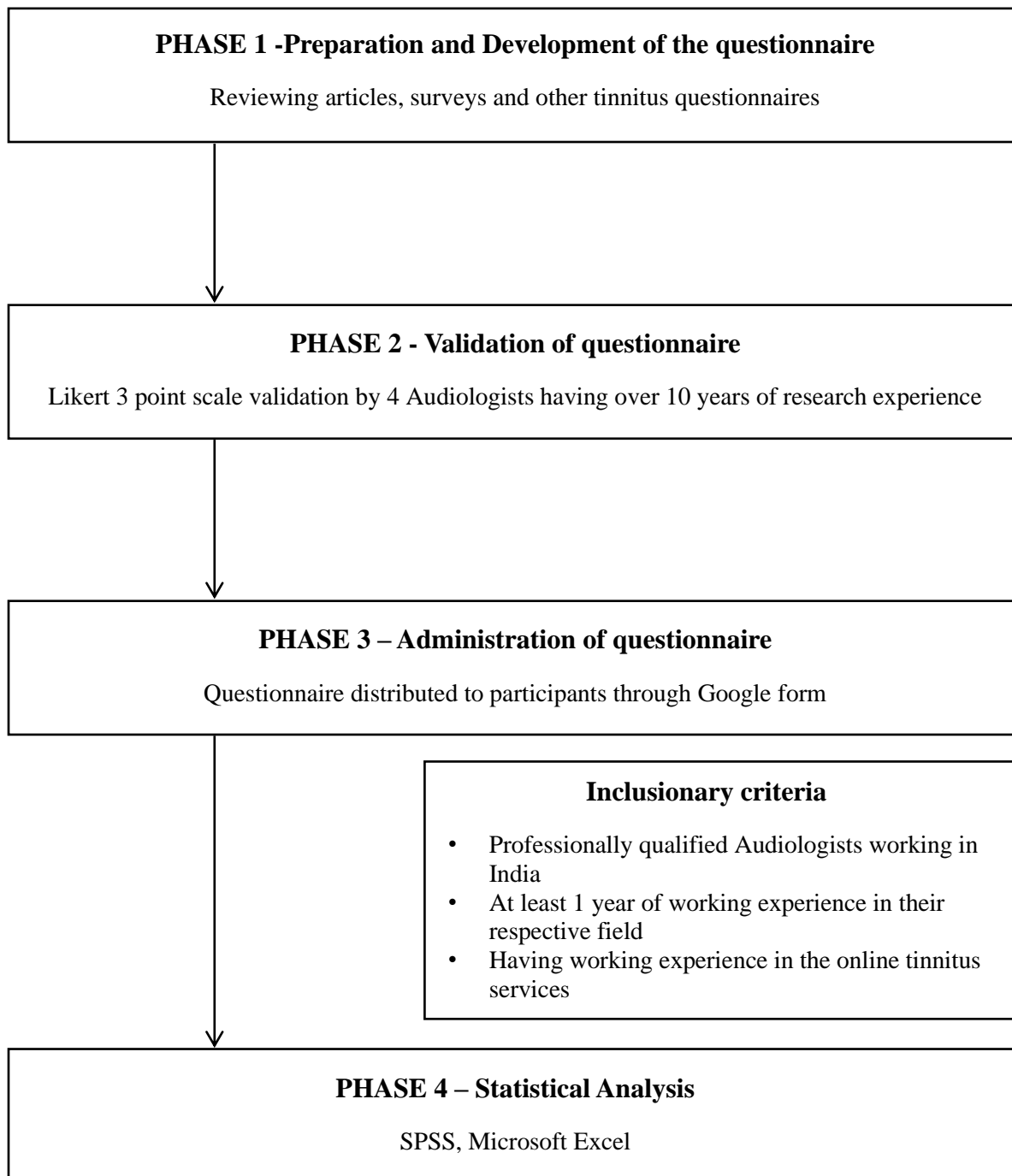
### **3.4 Statistical analysis**

The questions were examined, and they were finally organized and analysed as six domains in the questionnaire. All analyses within the questionnaire were conducted in Microsoft Excel and SPSS v.25 software. Descriptive statistics were employed to analyse

the response data. Percentages, frequency, graphs and tables were used to summarise the categorical variables in the questionnaires.

**Figure 1**

*Flowchart depicting the entire method of the present study*





## Chapter 4

### RESULTS and DISCUSSION

The present study aimed to assess the current practice in online tinnitus management among audiologists in India utilising a questionnaire-based method. The study was done among the audiologists with professional experience in audiology and tinnitus, and the obtained response was analysed using a descriptive statistics method.

The results are organised into the following three sections.

#### 4.1. Response rate of the questionnaire

#### 4.2. Responses of audiologists to the questionnaire

##### 4.2.1. Demographic information

##### 4.2.2. Offline Tinnitus management facilities

##### 4.2.3. Online tinnitus management facilities

##### 4.2.4. Online tinnitus management associated with other conditions

##### 4.2.5. Challenges of online tinnitus management faced among audiologists

#### 4.3. Summary of results

#### **4.1. Response rate of the questionnaire**

Of the total number of 400 audiologists who are currently working in India were expected to take part in the study; however, only 52 audiologists who are doing tinnitus management participated in the survey, which reflects a 13 % response rate. Hence from the 52 participants, 20 responses were considered for further analysis on the current online tinnitus practices based on the inclusion criteria. The audiologists' response rate to the survey questionnaire was strikingly low, and the majority of the responses revealed “limited” access to the online Tinnitus Management Program.

## 4.2 Response of the audiologists to the questionnaire

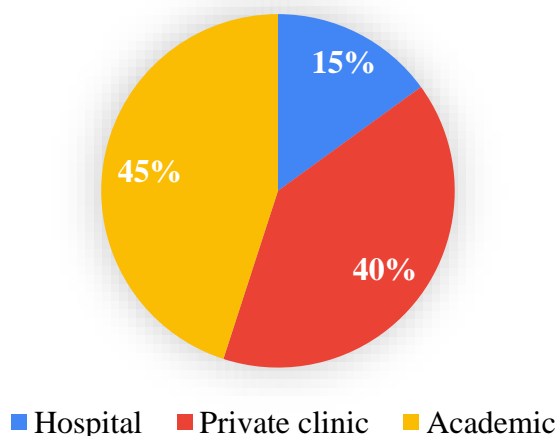
### 4.2.1 Demographic information

Out of 20 responses, the audiologists working in private clinical services provided 40% responses, while those working in academic institutions and hospital set-ups provided 45% and 15%, respectively (question number 3). The figure 2 depicts the online tinnitus practice at various working setups. The questionnaire response rate from the audiologists working in hospital setups was low, and only a few audiologists in the hospitals were found to offer a provision for the Online Tinnitus Management Program.

#### Figure 2

*Online Tinnitus management program offered by audiologists who are currently working in India at various working setups*

Online tinnitus management at different setups



Among the 20 audiologists who responded, 45% had a master's degree in audiology, 35% had a bachelor's degree, 15% had a MASLP degree, and one participant had an AuD (Doctor of Audiology) (question number 4). Most participants had a working experience of above 5 Years, followed by 3-4 years and 2-3 years and one year (question

number 5). Data from the responses obtained from participants showed that only 15.4 % of the audiologists treated more than 50 tinnitus subjects either offline or online. Data from the responses obtained from participants showed that 50% of the audiologists treated more than 50 tinnitus subjects either offline or online. In comparison, 20% of audiologists provided management for 25-50 subjects, and 25% and 15% of audiologists treated 10-25 or less than 10 subjects (question number 6). Table 2 reveals all the aforementioned demographic data of the participants considered for the present study.

From Table 2, it is clear that most responses from those who were doing the online tinnitus management are from academic and private practice setups. The minor responses were obtained from hospital setups in the current study. In support of this in India, a survey on the status of offline tinnitus management indicated that the rates of the Tinnitus Management Program had not been well implemented in many hospitals and institutions (Makar et al., 2012). Based on the current test findings, it was determined that various hospitals in India have not yet implemented the Online Tinnitus Management Program. But in the present study, various institutions are implementing online tinnitus therapy compared to hospital setups. The American Academy of Speech and Hearing (2018) conducted a survey of audiologists who were working in the field of tinnitus. All 68 responders to the completed surveys were Caucasian, who had practised tinnitus management for at least one year and had an average experience of more than ten years (Husain et al., 2018).

**Table 2***Demographic details of the participants*

<b>AUDIOLOGISTS</b>	<b>PERCENTAGE OF RESPONSES</b>
<b>Gender</b>	
Male	48%
Female	52%
<b>Types of setups</b>	
Hospital setup	15%
Private clinic	40%
Academic	45%
Others	-
<b>Higher education degree</b>	
BSc Speech and hearing	35%
MSc Audiology	45%
MASLP	15%
AuD	1%
PhD	-
<b>Years of experience</b>	
1 year	10%
2-3 years	30%
3-4 years	30%
Above 5 years	35%
<b>Numbers of tinnitus patients treated</b>	
Below 10	15%
10-25	25%
25-50	20%
>50	40%

*Note.* Empty cells are marked using “-” which means that no data were reported

#### ***4.2.2 Offline Tinnitus management facilities***

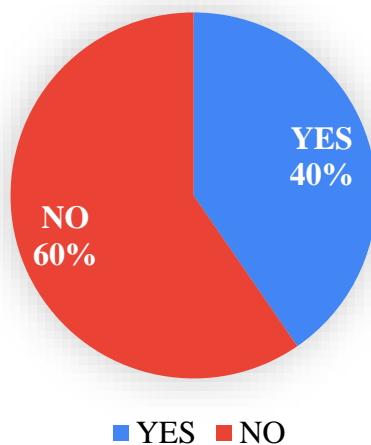
The domain of the questionnaire about offline tinnitus facilities (question numbers 7 to 9) investigated the facilities and requirements for tinnitus management at the participant's workplace. Out of the total 14 audiologists working in academic institutions, ten had facilities and requirements for tinnitus management. These data accounted for 19% percent of the total number of audiologists working in academic settings. Hence, to be precise, nine (17%) of participants employed in institutional settings were found to offer tinnitus management programs. When it comes to private clinics twelve (44%,) audiologists had the facilities for tinnitus management and in that, sixteen offered tinnitus management that accounting for 31% even though 4 of them did not have facility to offer tinnitus management (question number 8).

The overall percentage of the audiologists who were offering an offline tinnitus management program is depicted in Figure 2. On reviewing the data of tinnitus management program at different working setups, a total of 60% of participants were offering tinnitus management at their working place (Figure 3). Figure 4 illustrates the responses of participants offering offline tinnitus management at their working setups (hospitals, academic institutions & private clinics). In the hospital setups, the number of audiologists doing tinnitus management is found to be minimal (19%) when compared to institutional or clinical setups (question number 7). To summarize, when reviewing the data of actively working participants in all setups, 60% of the participants were offering rehabilitation programs for individuals with tinnitus while 52% of participants were found to have basic technical and professional requirements for the tinnitus management program.

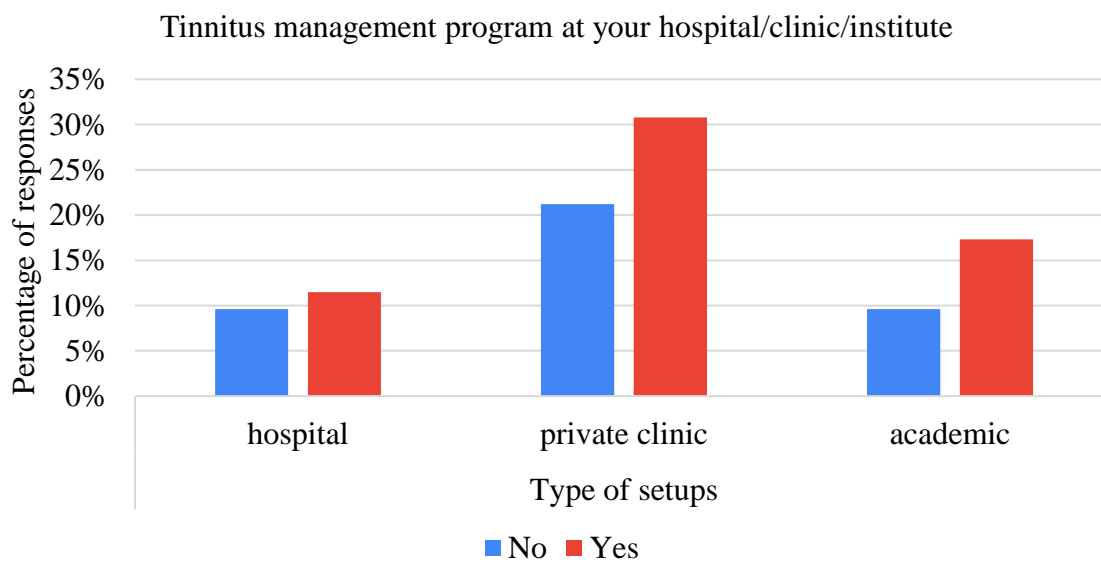
**Figure 3**

*Overall percentage of the Tinnitus management program among the participants*

Tinnitus management program Percentage

**Figure 4**

*Tinnitus management program offered by audiologists who are currently working in various setups in India*



The response received for the specialized training achieved by the participants, 73% were trained in tinnitus management during their Bachelor's or master's level education, 36% were self-trained through article/YouTube videos, and 37% received training from other clinicians who had practiced tinnitus management earlier (question number 9). Training for audiologist through online and offline courses accounts for 15%, while only 2% of participants had perceived a certified course for tinnitus. 9% of participants reported that they had not received any specific training for tinnitus management.

From the responses obtained, it is clear that most of the audiologists were trained for tinnitus management during their graduate or postgraduate course and they were self-studied through journal articles, you tube, and books. Also, very few have done the certified course related to tinnitus management and this could be due to the course being expensive, or it could be that most of them are not aware of the tinnitus management courses. The results of this finding is supported by Dawood, Khan and Bagwandin (2019) who based on a survey done on 243 audiologists in South Africa, reported that management of individuals with tinnitus is found to be difficult regardless of their level of competence. The main reason for limitations in providing tinnitus services' is lack of knowledge, training, or guidelines, all of which are impacted by contextual constraints.

#### ***4.2.3 Online tinnitus management facilities***

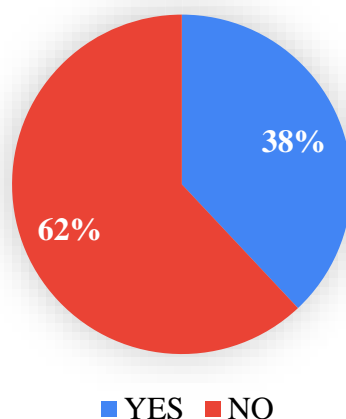
The next domain of the questionnaire investigated the facilities and requirements available for online tinnitus management at participant's workplace. Overall percentage of the online tinnitus management program among the audiologists who are currently working in India is depicted in figure 5 (question number 10). From the figure 5 it can be

seen that a small percentage (38%) of participants were providing online tinnitus management from the total participants, i.e., out of 52 audiologists 20 were providing online therapy. This part of question reveals the limited implementation of online tinnitus therapy among audiologists. Tinnitus management provided by audiologists is very limited and this could be related to the reasons for the limited use of tinnitus management.

**Figure 5**

*The overall percentage of the online Tinnitus management program among the audiologists who are currently working in India*

Online Tinnitus Management Percentage



From the data of 9 audiologists working in institutes, 35% of participants had technical and professional requirements for providing online tinnitus management (question number 11). Among the participants who were working in private clinics, 15% had the facilities for online tinnitus management, however only 5% of the audiologists who are working in the hospital setups had the technical and professional requirements for online tinnitus management. To recapitulate, among the actively working audiologists

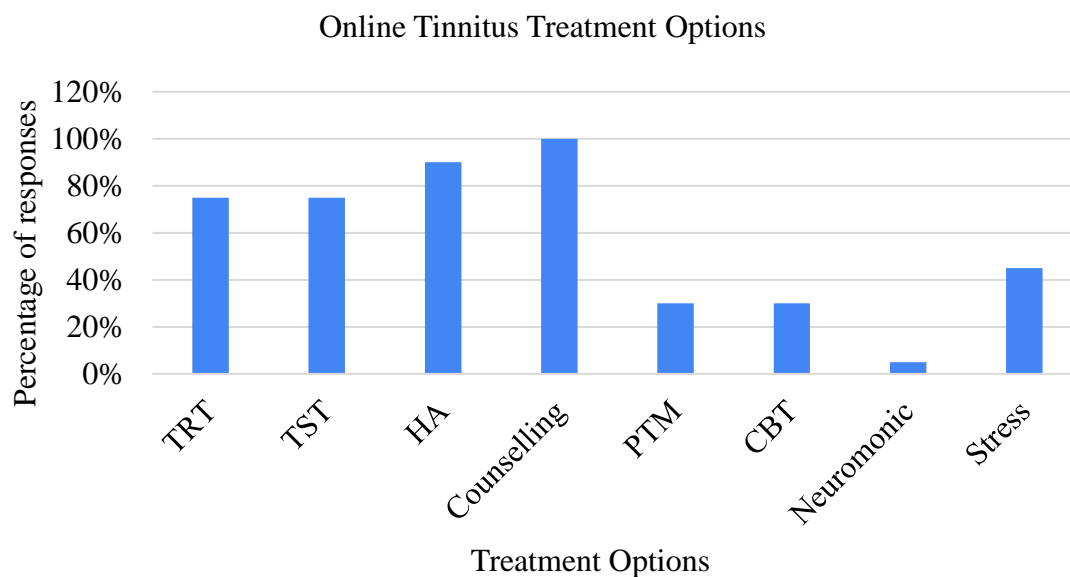


in all setups, 38% of the participants (n=20) were offering an online mode of rehabilitation program for individuals with tinnitus, and from the 38% of participants, 55% had the basic technical and professional requirements for the online tinnitus management program.

A variety of treatments have been documented in response to the type of tinnitus management offered by each participant through online mode (question number 12). All respondents were noted to have provided directive counselling (100%), 90 % provided hearing aids, and 75% of audiologists provided tinnitus retraining therapy and sound generators. A total of 45% of audiologists were providing stress management strategy, 30% of participants offered progressive tinnitus management in some capacity, and 30% provided CBT; however, when interrogated, only 5% claimed to have provided Neuromonics Tinnitus Management. The Figure 6 illustrated the online tinnitus management options offered or known by the audiologists who are currently practicing in India. Overall, it can be concluded that all respondents were providing a combination of the various treatments that are mentioned in the questionnaire. Hence, it is clear that directive counselling and hearing aids are the best combinations to treat individuals with tinnitus through online mode. Also, some were observed to opt for stress management and TRT along with the aforementioned combinations.

**Figure 6**

*Online tinnitus treatments offered by the audiologists who are currently working in India*



*Note.* TRT=Tinnitus retraining therapy, TST=Tinnitus sound therapy, HA=Hearing aid, PTM=Progressive tinnitus management, CBT=Cognitive behavioural therapy, Neuromonic=Neuromonic tinnitus management, Stress=Stress management strategy.

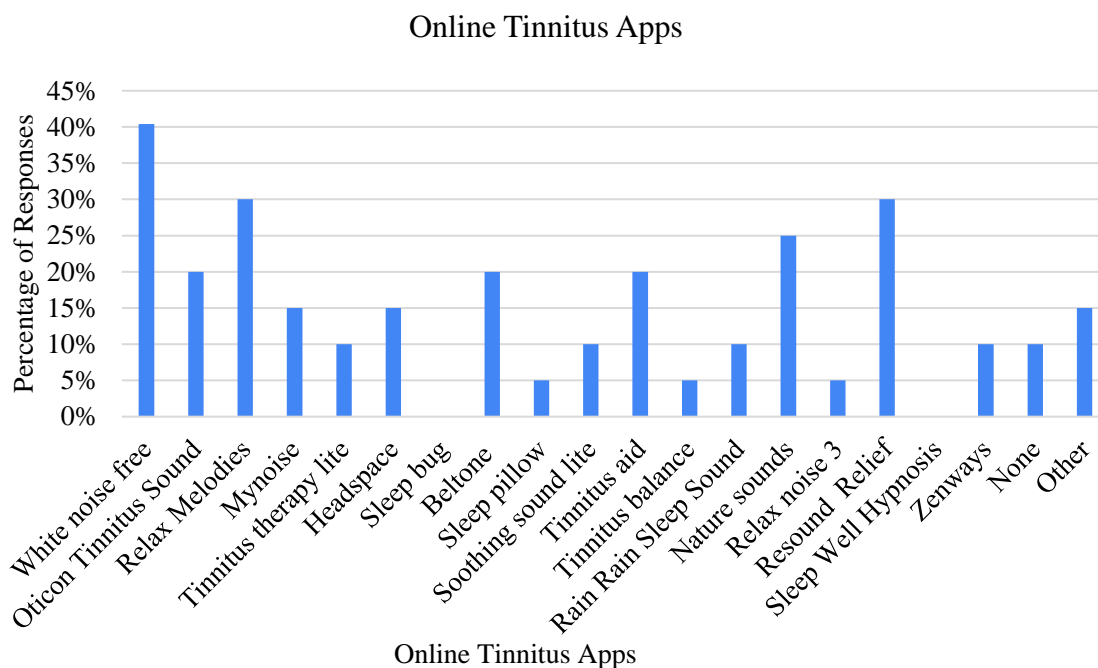
With regard to types of online tinnitus apps used for sound therapy (question number 13), 40% of clinicians preferred white noise, 30% preferred to resound relief and Relax Melodies: Sleep Sounds, 25% chose natural sounds, and 20% preferred Oticon Tinnitus Sound, Beltone Tinnitus Calmer, Tinnitus Aid: Nature Sounds to Mask Ear Ringing. The remaining one-fifth of the participants reported that they were using various stimuli such as choose my noise, rain sleep sound, Headspace: Guided Meditation & Mindfulness, Tinnitus Balance, Sleep Pillow Soothing Sounds Lite, Relax Noise 3, Zenways, Tinnitus Therapy Lite, and choose Sleep Bug: White Noise Soundscapes & Music Box, Starkey tinnitus, pink noise, speech noise, Signia notch therapy, Brownian

noise, Oto Tinnitus relief and therapy, oto tinnitus app, proprietary hearing aid apps. The figure 7 illustrates the responses of audiologists regarding the types of smartphone apps they opt for sound therapy. About 10% of the audiologists denied the usage of any kind of tinnitus applications.

Hence, it can be concluded that most of the participants in the current study agreed that tinnitus can be managed through smartphone applications. The current study results are supported by Abouzari et al. (2021) who has reported about online tinnitus therapy using a combination of mobile applications and CBT and concluded that mobile apps can offer a reliable and user-friendly platform for individualized therapy and tinnitus treatment. Recent research into the effectiveness of the Resound Tinnitus Relief Application revealed that the application has been downloaded more than 300,000 times and has 50 000 monthly active users. Studies verifying the tinnitus app are ongoing, and it has been discovered that after three months of continuous use in a therapy program, it appears to reduce tinnitus handicap (Michael, 2019).

**Figure 7**

*Online tinnitus apps for sound therapy offered or known by different audiologists*



The questionnaire that posed a question related to the duration in which the audiologists in their workplace started offering online tinnitus treatment was analysed and the respondents showed varied responses (question number 14). It was noted that 60% of participants had been doing the tinnitus management for more than a year, 5% had been doing it for 3-6 months, 20% were doing it for 6 months-1 a year and 15% for less than 3 months.

Family engagement during various stages of online tinnitus therapy (question number 15) was targeted and 15% of clinicians recommended family participation during the diagnostic evaluation while 20% during management. A small percentage of professionals (5%) suggested involving the family members during outcome appointments only. Finally, a majority of audiologists (55%) encouraged family

participation at all levels of rehabilitation while the remaining 5% of participants were disagreed with family participation. Overall, it can be said that most of the respondents (95%), encouraged family participation at any or all the stages of intervention while 5% do not. Similar findings were obtained in a UK health department based study, that aimed to formalize the management of tinnitus from primary care, among 138 audiologists. The results showed that most clinicians encouraged family involvement in the tinnitus service during the diagnostic evaluation, management and outcome sessions (Hoare et al., 2012).

The next question of the questionnaire interrogated the assessment of individuals with tinnitus through online mode and requested to specify the type questionnaire they are using for the same (question number 16). The majority of the responses noted were of mixed type and included more than one method for assessment of tinnitus. The results indicated that from the total participants who are offering online tinnitus management, 55% of the audiologists used structured interviews, 20% used objective measures (such as tinnitus pitch & loudness), 45% used unstructured interviews, and 10% used visual analog scales. About 50% of participants used questionnaires along with the aforementioned methods such as tinnitus handicap inventory (THI) which was the most commonly validated questionnaire, and the Tinnitus Functional Index. The remaining 15% of the audiologists denied the administration of online tinnitus assessments.

When the participants were specifically asked about management of tinnitus subjects with hearing loss through online mode (question number 17), 55 % offered online Tinnitus management with a hearing aid while 10% of the respondents were reported to have used only a hearing aid for treating tinnitus. 20 % of the participants were providing Tinnitus management alone. Apart from these responses, 6% of

audiologists reported additional responses such as "Initially provide hearing aid (HA) only, and if the prognosis is poor, later starts with specific tinnitus management along with hearing aid," "If the individuals have hearing loss, they were requested to have a detailed audiological assessment followed by management for hearing loss, subsequently tinnitus management options will be recommended online or offline". From these responses, we can conclude that audiologists preferred giving hearing aid to treat tinnitus for the hearing impaired because in most of the cases tinnitus is found to disappear after using hearing aid. The results of the current study was supported by a study that concluded that both hearing aid and "combination devices" (hearing aids with a built-in sound generator) reduced functional tinnitus effects significantly, with a focus on two randomized trials (Henry et al., 2008).

When asked specifically about the approaches for hearing aid users with tinnitus versus those without tinnitus during the online tinnitus management (question number 18), 70% of respondents reported to have not used different criteria between these two conditions, and only 30% of the audiologists used different criteria. Those criteria were (question number 19) "while using HA, patients should use the masking noise provided by the audiologists fine-tune their hearing aid, and so on".

Reports on the measurement of treatment outcomes through online mode by the participants (question number 20) were that, 60% from the total audiologists who were doing online tinnitus management reported using a questionnaire, 45% used a structured interview, 40% used an unstructured interview, 15% used objective measures (e.g., tinnitus pitch & loudness), and only 10% used a visual analogue scale (VAS) at this stage. The number of audiologists who used a tinnitus-specific questionnaire to measure

treatment outcomes outnumbered of those who used it to diagnose. Tinnitus-specific questionnaires THI (2%), TFI (2%), and TRQ (1%) were reported for evaluating outcomes after management. The combination of the questionnaire with structured interview and objective measures, combination of the questionnaire with unstructured interview and objective measures are the most reported responses. However, 15 % of the audiologists have not employed any online treatment outcome measures, and 4 % reported the unawareness of tinnitus outcome measures through online mode.

The next question was directed to the factors that the participants believed to play a critical role in deciding whether tinnitus treatment was effective or not (question number 21). In total, 71% of the participants agreed to the reduced awareness of tinnitus perception or increased habituation in individuals with tinnitus, 62% of respondents chosen patient stress/anxiety tolerance, 60% chosen patient's tinnitus awareness as a variable, 35% chosen tinnitus loudness reduction, 38% choose patient complaint and 36% showed enhanced understanding of tinnitus, and 27% choose tinnitus sound quality changes. Not having realistic expectations of tinnitus management outcomes and temporary relief from tinnitus among individuals with tinnitus are the other responses that accounted for 31% and 19% respectively. It was noted that most of them reported a combination of responses such as reduced awareness of tinnitus perception or increased habituation along with patient stress/anxiety tolerance and tinnitus awareness.

#### ***4.2.4. Online tinnitus management associated with other conditions***

From the total participants, who were surveyed on the need for psychologically focused tinnitus therapy for individuals with tinnitus, 92% of the respondent agreed the need for such a psychological targeted therapy (question number 22). The Figure 8

depicts the responses of various audiologists regarding the need for providing psychologically focused online tinnitus management. Figure 9 illustrates the various online tinnitus management options for psychologically focused tinnitus therapy by different audiologists (question number 23). From figure 9, it can be seen that 90% from the total participants who were opting for online management offering online counseling for psychological problems associated with tinnitus while 50 % from the total chosen cognitive behavioral therapy. About 55% preferred Lifestyle advice and sound therapy ,45% of participants preferred tinnitus education. Tinnitus retraining therapy chosen by 40% and problem-solving behavioral intervention (20%) & psycho education (30%) were offered by a minority of the population (Fig 9). On the other hand, 2% of audiologists were not giving any particular treatment for this problem and another 2 % reported the open-ended option and having an opinion to refer to a psychologist. Overall, a significant majority of the respondents agreed to provide either any of the one or a combination of the aforementioned services for managing psychological aspects related to tinnitus. Counselling, lifestyle advice, sound therapy and CBT were the most suggested option for tinnitus associated with psychological issues. Similar supporting findings were published in a review to identify and compare current clinical guidelines for the assessment and treatment of subjective tinnitus in adults from Denmark, Germany, Sweden, the Netherlands, and the United States. The study concluded that the potential scope of psychological treatments for tinnitus was rather broad. Except for Sweden, all guidelines clearly recommended providing information and education regarding tinnitus, and treatment alternatives like CBT was given for tinnitus with psychological issues (Fuller et al., 2017).

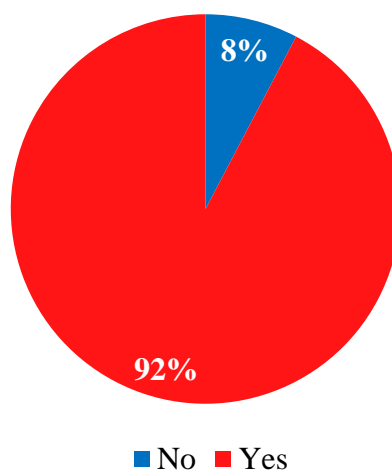


Additionally, there was a question which focused on whether there is a need for additional training (psychological treatments) for audiologists in treating individuals with tinnitus associated with psychological conditions (question number 24). Results indicated that nearly three-quarters (75%) responded that there was no need for additional training for the audiologist to provide psychological therapy, with the remaining 25 % responded yes.

**Figure 8**

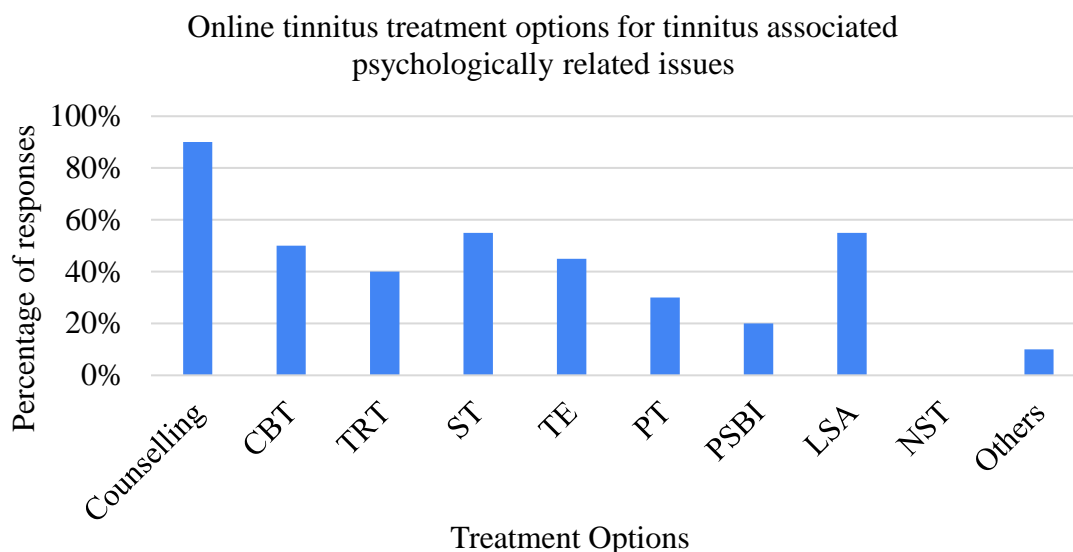
*Responses of audiologists towards the need for providing psychologically focused online tinnitus therapy*

Need for psychologically focused tinnitus therapy



**Figure 9**

*Audiologist's responses on online tinnitus treatment options for tinnitus-associated psychologically related issues*



*Note.* CBT=Cognitive Behavioural Therapy, TRT=Tinnitus Retraining Therapy, TE=Tinnitus education, PE=Psycho education, PSBI=Problem solving behavioural intervention, ST=Sound therapy, LSA=Life style advice, NST= No specific treatments given.

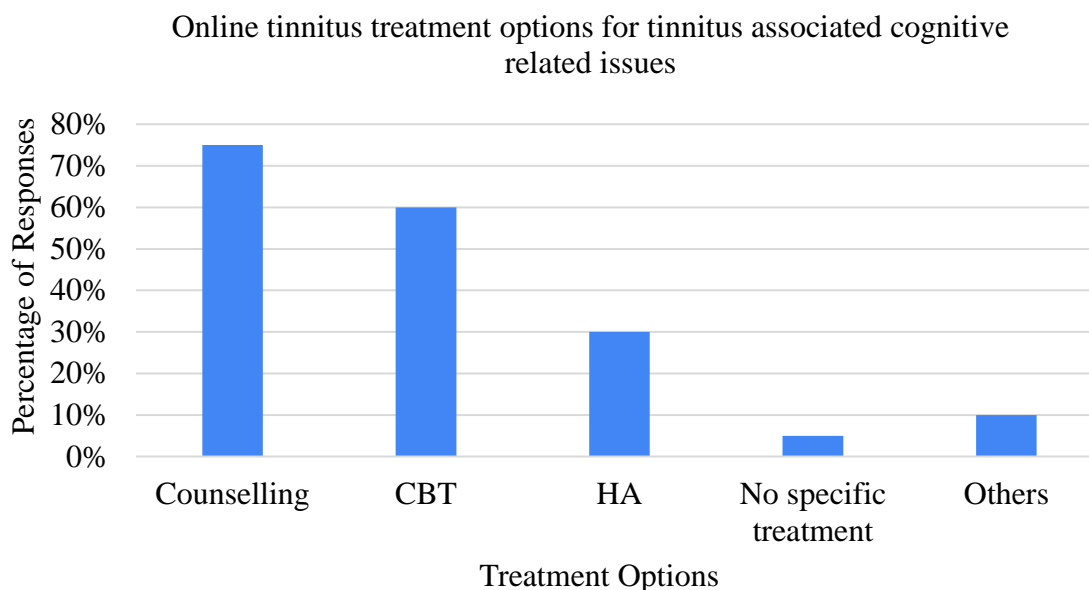
The participants agreement on tinnitus related cognitive issues (focus, attention, concentration & working memory) had a similar fashion to the psychological issues (question number 25). Majority of the audiologists indicated the necessity for cognitive-focused tinnitus therapy (85%). Respondents were asked to justify their responses by giving reasons for their agreement or disagreement (question number 27). Some were provided justifications to support their claims, such as the necessity for a holistic approach to tinnitus, the need for an increase in attention, the habituation of tinnitus and

improvement of quality of life, focus shift and reassurances, the enhancement of working memory, and the ability to get over the negative emotions connected with tinnitus.

The participant's responses on the online tinnitus treatment options for tinnitus-associated cognitive issues (question number 27) is illustrated in figure 10. It is evident from the figure 10 that over 75% & 60 % from the total respondents those who were doing online tinnitus management provided the direct counselling and CBT, while 30% from the total participants offered hearing aids as specific strategies for managing cognitive-related issues in tinnitus. A small percentage of participants (4%) offered some form of attention and working memory activities. On the other hand, 5% were not providing any specific cognitive approaches. To recapitulate, the majority of responders provided any of these management options, that is; CBT and counseling, along with hearing aids, or a combination of the three. Beukes et al. (2021) conducted a study for the effectiveness of internet based cognitive behavioural therapy (iCBT) in 27 tinnitus patients. After weekly monitoring of the outcome data, therapy through online mode leads to a higher reduction in tinnitus distress. And also there was a reduction in the secondary issues such as negative tinnitus thoughts, cognitive problems and sleeplessness. During the 2-month follow-up also, the results remained constant. From these claims, we can confirm that there is a necessity to consider cognitive issues while giving tinnitus therapy.

**Figure 10**

*Participant's response on Online tinnitus treatment options for tinnitus associated cognitive issues*



*Note.* CBT = Cognitive Behavioural Therapy, HA=Hearing aid

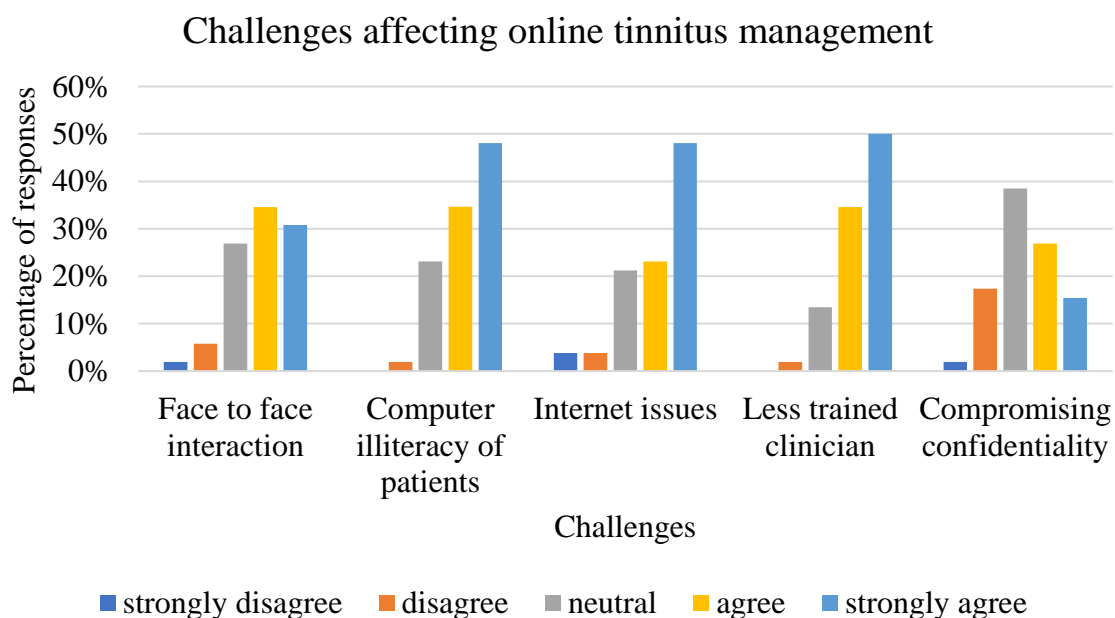
#### ***4.2.5. Challenges of online tinnitus management faced among audiologists***

The participant's response on the challenges affecting online tinnitus management (question number 28) is depicted in figure 11. From the figure 11, it can be observed that most of the respondents consistently answered strongly agree or agree with the challenges such as less trained clinicians (85%) and Internet issues (71%) followed by challenges such as computer patient illiteracy (75%) and lack of face-to-face interaction (65%). Compromising confidentiality (42%) was the least responded challenge option among all the responses. These findings is supported by Rajapandy, Prabu and Manoov (2013) who determined the trends in the expansion of the internet in both urban and rural India. According to this study, there was less internet connectivity in rural areas compared to

urban areas. The rate of subscriptions for wired narrowband, broadband and wireless internet is strongly correlated with the urban growth rate when compared to rural. Another study was conducted on the opinion of telepractice in India from the time it first emerged to till present, by analysing review article published by speech language pathologists (SLPs) and audiologists in India. Technical problems were listed as telepractice difficulties by majority of the respondents. Lack of direct feedback, distractions from the environment at the client's end, and concerns about client confidentiality were mentioned as difficulties in the implementation of telepractice (Rangaswamy & Rao, 2018).

**Figure 11**

*Participant's responses on the Challenges affecting online tinnitus management*



Almost all the participants responded to the open-ended questions asked about other challenges except the aforementioned challenges (question number 29). One of the respondents reported the ignorance of hospital setups toward online tinnitus management.

In the present study among the participants who were carrying out online tinnitus management in all working setups, less than 10% of responses were obtained from the hospital setups and that itself supports the ignorance of hospital setups toward online tinnitus management. Another response was the aggravation of tinnitus due to mobile/desktop screen time, which was further supported by Hutter et al. (2010). They suggested that increased high intensity of use and long duration of mobile phone use might be linked to a doubling of the risk of getting chronic tinnitus.

More than half of the participants (55%) reckon that tinnitus without hearing loss was more difficult to treat online (question number 30) and the remaining 45% responses that the tinnitus with hearing loss was more difficult to treat in online mode. But the difficulty in managing tinnitus in patients with hearing loss varies based on the severity of hearing levels. The corresponding hearing severity levels were which can be taken for online therapy is the following (question number 31), a moderate degree of hearing loss by 60%, severe loss by 25%, moderately severe loss by 15% and no one responded for profound hearing loss. Hence, it can be confirmed that majority of the participants (95%) agree that there was an influence on severity of hearing levels in individuals with tinnitus through online mode (question number 32). These responses was further supported by Bartnik, Fabijańska and Rogowski (2001) which compared TRT with patients having tinnitus only (group 1) and patients having tinnitus along with hearing loss (group 2). Based on the outcome measures, they found that there was a significant improvement of habituation about 70% for patients in group 1 and about 90% for patients in group 2.

Further it was noted that, 45% of individuals responded that assessing and measuring outcomes in online tinnitus therapy was more difficult (question number 33).

The prime reason for the agreement (question number 34) was “the practical difficulty in performing objective testing for outcomes measures through online mode (14%) followed by understanding the psychological status and behaviour of the patients (12%). A small percentage of subjects (4%) stated that online mode was not a natural way and the reliability was questionable. In support of this statement, a recent study introduced the "hybrid" approach to tinnitus therapy in which the main therapy sessions could be conducted online while the crucial assessment and outcome measures may be done offline (Scaglione & Brianna, 2021). The prime reason for participants’ agreement towards offline assessment and outcome measures of tinnitus was the practical difficulty in carrying out objective measures such as loudness matching, pitch matching, and residual inhibition. However, a recent protocol developed by Cima et al. (2019) did not give much importance to objective assessment of tinnitus. Since tinnitus was a fluctuating condition and its unpredictable nature towards stability, also the loudness and pitch identification don’t have any importance in the treatment part (Cima et al., 2019). Another supporting review to this statement was supported by published article that aimed to identify and compare current clinical guidelines from Denmark, Germany, Sweden, Netherlands and the United States for the assessment and treatment of subjective tinnitus in adults. The results indicated that majority used audiometric testing, physical examination and validated questionnaire(s) to assess tinnitus-related suffering, and referral to a psychologist when necessary. The German guidelines included objective measures such as tinnitus loudness assessments, residual inhibition, and so on along with psychoacoustic measures. Other guidelines in this evaluation did not recommend psychoacoustic measures of tinnitus frequency or intensity (Fuller et al., 2017).

In response to the question targeted on the specialized tinnitus training that the participant acquired, Majority of the responses receives as the academic training during bachelor's or master's training period. On reviewing the RCI syllabus for BASLP, MASLP, and MSc Audiology courses the module dealing with tele audiology assessment and rehabilitation of tinnitus has got less preference (Curriculum Framework Bachelor in Audiology and Speech-Language Pathology (B.ASLP) 2017-18). This might be the reason for the reduced awareness of audiologists about online modes of tinnitus rehabilitation and reduced number of participants in the present study who are doing the same at their workplace.

In response to the question (question number 35) "in your opinion, online or offline tinnitus therapy is more beneficial to patients?" a full range of responses surfaced. Relatively, a large proportion of individuals (90.4%) preferred offline treatment. Participants provided arguments for their selection of offline mode (question number 36), including the need for face-to-face connection in therapy and counselling (52%), the possibility of technical difficulties when receiving therapy online (30%), and other factors such as patient misinterpretation of instructions, lack of understanding from patient's side, etc. The remaining 9.6 % of the respondents preferred online tinnitus management over offline management. These minority population reckons that during pandemics, online mode of management was more practical than offline, and in the current technological era, online mode is more significant than the conventional mode of treatment. A small percentage of participants gave neutral responses, suggesting that both offline and online have their own benefits and demerits.



From these results, it can be inferred that majority of the audiologists preferred the offline mode of tinnitus management over the online mode. A similar conclusion with respect to preference of participant's responses for offline mode is available in the literature. An unpublished dissertation by Nikhil (2018) who examined the preferences of 30 tinnitus patients and audiologists for online and offline tinnitus treatment mode. The results from their study reported that offline option was preferred by 70 % of the audiologists. Their study indicated the need for offline training to give better face validity and solve the patient's difficulties, as well as higher validity over an online mode-based approach due to technology restrictions when compared to offline mode. Hence, it can be concluded that most of the participants believed that conventional tinnitus management was more convenient for professionals due to advantage of face-to-face interaction. Additionally, a lack of technical knowledge among the professionals as well as the patients might have an impact on the participant's agreement.

On the other hand, a minority of the respondents stand with the novel online mode and the reported reasons for this agreement are the applicability and practicality in the modern technological era. The most reported reason are cost and time effectiveness. Some of the literature supports the minorities agreement i.e., preference of online mode. In a study by Beukes et al. (2018) consisting of 92 participants who were undergoing either an internet-based cognitive behavioural therapy (CBT) intervention or individualized face-to-face clinical care. Both online and offline mode were found to be equally helpful in reducing tinnitus distress and most tinnitus-associated issues such as insomnia, anxiety, depression, hearing disability, hyperacusis, cognitive failures, and satisfaction with life. But when considering the necessary resources, iCBT was more

time-effective than individualized face-to-face therapy when considering primarily clinician time. Similar results were reported by Prabhu et al. (2019), Aazh et al. (2021) and Paul et al. (2021).

Results from an unpublished dissertation analysed the preference of tinnitus treatment mode i.e., from online or offline mode from 30 tinnitus patients. Their study concluded that 60% of clients preferred the online mode of treatment. The reasons suggested by authors were that online therapy is more time-saving, cost-effective, and also avoids travel constraints when compared to offline (Nikhil, 2018). This was further supported by some of western authors Aazh et al. (2021) and Guitton (2013). Hence, it can be concluded that online treatment is proven to be prioritized by some of the participants in the study, because of the above-mentioned reasons.

Finally, respondents were asked for suggestions to improve online tinnitus management (question number 37). 38 % of individuals suggested that there is a need for awareness and training among the audiologists about the availability and facilities of online tinnitus management. Moreover, 28 % of them suggested that there is a need for well-established software and apps for online tinnitus management, assessment, and outcome measures, and 14 % suggested that proper protocols or guidelines were required for the online mode of tinnitus management. The remaining 2% suggested improving the clients' technical skills as well as raising awareness among tinnitus patients about the online mode.

The above results of the present study was further supported by the study conducted by Scaglione and Brianna (2021) showed how to assess and manage annoying tinnitus using a hybrid delivery model that combines telemedicine and face-to-face

encounters. While telemedicine was used for counselling, teaching, and remote programming of treatment devices, in-person services were employed for audiological assessment and fitting treatment equipment. The study concluded by recommending future care to be provided using the same combination strategy that has allowed the patient to receive treatment in a safe manner throughout the pandemic. It can be suggested that other than the pure offline or online mode, a “hybrid” method of tinnitus therapy can be developed and validated, so that essential assessment and outcome measures can be done through offline mode while the major therapy sessions can be delivered through online mode. These kinds of approach can save the cost and time of the clinician as well as the client and is found to be more applicable during pandemic or any other kind of emergency situation. The results are in consonance with the study results by Aazh et al. (2020) done during COVID-19 lockdown reported that patients were offered telehealth CBT via video using a web-based platform on 113 patients and the results suggested that 80% of patients accepted the telemode intervention.

### **Summary of results**

- The response rate from audiologists for the questionnaire was relatively low. The majority of respondents indicated that they did not have access to the online Tinnitus Management Program.
- Among the total participants, 52% had necessary resources and infrastructure for a tinnitus management program, and 60% are providing treatment options for those who suffer from tinnitus. A small proportion (38%) of participants offer online tinnitus management, with 45% doing so in institutional settings, 40% in private clinical settings, and 15% in hospital setups.

- With regard to online tinnitus apps used for sound therapy, most audiologists choose white noise, resound relief, Relax Melodies: Sleep Sounds and natural sounds.
- Most participants agreed on the necessity for inclusion of psychological and cognitive focused tinnitus therapy for individuals. Lifestyle modification, counselling, CBT and hearing aids or the combination of any are the approaches offered by majority of the participants.
- The major challenges experienced by audiologists during online tinnitus management are Internet related issues and less trained clinicians.
- Finally, the most common suggestions offered by audiologists for the online mode of tinnitus therapy are the need to create awareness and training among the audiologists regarding the availability and facilities of online tinnitus management.
- The other suggestions included need for well-established software and apps for online tinnitus management, assessment, and outcome measurements, and a few advised adequate protocols or guidelines required for the online mode of tinnitus management.

## Chapter 5

### SUMMARY and CONCLUSIONS

The aim of the present questionnaire-based study was to investigate the current practice of online tinnitus treatment among audiologists in India. Three distinct phases of the investigation were conducted starting with phase 1, where the questionnaire was developed by referring to the available literature with the primary intention of gathering comprehensive data on the tele-practice of tinnitus management. The developed questionnaire had six domains with a total of 37 questions that covered different areas, such as online and offline tinnitus assessment, management and outcome measures, strategies for managing tinnitus-related issues, and challenges, and was taken into account for validation. In the second stage, the questionnaire was submitted to four experienced professional audiologists for validation. The validation was followed by the development of the final questionnaire using the validators' recommendations and corrections. In the third phase, the final questionnaire was uploaded in Google Forms and distributed through several online modes. Descriptive statistics were used to tabulate and interpret the recorded data.

The current study findings revealed the less number of audiology practitioners in India who deals with tinnitus through online mode. Based on the response from the participants who engaged in online management, it is evident that counselling, TRT, and hearing aids or a combination of any of these are the most offered online tinnitus management option. With regard to smartphone applications utilised for online therapy, the majority of the respondents chose white noise and resound tinnitus reduction apps for sound therapy. Most of them recommended the necessity of specific therapy for the

accompanying tinnitus problems, including psychosocial and cognitive problems. In connection with cognitive and psychological issues, psychological issues are addressed and treated more frequently through online therapy, with CBT and counselling being chosen as a combination (both online & offline). The majority of them identified factors such as computer illiteracy of subjects and lack of trained clinicians as the pivotal and prime obstacles to implementing a structured online tinnitus management program.

To recapitulate, the study findings project the dearth of online modes of tinnitus treatment services among audiologists in India. In spite of the fact that there is a lot of recent western research on the advantages of tele-practice in the tinnitus sector, most audiologists in India are unaware of the online management of tinnitus. From the participant's responses, it can be concluded that a hybrid model of therapy, which combines both offline and online modes are most applicable approach for treating individuals with tinnitus. For initial assessment, we can use the offline mode, and for subsequent treatment and outcome measures, the online mode can be utilized.

### **5.1 Clinical Implications of the study:**

- The pivotal application of the present study is to get insight into the various online tinnitus treatment options available to audiologists in India and to track the awareness level of online tinnitus opportunities and possibilities among audiologists.
- Moreover, the study results explain how tinnitus-related psychological and cognitive issues can be addressed and treated with the online mode than the conventional method.
- The other implication of the study is that the challenging factors existing in implementing the online therapy, and understanding whether resolving these

difficulties will aid in the formation of future advancements in online tinnitus therapy.

## **5.2 Limitations of the study:**

The minimal sample size is the major limitation of the present study. Out of 403 invitations, only 52 participants were respondents and 20 of the respondents were practising online tinnitus management. The assumed reason for the limited participation might be the lack of the number of audiologists who are specialised in treating tinnitus, especially through online mode. Lack of awareness, essential tools and infrastructure for implementing effective online tinnitus management programs might be the other contributing factors.

## **5.3 Future Directions**

- The following study assesses the existing practice of audiologists in the area of online tinnitus practice. In order to obtain more accurate and reliable results, a larger sample of populations must be studied in the future.
- It is evident from the present study that a non-uniformity exists in the online tinnitus treatment delivery due to the lack of a standard protocol or guidelines. Hence development and validation of an appropriate protocol to deliver effective online tinnitus practice are essential.
- The need for developing software for performing online tinnitus assessment, treatments, and outcome measures was suggested by the majority of the participants. Hence, more research in this field is pivotal for the development of such software.
- A comparison study of the online and offline tinnitus therapeutic methods can be carried out in the Indian context. This will help in deciding which mode will be more beneficial for patients and audiologists while implementing the tinnitus rehabilitation.

## REFERENCES

- Aazh, H., Swanepoel, D. W., & Moore, B. C. J. (2021). Telehealth tinnitus therapy during the COVID-19 outbreak in the UK: uptake and related factors. *International Journal of Audiology*, *60*(5), 322–327.  
<https://doi.org/10.1080/14992027.2020.1822553>
- Abouzari, M., Goshtasbi, K., Sarna, B., Ghavami, Y., Parker, E. M., Khosravi, P., Mostaghni, N., Jamshidi, S., Saber, T., & Djalilian, H. R. (2021). Adapting Personal Therapies Using a Mobile Application for Tinnitus Rehabilitation: A Preliminary Study. *Annals of Otolaryngology, Rhinology and Laryngology*, *130*(6), 571–577. <https://doi.org/10.1177/0003489420962818>
- Adamchic, I., Tass, P. A., Langguth, B., Hauptmann, C., Koller, M., Schecklmann, M., Zeman, F., & Landgrebe, M. (2012). Linking the Tinnitus Questionnaire and the subjective Clinical Global Impression: Which differences are clinically important? *Health and Quality of Life Outcomes*, *10*, 79. <https://doi.org/10.1186/1477-7525-10-79>.
- Aithal, A., & Aithal, P. S. (2020). Development and Validation of Survey Questionnaire & Experimental Data – A Systematical Review-based Statistical Approach. *SSRN Electronic Journal*. <https://doi.org/10.2139/SSRN.3724105>.
- American Tinnitus Association. Retrieved July 24, 2022, from <https://www.ata.org>
- ASHA (2019) - Google Search. Retrieved July 24, 2022, from <https://www.google.com/search>
- Atik, A. (2011). Pathophysiology and Treatment of Tinnitus: An Elusive Disease. *Indian Journal of Otolaryngology and Head & Neck Surgery*, *66*(S1), 1–5.



<https://doi.org/10.1007/s12070-011-0374-8>

Bartnik, G., Fabijańska, A., & Rogowski, M. (2001). Effects of tinnitus retraining therapy (TRT) for patients with tinnitus and subjective hearing loss versus tinnitus only. *Scandinavian Audiology*, 30(1), 206–208.  
<https://doi.org/10.1080/010503901300007542>.

Beukes, E. W., Andersson, G., Allen, P. M., Manchaiah, V., & Baguley, D. M. (2018). Effectiveness of Guided Internet-Based Cognitive Behavioral Therapy vs Face-to-Face Clinical Care for Treatment of Tinnitus. *JAMA Otolaryngology-Head & Neck Surgery*, 144(12), 1126. <https://doi.org/10.1001/jamaoto.2018.2238>.

Beukes, E. W., Andersson, G., Fagelson, M., & Manchaiah, V. (2022). Internet-Based Audiologist-Guided Cognitive Behavioral Therapy for Tinnitus: Randomized Controlled Trial. *Journal of Medical Internet Research*, 24(2).  
<https://doi.org/10.2196/27584>.

Beukes, E. W., Onozuka, J., Brazell, T. P., & Manchaiaha, V. (2021). Coping With Tinnitus During the COVID-19 Pandemic. *American Journal of Audiology*, 30(2), 385–393. [https://doi.org/10.1044/2021\\_AJA-20-00188](https://doi.org/10.1044/2021_AJA-20-00188).

Bhatt, J. M., Lin, H. W., & Bhattacharyya, N. (2016). Tinnitus Epidemiology: Prevalence, Severity, Exposures And Treatment Patterns In The United States: Bhatt JM: Tinnitus in the United States. *JAMA Otolaryngology- Head & Neck Surgery*, 142(10), 959. <https://doi.org/10.1001/JAMAOTO.2016.1700>.

Cima, R. F. F., Mazurek, B., Haider, H., Kikidis, D., Lapira, A., Noreña, A., & Hoare, D. J. (2019). A multidisciplinary European guideline for tinnitus: diagnostics, assessment, and treatment. *HNO*, 67(1), 10–42. <https://doi.org/10.1007/S00106-019->

[0633-7/TABLES/13](#)

- Coles, R. R. A., & Hallam, R. S. (1987). Tinnitus and its management. *British Medical Bulletin*, 43(4), 983–998.  
<https://doi.org/10.1093/OXFORDJOURNALS.BMB.A072230>
- Curriculum Framework Bachelor in Audiology and Speech-Language Pathology (B. ASLP) Norms and Guidelines Course Content Effective from Academic Session 2017-18 Four Years Duration (n.d.). Retrieved July 21, 2022, from [www.rehabcouncil.nic.in](http://www.rehabcouncil.nic.in)
- Dawood, F., Khan, N. B., & Bagwandin, V. (2019). Management of adult patients with tinnitus: Preparedness, perspectives and practices of audiologists. *South African Journal of Communication Disorders*, 66 (1).  
<https://doi.org/10.4102/sajcd.v66i1.621>.
- De Ridder, D., Schlee, W., Vanneste, S., Londero, A., Weisz, N., Kleinjung, T., Shekhawat, G. S., Elgoyhen, A. B., Song, J.-J., Andersson, G., Adhia, D., de Azevedo, A. A., Baguley, D. M., Biesinger, E., Binetti, A. C., Del Bo, L., Cederroth, C. R., Cima, R., Eggermont, J. J., ... Langguth, B. (2021). Tinnitus and tinnitus disorder: Theoretical and operational definitions (an international multidisciplinary proposal). *Progress in Brain Research*, 1–25.  
<https://doi.org/10.1016/bs.pbr.2020.12.002>
- Esmaili, A. A., & Renton, J. (2018). A review of tinnitus. *Australian Journal of General Practice*, 47(4), 205–208. <https://doi.org/10.31128/AJGP-12-17-4420>.
- Forti, S., Costanzo, S., Crocetti, A., Pignataro, L., del Bo, L., & Ambrosetti, U. (2009). Are results of tinnitus retraining therapy maintained over time? 18-month follow-up

after completion of therapy. *Audiology & Neuro-Otology*, 14(5), 286–289.

<https://doi.org/10.1159/000212106>.

Fortune, D. S., Haynes, D. S., & Hall, J. W. (1999). TINNITUS. *Medical Clinics of*

North America, 83(1), 153–162. [https://doi.org/10.1016/s0025-7125\(05\)70094-8](https://doi.org/10.1016/s0025-7125(05)70094-8)

Fournier, P., & Hébert, S. (2013). Gap detection deficits in humans with tinnitus as

assessed with the acoustic startle paradigm: does tinnitus fill in the gap? *Hearing*

*Research*, 295, 16–23. <https://doi.org/10.1016/J.HEARES.2012.05.011>

Fournier, P., Cuvillier, A. F., Gallego, S., Paolino, F., Paolino, M., Quemar, A., Londero,

A., & Norena, A. (2018). A New Method for Assessing Masking and Residual

Inhibition of Tinnitus. *Trends in Hearing*, 22.

<https://doi.org/10.1177/2331216518769996>

Fuller, T. E., Haider, H. F., Kikidis, D., Lapira, A., Mazurek, B., Norena, A., Rabau, S.,

Lardinois, R., Cederroth, C. R., Edvall, N. K., Brueggemann, P. G., Rosing, S. N.,

Kapandais, A., Lungaard, D., Hoare, D. J., & Cima, R. F. F. (2017). Different

teams, same conclusions? A systematic review of existing clinical guidelines for

the assessment and treatment of tinnitus in adults. *Frontiers in Psychology*, 8

(FEB), 206. <https://doi.org/10.3389/FPSYG.2017.00206/BIBTEX>.

Genitsaridi, E., Partyka, M., Gallus, S., Lopez-Escamez, J. A., Schecklmann, M.,

Mielczarek, M., Trpchevska, N., Santacruz, J. L., Schoisswohl, S., Riha, C.,

Lourenco, M., Biswas, R., Liyanage, N., Cederroth, C. R., Perez-Carpena, P.,

Devos, J., Fuller, T., Edvall, N. K., Hellberg, M. P., Hall, D. A. (2019).

Standardised profiling for tinnitus research: The European School for

Interdisciplinary Tinnitus Research Screening Questionnaire (ESIT-SQ). *Hearing*

- Research,377, 353–359. <https://doi.org/10.1016/J.HEARES.2019.02.017>.
- Gilani, V. M., Ruzbahani, M., Mahdi, P., Amali, A., Khoshk, M. H. N., Sameni, J., Yazdi, A. K., & Emami, H. (2013). Temporal Processing Evaluation in Tinnitus Patients: Results on Analysis of Gap in Noise and Duration Pattern Test. *Iranian Journal of Otorhinolaryngology*, 25(73), 221. </pmc/articles/PMC3846254/>
- Guitton, M. J. (2013). Telemedicine in Tinnitus: Feasibility, Advantages, Limitations, and Perspectives. *ISRN Otolaryngology*, 2013, 1–7. <https://doi.org/10.1155/2013/218265>.
- Haider, H. F., Bojić, T., Ribeiro, S. F., Paço, J., Hall, D. A., & Szczepek, A. J. (2018). Pathophysiology of subjective tinnitus: Triggers and maintenance. *Frontiers in Neuroscience*, 12(NOV), 866. <https://doi.org/10.3389/FNINS.2018.00866/BIBTEX>
- Han, B. I., Lee, H. W., Kim, T. Y., Lim, J. S., & Shin, K. S. (2009). Tinnitus Characteristics, Causes, Mechanisms, and Treatments. *Journal of Clinical Neurology (Seoul, Korea)*, 5(1), 11. <https://doi.org/10.3988/JCN.2009.5.1.11>
- Han, M., Yang, X., & Lv, J. (2021). Efficacy of tinnitus retraining therapy in the treatment of tinnitus: A meta-analysis and systematic review. *American Journal of Otolaryngology*, 42(6), 103151. <https://doi.org/10.1016/J.AMJOTO.2021.103151>
- Henry, J. A., Dennis, K. C., & Schechter, M. A. (2005). General Review of Tinnitus. *Journal of Speech, Language, and Hearing Research*, 48(5), 1204–1235. [https://doi.org/10.1044/1092-4388\(2005/084](https://doi.org/10.1044/1092-4388(2005/084)
- Henry, J. A., & Meikle, M. B. (2000). Psychoacoustic measures of tinnitus. *Journal of the American Academy of Audiology*, 11(3), 138–155. <https://doi.org/10.1055/S-0042-1748040>

- Henry, J. A., Roberts, L. E., Caspary, D. M., Theodoroff, S. M., & Salvi, R. J. (2014). Underlying Mechanisms of Tinnitus: Review and Clinical Implications. *Journal of the American Academy of Audiology*, 25(01), 005–022.  
<https://doi.org/10.3766/jaaa.25.1.2>
- Henry, J., & Wilson, P. (1996). The Psychological Management of Tinnitus: Comparison of a Combined Cognitive Educational Program, Education Alone and a Waiting-List Control. *The International Tinnitus Journal*, 2, 9–20.  
<https://europepmc.org/article/med/10753339>.
- Henry, J. A., Zaugg, T. L., Myers, P. J., & Schechter, M. A. (2008). Progressive Audiologic Tinnitus Management. *ASHA Leader*, 13(8), 14–17.  
<https://doi.org/10.1044/LEADER.FTR2.13082008.14>
- Henry, J. A. (2016). “Measurement” of Tinnitus. *Otology and Neurotology*, 37(8), e276–e285. <https://doi.org/10.1097/MAO.0000000000001070>
- Hoare, D. J., Gander, P. E., Collins, L., Smith, S., & Hall, D. A. (2012). Management of tinnitus in English NHS audiology departments: an evaluation of current practice. *Journal of Evaluation in Clinical Practice*, 18(2), 326–334.  
<https://doi.org/10.1111/J.1365-2753.2010.01566.X>
- Hoare, D. J., Searchfield, G. D., el Refaie, A., & Henry, J. A. (2014). Sound therapy for tinnitus management: Practicable options. *Journal of the American Academy of Audiology*, 25(1), 62–75. <https://doi.org/10.3766/JAAA.25.1.5>
- Hobson, J., Chisholm, E., & el Refaie, A. (2012). Sound therapy (masking) in the management of tinnitus in adults. *Cochrane Database of Systematic Reviews*.  
<https://doi.org/10.1002/14651858.cd006371.pub3>

Home Page | NIDCD. Retrieved July 31, 2022, from <https://www.nidcd.nih.gov/>

Husain, F. T., Gander, P. E., Jansen, J. N., & Shen, S. (2018). Expectations for Tinnitus Treatment and Outcomes: A Survey Study of Audiologists and Patients. *Journal of the American Academy of Audiology* 29.04: 313-336.  
<https://doi.org/10.3766/jaaa.16154>.

Hutter, H. P., Moshammer, H., Wallner, P., Cartellieri, M., Denk-Linnert, D. M., Katzinger, M., Ehrenberger, K., & Kundi, M. (2010). Tinnitus and mobile phone use. *Occupational and Environmental Medicine*, 67(12), 804–808.  
<https://doi.org/10.1136/OEM.2009.048116>.

ieso Online Therapy | The benefits of online CBT. (2021).

<https://www.iesohealth.com/wellbeing-blog/the-benefits-of-online-cbt>

Jackson, J. G., Coyne, I. J., & Clough, P. J. (2014). A preliminary investigation of potential cognitive performance decrements in non-help-seeking tinnitus sufferers. *International Journal of Audiology*, 53(2), 88–93.  
<https://doi.org/10.3109/14992027.2013.846481>.

Jastreboff, P. J. (1990). Phantom auditory perception (tinnitus): mechanisms of generation and perception. *Neuroscience Research*, 8(4), 221–254.  
[https://doi.org/10.1016/0168-0102\(90\)90031-9](https://doi.org/10.1016/0168-0102(90)90031-9)

Jastreboff, P. J., & Hazell, J. W. P. (1998). Treatment of tinnitus based on a neurophysiological model. *Tinnitus treatment and relief*, 201-217.

Jastreboff, P. J. (2011). Tinnitus retraining therapy. *Textbook of Tinnitus*, 575–596.  
[https://doi.org/10.1007/978-1-60761-145-5\\_73](https://doi.org/10.1007/978-1-60761-145-5_73)

Jastreboff, P. J. (2015). 25 years of tinnitus retraining therapy. *Hno*, 63(4), 307-311.

<https://link.springer.com/article/10.1007/s00106-014-2979-1>

- Jose, F. (2021). Prevalence And Characteristics Of Tinnitus In Individuals With Normal Hearing.
- Jun, H. J., & Park, M. K. (2013). Cognitive Behavioral Therapy for Tinnitus: Evidence and Efficacy. *Korean Journal of Audiology*, 17(3), 101. <https://doi.org/10.7874/KJA.2013.17.3.101>
- Kalle, S., Schlee, W., Pryss, R. C., Probst, T., Reichert, M., Langguth, B., & Spiliopoulou, M. (2018). Review of smart services for tinnitus self-help, diagnostics and treatments. *Frontiers in Neuroscience*, 12(AUG), 541. <https://doi.org/10.3389/FNINS.2018.00541/BIBTEX>.
- Kaltenbach, J. A., Rachel, J. D., Mathog, T. A., Zhang, J., Falzarano, P. R., & Lewandowski, M. (2002). Cisplatin-Induced Hyperactivity in the Dorsal Cochlear Nucleus and Its Relation to Outer Hair Cell Loss: Relevance to Tinnitus. *Journal of Neurophysiology*, 88(2), 699–714. <https://doi.org/10.1152/jn.2002.88.2.699>
- Koerner, T. K., Papesh, M. A., & Gallun, F. J. (2020). A questionnaire survey of current rehabilitation practices for adults with normal hearing sensitivity who experience auditory difficulties. *American Journal of Audiology*, 29(4), 738–761. [https://doi.org/10.1044/2020\\_AJA-20-00027](https://doi.org/10.1044/2020_AJA-20-00027)
- Konadath, S. & C Chatni, S & G., Jayaram & Maruthy, S. & Gupt, M & P Swamy, S. (2013). Prevalence Of Communication Disorders In A Rural Population Of India. *Journal of Hearing Science* 3. <https://www.researchgate.net/publication/340454580>
- Kim, S. H., Kim, D., Lee, J.-M., Lee, S. K., Kang, H. J., Yeo, S. G., Kim, S. H. ; Kim, D.; Lee, J.-M. ; Lee, S. K. ; Kang, H. J. ; Yeo, S. G., Stadio, A. di, & Ralli, M.

- (2021). Review of Pharmacotherapy for Tinnitus. *Healthcare 2021, Vol. 9, Page 779, 9(6), 779.*<https://doi.org/10.3390/HEALTHCARE9060779>
- Kochkin, S. & Tyler, R. & Born, J. (2011). MarkeTrak VIII: The prevalence of tinnitus in the United States and the self-reported efficacy of various treatments. *Hear Rev.* 18(12). 10-27. <https://www.researchgate.net/publication/312879493>
- Kutyba, J., Jedrzejczak, W. W., Gos, E., Bieñkowska, K., Raj-Koziak, D., & Skarżyński, P. H. (2021). Self-help interventions chosen by subjects with chronic tinnitus—a retrospective study of clinical patients. *International Journal of Audiology.* <https://doi.org/10.1080/14992027.2021.1964040>.
- Landgrebe, M., Langguth, B., Rosengarth, K., Braun, S., Koch, A., Kleinjung, T., May, A., de Ridder, D., & Hajak, G. (2009). Structural brain changes in tinnitus: Grey matter decrease in auditory and non-auditory brain areas. *NeuroImage*, 46(1), 213–218. <https://doi.org/10.1016/j.neuroimage.2009.01.069>.
- Langguth, B., Kreuzer, P. M., Kleinjung, T., & de Ridder, D. (2013). Tinnitus: causes and clinical management. *The Lancet Neurology*, 12(9), 920–930. [https://doi.org/10.1016/S1474-4422\(13\)70160-1](https://doi.org/10.1016/S1474-4422(13)70160-1).
- Langguth, B., Landgrebe, M., Schlee, W., Schecklmann, M., Vielsmeier, V., Steffens, T., Staudinger, S., Frick, H., & Frick, U. (2017). Different patterns of hearing loss among tinnitus patients: A latent class analysis of a large sample. *Frontiers in Neurology*, 8(FEB), 46. <https://doi.org/10.3389/FNEUR.2017.00046/BIBTEX>.
- Langguth, B., Zowe, M., Landgrebe, M., Sand, P., Kleinjung, T., Binder, H., Hajak, G., & Eichhammer, P. (2006). Transcranial Magnetic Stimulation for the Treatment of Tinnitus: A New Coil Positioning Method and First Results. *Brain Topography*



- 2006 18:4, 18(4), 241–247. <https://doi.org/10.1007/S10548-006-0002-1>.
- Lewis, S., Chowdhury, E., Stockdale, D., & Kennedy, V. (2020). Assessment and management of tinnitus: summary of NICE guidance. *BMJ*, 368.<https://doi.org/10.1136/BMJ.M976>
- Li, J., Jin, J., Xi, S., Zhu, Q., Chen, Y., Huang, M., & He, C. (2019). Clinical efficacy of cognitive behavioral therapy for chronic subjective tinnitus. *American Journal of Otolaryngology*, 40(2), 253–256. <https://doi.org/10.1016/J.AMJOTO.2018.10.017>
- Lin, F. C., Chien, H. Y., Chen, S. H., Kao, Y. C., Cheng, P. W., & Wang, C. (2020). Voice Therapy for Benign Voice Disorders in the Elderly: A Randomized Controlled Trial Comparing Telepractice and Conventional Face-to-Face Therapy. *Journal of Speech, Language, and Hearing Research*, 63(7), 2132–2140. [https://doi.org/10.1044/2020\\_JSLHR-19-00364](https://doi.org/10.1044/2020_JSLHR-19-00364)
- Liu, Y. W., Wang, B., Chen, B., Galvin, J. J., & Fu, Q. J. (2020). Tinnitus impairs segregation of competing speech in normal-hearing listeners. *Scientific Reports*, 10(1). <https://doi.org/10.1038/S41598-020-76942-1>.
- Lockwood, A. H., Salvi, R. J., & Burkard, R. F. (2002). Tinnitus. 347(12),904–910. <https://doi.org/10.1056/NEJMRA013395>
- Makar, S.K., Kumar, S., Narayanan, S., & Chatterjee, I. (2012). Status of the tinnitus management program in India-A Survey. *International Tinnitus Journal*, 17(1), 54–60. [www.tinnitusjournal.com](http://www.tinnitusjournal.com)
- Makar, S. K., Biswas, A., & Shatapathy, P. (2014). The Impact of Tinnitus on Sufferers in Indian Population. *Indian Journal of Otolaryngology and Head & Neck Surgery*, 66 (Suppl 1), 37. <https://doi.org/10.1007/S12070-011-0291-X>.

- Makar, S. K. (2021). Etiology and Pathophysiology of Tinnitus - A Systematic Review. *The International Tinnitus Journal*, 25(1). <https://doi.org/10.5935/0946-5448.20210015>
- Manche, S. K., Madhavi, J., Meganadh, K. R., & Jyothy, A. (2016). Association of tinnitus and hearing loss in otological disorders: a decade-long epidemiological study in a South Indian population. *Brazilian Journal of Otorhinolaryngology*, 82(6), 643–649. <https://doi.org/10.1016/J.BJORL.2015.11.007>
- McCormack, A., Edmondson-Jones, M., Somerset, S., & Hall, D. (2016). A systematic review of the reporting of tinnitus prevalence and severity. *Hearing Research*, 337, 70–79. <https://doi.org/10.1016/J.HEARES.2016.05.009>
- McKenna, L., Handscomb, L., Hoare, D. J., & Hall, D. A. (2014). A Scientific Cognitive Behavioral Model of Tinnitus: Novel Conceptualizations of Tinnitus Distress. *Frontiers in Neurology*, 5(OCT). <https://doi.org/10.3389/FNEUR.2014.00196>
- Meikle, M. B., Henry, J. A., Griest, S. E., Stewart, B. J., Abrams, H. B., McArdle, R., Myers, P. J., Newman, C. W., Sandridge, S., Turk, D. C., Folmer, R. L., Frederick, E. J., House, J. W., Jacobson, G. P., Kinney, S. E., Martin, W. H., Nagler, S. M., Reich, G. E., Searchfield, G., ... Vernon, J. A. (2012). The tinnitus functional index: development of a new clinical measure for chronic, intrusive tinnitus. *Ear and Hearing*, 33(2), 153–176. <https://doi.org/10.1097/AUD.0B013E31822F67C0>
- Mehdi, M., Riha, C., Neff, P., Dode, A., Pryss, R., Schlee, W., Reichert, M., & Hauck, F. J. (2020). Smartphone apps in the context of tinnitus: Systematic review. *Sensors (Switzerland)*, 20(6). <https://doi.org/10.3390/S20061725>
- Michael Piskosz, MS. (2019). Tinnitus Management in the Digital Age: The Efficacy of

ReSound Relief. <https://www.audiologyonline.com/articles/tinnitus-management-in-digital-age-25256>.

- Møller, M. B., Møller, A. R., Jannetta, P. J., & Jho, H. D. (1993). Vascular decompression surgery for severe tinnitus: selection criteria and results. *The Laryngoscope*, 103 (4 Pt 1), 421–427. <https://doi.org/10.1002/LARY.5541030410>
- Moller, A. R., & Roberson J., J. (1997). A double-blind placebo-controlled trial of baclofen in the treatment of tinnitus. *The American Journal of Otology*, 18(2), 268–269. <https://europepmc.org/article/MED/9093691>
- Møller, A. R. (2007). Tinnitus: presence and future. *Progress in Brain Research*, 166, 3–16. [https://doi.org/10.1016/S0079-6123\(07\)66001-4](https://doi.org/10.1016/S0079-6123(07)66001-4)
- Nagaraj, M. K., & Prabhu, P. (2020). Internet/smartphone-based applications for the treatment of tinnitus: a systematic review. In *European Archives of Oto-Rhino-Laryngology* (Vol. 277, Issue 3, pp. 649–657). Springer. <https://doi.org/10.1007/s00405-019-05743-8>
- Newman, C. W., Jacobson, G. P., & Spitzer, J. B. (1996). Development of the Tinnitus Handicap Inventory. *Archives of Otolaryngology--Head & Neck Surgery*, 122(2), 143–148. <https://doi.org/10.1001/ARCHOTOL.1996.01890140029007>
- Nikhil J. (2018). Efficacy of using Internet based Cognitive Behavioral Therapy (iCBT) for Adults with Tinnitus in Indian context.
- Nondahl, D. M., Cruickshanks, K. J., Wiley, T. L., Klein, R., Klein, B. E. K., & Tweed, T. S. (2002). Prevalence and 5-Year Incidence of Tinnitus among Older Adults: The Epidemiology of Hearing Loss Study. *Journal of the American Academy of Audiology*, 13(06), 323–331. <https://doi.org/10.1055/s-0040-1715975>

- Nondahl, D. M., Cruickshanks, K. J., Huang, G. H., Klein, B. E., Klein, R., Tweed, T. S., & Zhan, W. (2012). Generational Differences in the Reporting of Tinnitus. *Ear & Hearing, 33*(5), 640–644. <https://doi.org/10.1097/aud.0b013e31825069e8>
- Nuttall, A. L., Meikle, M. B., & Trune, D. R. (2004). Peripheral processes involved in tinnitus. *Tinnitus: Theory and management, 52-68*.
- Oosterloo, B. C., Croll, P. H., Baatenburg De Jong, R. J., Kamran Ikram, M., & Goedegebure, A. (2021). Prevalence of Tinnitus in an Aging Population and Its Relation to Age and Hearing Loss. *Original Research-Otology and Neurotology Otolaryngology-Head and Neck Surgery, 859-868*.  
<https://doi.org/10.1177/0194599820957296>
- Overview | Hearing loss in adults: assessment and management | Guidance | NICE.  
Retrieved. July 26, 2022, from <https://www.nice.org.uk/guidance/ng98>
- Pattyn, T., van den Eede, F., Vanneste, S., Cassiers, L., Veltman, D. J., van de Heyning, P., & Sabbe, B. C. G. (2016). Tinnitus and anxiety disorders: A review. *Hearing Research, 333, 255-265*. <https://doi.org/10.1016/J.HEARES.2015.08.014>.
- Paul, N., das Singh, U., Banerjee, S., & Chatterjee, I. (2021). App-Based And Online Trt: An Efficacy Study. In *International Research Journal of Modernization in Engineering Technology and Science* [www.irjmets.com](http://www.irjmets.com) @International Research Journal of Modernization in Engineering (Vol. 387). [www.irjmets.com](http://www.irjmets.com)
- Penner, M. J., & Bilger, R. C. (1992). Consistent Within-Session Measures of Tinnitus. *Journal of Speech and Hearing Research, 35*(3), 694–700.  
<https://doi.org/10.1044/JSHR.3503.694>
- Pinto, P. C. L., Marcelos, C. M., Mezzasalma, M. A., Osterne, F. J. V., de Melo Tavares

- de Lima, M. A., & Nardi, A. E. (2014). Tinnitus and its association with psychiatric disorders: systematic review. *The Journal of Laryngology and Otology*, 128(8), 660–664. <https://doi.org/10.1017/S0022215114001030>
- Polinski, J. M., Barker, T., Gagliano, N., Sussman, A., Brennan, T. A., & Shrank, W. H. (2016). Patients' Satisfaction with and Preference for Telehealth Visits. *Journal of General Internal Medicine*, 31(3), 269–275. <https://doi.org/10.1007/S11606-015-3489-X>
- RA, D., & S, V. H. (2004). Hearing Loss: Determining Eligibility for Social Security Benefits. <https://doi.org/10.17226/11099>
- Raj-Koziak, D., Gos, E., Kutyba, J., Skarzynski, H., & Skarzynski, P. H. (2021). Decreased Sound Tolerance in Tinnitus Patients. *Life (Basel, Switzerland)*, 11(2), 1–12. <https://doi.org/10.3390/LIFE11020087>.
- Rajapandy, M., Prabu, M., & Manoov, R. (2013). Analyzing the Impact of Internet in Rural India A Bioinformatics Tool to Identify Nested Motifs View project Churn Prediction and Retention in Banking, Telecom and IT Sectors Using Machine Learning Techniques View project Analyzing the Impact of Internet in Rural India. <https://www.researchgate.net/publication/264159967>.
- Ramkumar, V., Selvakumar, K., Vanaja, C., Hall, J. W., Nagarajan, R., & Neethi, J. (2016). Parents' perceptions of tele-audiological testing in a rural hearing screening program in South India. *International Journal of Pediatric Otorhinolaryngology*, 89, 60–66. <https://doi.org/10.1016/j.ijporl.2016.07.028>.
- Ramkumar, V. (2020). Teleaudiology Practices in Asia. *Advances in Audiology and Hearing. Science*, 365–384. <https://doi.org/10.1201/9780429292620-17>.

- Rangaswamy, Y., & Rao, P. (2018). Tele Speech-Language Pathology and Audiology in India - A Short Report. *Journal of the International Society for Telemedicine and EHealth*, 6(1), e19 (1-8). Retrieved from <https://journals.ukzn.ac.za/index.php/JISfTeH/article/view/446>
- Reyes, S. A., Salvi, R. J., Burkard, R. F., Coad, M. lou, Wack, D. S., Galantowicz, P. J., & Lockwood, A. H. (2002). Brain imaging of the effects of lidocaine on tinnitus. *Hearing Research*, 171(1-2), 43-50. [https://doi.org/10.1016/S0378-5955\(02\)00346-5](https://doi.org/10.1016/S0378-5955(02)00346-5)
- Rizzardo, R., Savastano, M., Maron, M. B., Mangialaio, M., & Salvadori, L. (1998). Psychological distress in patients with tinnitus. *Journal of Otolaryngology*, 27(1), 21-25.
- Roberts, L. E. (2007). Residual inhibition. *Progress in brain research*, 166, 487-495. <https://www.sciencedirect.com/science/article/pii/S0079612307660476>
- Sanches, S. G. G., Samelli, A. G., Nishiyama, A. K., Sanchez, T. G., & Carvalho, R. M. M. (2010). GIN Test (Gaps-in-Noise) in normal listeners with and without tinnitus. *Pro-Fono : Revista de Atualizacao Cientifica*, 22(3), 257-262. <https://doi.org/10.1590/S0104-56872010000300017>
- Scaglione, T., & Kuzbyt, B. (2021). Tinnitus Management: The Utilization of a Hybrid Telehealth and In-Person Delivery Model. *Seminars in Hearing*, 42(2), 115-122. <https://doi.org/10.1055/S-0041-1731692>
- Schad, M. L., Mcmillan, G. P., Thielman, E. J., Groon, K., Morse-Fortier, C., Martin, J. L., & Henry, J. A. (2018). Comparison of acoustic therapies for tinnitus suppression: A preliminary trial. *Taylor & Francis*, 7(2), 143-149. <https://doi.org/10.1080/14992027.2017.1385862>

- Schaette, R., König, O., Hornig, D., Gross, M., & Kempter, R. (2010). Acoustic stimulation treatments against tinnitus could be most effective when tinnitus pitch is within the stimulated frequency range. *Hearing Research*, 269(1–2), 95–101. <https://doi.org/10.1016/J.HEARES.2010.06.022>.
- Schlittenlacher, J., Turner, R. E., & Moore, B. C. J. (2018). Audiogram estimation using Bayesian active learning. *The Journal of the Acoustical Society of America*, 144(1), 421–430. <https://doi.org/10.1121/1.5047436>
- Schoisswohl, S., Agrawal, K., Simoes, J., Neff, P., Schlee, W., Langguth, B., & Schecklmann, M. (2019). RTMS parameters in tinnitus trials: a systematic review. *Scientific Reports* 9:1, 9(1), 1–11. <https://doi.org/10.1038/s41598-019-48750-9>
- Shargorodsky, J., Curhan, G. C., & Farwell, W. R. (2010). Prevalence and Characteristics of Tinnitus among US Adults. *The American Journal of Medicine*, 123(8), 711–718. <https://doi.org/10.1016/j.amjmed.2010.02.015>
- Shekhawat, G. S., Searchfield, G. D., & Stinear, C. M. (2013). Role of hearing aids in tinnitus intervention: A scoping review. *Journal of the American Academy of Audiology*, 24(8), 747–762. <https://doi.org/10.3766/JAAA.24.8.11/BIB>
- Sereda, M., Xia, J., el Refaie, A., Hall, D. A., & Hoare, D. J. (2018). Sound therapy (using amplification devices and sound generators) for tinnitus. *Cochrane Database of Systematic Reviews*, 2018(12). <https://doi.org/10.1002/14651858>.
- Sereda, M., Smith, S., Newton, K., & Stockdale, D. (2019). Mobile Apps for Management of Tinnitus: Users' Survey, Quality Assessment, and Content Analysis. *JMIR mHealth and uHealth*, 7(1), e10353. <https://doi.org/10.2196/10353>.

- Seydel, C., Haupt, H., Szczepek, A. J., Hartmann, A., Rose, M., & Mazurek, B. (2014). Three years later: report on the state of well-being of patients with chronic tinnitus who underwent modified tinnitus retraining therapy. Karger.Com. <https://doi.org/10.1159/000363728>
- Simoes, J. P., Daoud, E., Shabbir, M., Amanat, S., Assouly, K., Biswas, R., Casolani, C., Dode, A., Enzler, F., Jacquemin, L., Joergensen, M., Kok, T., Liyanage, N., Lourenco, M., Makani, P., Mehdi, M., Ramadhani, A. L., Riha, C., Santacruz, J. L., ... Genitsaridi, E. (2021). Multidisciplinary Tinnitus Research: Challenges and Future Directions From the Perspective of Early Stage Researchers. *Frontiers in Aging Neuroscience*, 13, 179. <https://doi.org/10.3389/FNAGI.2021.647285>
- Stevens, C., Walker, G., Boyer, M., & Gallagher, M. (2007). Severe tinnitus and its effect on selective and divided attention. [Http://Dx.Doi.Org/10.1080/14992020601102329](http://dx.doi.org/10.1080/14992020601102329), 46(5), 208–216. <https://doi.org/10.1080/14992020601102329>
- Thirunavukkarasu, K., & Geetha, C. (2013). One-year prevalence and risk factors of tinnitus in older individuals with otological problems. *The International Tinnitus Journal*, 18(2). <https://doi.org/10.5935/0946-5448.20130023>
- Thompson, D. M., Hall, D. A., Walker, D. M., & Hoare, D. J. (2017). Psychological Therapy for People with Tinnitus: A Scoping Review of Treatment Components. *Ear and Hearing*, 38(2), 149–158. <https://doi.org/10.1097/AUD.0000000000000363>
- Topak, M., Sahin-Yilmaz, A., Ozdoganoglu, T., Yilmaz, H. B., Ozbay, M., & Kulekci, M. Intratympanic methylprednisolone injections for subjective tinnitus. Cambridge.Org. <https://doi.org/10.1017/S0022215109990685>



- Tutaj, L., Hoare, D. J., & Sereda, M. (2018). Combined Amplification and Sound Generation for Tinnitus: A Scoping Review. *Ear and Hearing*, 39(3), 412. <https://doi.org/10.1097/AUD.0000000000000516>
- Tunkel, D. E., Bauer, C. A., Sun, G. H., Rosenfeld, R. M., Chandrasekhar, S. S., Cunningham, E. R., Archer, S. M., Blakley, B. W., Carter, J. M., Granieri, E. C., Henry, J. A., Hollingsworth, D., Khan, F. A., Mitchell, S., Monfared, A., Newman, C. W., Omole, F. S., Phillips, C. D., Robinson, S. K., ... Whamond, E. J. (2014). Clinical practice guideline: Tinnitus. *Otolaryngology - Head and Neck Surgery (United States)*, 151(2), S1–S40. <https://doi.org/10.1177/0194599814545325>
- Vernon, J. A., & Sanders, B. T. (2001). *Tinnitus: Questions and answers* (1st ed.). Pearson. 276
- Vernon, J., Griest, S., & Press, L. (1990). Attributes of tinnitus and the acceptance of masking. *American Journal of Otolaryngology--Head and Neck Medicine and Surgery*, 11(1), 44–50. [https://doi.org/10.1016/0196-0709\(90\)90169-V](https://doi.org/10.1016/0196-0709(90)90169-V)
- What Is Tinnitus? — Causes and Treatment | NIDCD. Retrieved November 19, 2021, from <https://www.nidcd.nih.gov/health/tinnitus>
- Wier, C. C., Jesteadt, W., & Green, D. M. (1976). A comparison of method-of-adjustment and forced-choice procedures in frequency discrimination. *Perception & Psychophysics*, 19(1), 75–79. <https://doi.org/10.3758/BF03199389>
- Xiong, B., Liu, Z., Liu, Q., Peng, Y., Wu, H., Lin, Y., Zhao, X., & Sun, W. (2019). Missed hearing loss in tinnitus patients with normal audiograms. *Hearing Research* 384, 107826. <https://doi.org/10.1016/J.HEARES.2019.107826>.

Yang, G., Lobarinas, E., Zhang, L., Turner, J., Stolzberg, D., Salvi, R., & Sun, W. (2007).

Salicylate induced tinnitus: behavioral measures and neural activity in auditory cortex of awake rats. *Hearing Research*, 226(1–2), 244–253.

<https://doi.org/10.1016/J.HEARES.2006.06.013>.

## APPENDIX

### **Questionnaire for evaluating the current practice in online tinnitus management among the audiologists in India**

The questions can be grouped under 4 categories.

- A) Demographic details.
- B) Offline Tinnitus management facilities are available in your clinic/institute/hospital.
- C) Online tinnitus management facilities are available in your clinic/institute/hospital.
- D) Online tinnitus management program details
- E) Online tinnitus management associated with other conditions
- F) Challenges of online tinnitus management faced among audiologists

#### ***A) Demographic information***

1. Name:

2. Email id:

3. The type of setup in which you are working currently?

Hospital set-up ( ), Private Clinics set-up ( ), Academic set-up ( ), Other ( )

4. Education qualification:

BSc Speech and Hearing ( ), MSc Audiology ( ), MASLP ( ), AuD ( ), PhD ( )

5. Year of experience in the field

1 year ( ), 2-3 years ( ), 3-4 years ( ), above 5 years ( )

6. Number of the tinnitus patients you have done management till now

Below 10 ( ), 10-25( ), 25-50( ), Above 50( )

***B) Offline Tinnitus management facilities available in your clinic/institute/hospital***

7. Is there a tinnitus management program at your hospital/clinic/institute?

Yes ( ), No ( )

8. Did your clinic/hospital/institute meets technical and professional requirement to deliver an effective tinnitus rehabilitation?

Yes ( ), No ( )

9. What kind of specialized tinnitus training have you had?

Check all that apply.

Certified tinnitus training ( ), Self-study through article/YouTube videos ( ),

Trained during bachelors/masters training program ( ), Online/offline courses ( ),

In practice training from other clinicians ( ), No training attained ( ), others ( )

***C) Online tinnitus management facilities available in your clinic/institute/hospital***

10. Is there an online tinnitus management program at your hospital/clinic/institute?

Yes ( ), No ( )

11. Did your clinic/hospital/institute meets technical and professional requirement to deliver an effective online tinnitus rehabilitation?

Yes ( ), No ( )

***D) Online tinnitus management program details***

12. Please indicate whether you offer or utilize each of the treatment listed below

Check all that apply.

Tinnitus Retraining Therapy ( ), Tinnitus sound therapy / tinnitus maskers ( ), hearing aids ( ), Directive counselling ( ), Progressive tinnitus management ( ), Cognitive behavioural therapy ( ), Neuromonic tinnitus management ( ), Stress management strategy ( ), others ( )

13. What are the different sorts of online tinnitus apps used for sound therapy?

Check all that apply.

White Noise Free ( ), Oticon Tinnitus Sound ( ), Relax Melodies: Sleep Sounds( ), myNoise ( ), Tinnitus Therapy Lite ( ), Headspace: Guided Meditation & Mindfulness ( ), Sleep Bug: White Noise Soundscapes & Music Box ( ), Beltone Tinnitus Calmer ( ), Sleep Pillow( ), Soothing Sounds Lite ( ), Tinnitus Aid: Nature sounds to mask ear ringing ( ), Tinnitus Balance ( ), Rain Rain Sleep Sounds ( ), Nature Sounds ( ), Relax Noise 3( ), ReSound Relief ( ), Sleep Well Hypnosis( ), Zenways ( ), None of the above ( ), others ( )

14. When did your clinic/hospital start offering an online tinnitus management programme?

Less than 3 months ( ), 3-6 months ( ), 6 months-1 year ( ), More than 1 year ( ),  
Not at all done ( )

15. Do you promote family participation in the following stages of online tinnitus management?

In the assessment stages ( ), In the treatment stages ( ), In the treatment outcome stages ( ), All of the above ( ) None of the above ( )

16. How do you go about assessing individuals with tinnitus online? (if you are using any questionnaire, please specify in the other option)

Check all that apply.

Structured interview ( ), Unstructured interview ( ), Objective measures ( ), A visual analogue scale ( ), Not at all doing online assessment ( ), Questionnaires (please specify \_\_), others ( )

17. How do you treat individuals with tinnitus having hearing loss in online mode?

Provided online Tinnitus management with hearing aid ( ), Provided only Tinnitus management ( ), Only hearing aid provided ( ), Other ( )

18. Do you recommend any specialized approaches for hearing aid users with tinnitus over those without tinnitus during online tinnitus management?

Yes ( ), No ( )

19. If yes, can you explain the approach and how it can be used in the online mode?

20. In online tinnitus therapy, what measures do you employ to evaluate treatment outcomes? (If you are using any questionnaire, please specify in the other option)

Check all that apply.

Structured interview ( ), Unstructured interview ( ), Objective measures (e.g., tinnitus pitch and loudness) ( ), A visual analogue scale ( ), No outcome measures used ( ), Questionnaires (please specify \_\_\_), others ( )

21. What variables do you think are crucial in determining whether the treatment provided for tinnitus is successful or not?

Check all that apply

Reduced awareness of tinnitus perception or increased habituation ( ), Complaint reported by the patient ( ), Stress/anxiety tolerance ( ), Awareness of tinnitus ( ), Tinnitus sound quality changes ( ), Enhanced understanding of tinnitus ( ), Temporary recovery from tinnitus ( ), Not having realistic expectation of tinnitus management outcomes ( ), Reduction of tinnitus loudness ( ), others ( )

***E) Online tinnitus management associated with other conditions***

22. Is there any need for providing psychologically focused tinnitus therapy for the psychological problem associated with tinnitus?

Yes ( ), No ( )

23. What are the online treatment options for the psychological problems (anxiety, depression, distress, sleeping problems etc.) associated with tinnitus?

Check all that apply.

Counselling ( ), Cognitive Behavioural Therapy ( ), Tinnitus Retraining Therapy ( ), Tinnitus education ( ), Psycho education ( ), Problem solving behavioural intervention ( ), Sound therapy ( ), Lifestyle advice ( ), No specific treatments given ( ), others ( )

24. Is there any additional training (psychological treatments) given for audiologists in treating individuals with tinnitus associated with psychological conditions in your clinic/institute/hospital

Yes ( ), No ( )

25. Is there any need for providing cognitive-focused tinnitus therapy for the cognitive problems (focus attention, concentration, working memory) associated with tinnitus?

Yes ( ), No ( )

26. Can you justify your answer?



27. If yes, what are the online treatment options for the cognitive problem associated with tinnitus?

Check all that apply.

Cognitive behavioural therapy ( ), Counselling ( ), Hearing aids ( ), No specific treatments given ( ), others ( )

***F) Challenges of online tinnitus management faced among audiologists***

28. Which one is the most challenging issue in online tinnitus management?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Internet issues					
Computer illiteracy of patients					
Lack of face-to-face interaction					
Less trained clinicians					
Compromising confidentiality					

29. Any other challenging issues other than these above-mentioned challenges?

30. In your opinion, tinnitus with hearing loss or with normal limits, which one is more difficult to treat through online mode?

Yes ( ), No ( )

31. Tinnitus with hearing loss patients, up to which degree of hearing loss we can take for online therapy?

Mild ( ), moderate ( ), moderately severe ( ), severe ( ), profound ( )

32. Is the severity of tinnitus have any effect on online tinnitus management?

Yes ( ), No ( )

33. Is assessment and outcome measures is more challenging in online tinnitus therapy?

Yes ( ), No ( )

34. If yes, can you tell the reason?

35. In your opinion, online or offline tinnitus therapy is more beneficial to patients?

Online ( ), offline ( )

36. Can you justify the above-mentioned statement?

37. Any suggestions on how to make the future of online tinnitus management better?