

Advancing Personalized Tinnitus Care: A Prospective Multicentre Evaluation of the MyTMD Tinnitus Matching Device and TMe-Solution in the tinnitus patients in India

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ABSTRACT

Background: Tinnitus is the conscious perception of sound, such as ringing, buzzing, or hissing, in one or both ears or within the head in the absence of an external acoustic stimulus. It is a highly prevalent condition, affecting more than 740 million adults worldwide, with over 120 million individuals experiencing bothersome symptoms that substantially impair their quality of life. Despite its high prevalence, tinnitus remains a significant clinical challenge due to its heterogeneous presentation, largely idiopathic etiology, and complex underlying pathophysiology. These factors complicate accurate diagnosis and the selection of effective treatment strategies for ENT specialists and audiologists. The novel Tinnitus Matching Device (MyTMD), combined with the IoT-based personalized tinnitus management platform (TMe-Solution), offers a comprehensive approach for precise tinnitus characterization and customized management. Preliminary evaluations have demonstrated its potential to improve the accuracy of tinnitus assessment and support individualized treatment.

Methodology: This was a multicentre, open-label clinical study involving patients aged 18–65 years with idiopathic moderate-to-severe tinnitus. Eligible participants were enrolled and followed for 60 days. All participants attended follow-up visits on Day 30 and Day 60 for the assessment of treatment efficacy and safety. The primary efficacy endpoint was the change in the Tinnitus Handicap Inventory (THI) score from baseline to the end of treatment (Day 60). Secondary efficacy endpoints included changes from baseline to Day 60 in the Numerical Rating Scale (NRS) scores for tinnitus loudness, duration, and annoyance.

Result: A total of 43 patients were enrolled in the study. The mean age of the participants was 47.9 years. The study population comprised 22 men and 21 women, indicating a nearly equal sex distribution. At the end of the 60-day treatment period, the mean Tinnitus Handicap Inventory (THI) score decreased by 59.75% compared with baseline. Similarly, the Numerical Rating Scale (NRS) scores showed a progressive reduction in symptom severity, including ear fullness (56.19% reduction), tinnitus loudness (69.29% reduction), degree of annoyance (67.85% reduction), and tinnitus duration (70.22% reduction) from baseline to Day 60.

Conclusion: Precise tinnitus matching and effective tinnitus management continue to pose significant challenges for clinicians. Many patients remain dissatisfied with the currently available treatment options due to their limited effectiveness and lack of personalization. The novel, non-invasive tinnitus matching device (MyTMD) enables precise characterization of tinnitus, facilitating individualized assessment. The accompanying tinnitus management software (TMe-Solution) provides a comprehensive IoT-based platform that supports personalized treatment through customized tinnitus masking, Tinnitus Retraining Therapy (TRT), attention diversion techniques, and cognitive behavioral therapy (CBT). Together, the MyTMD and TMe-Solution offer an integrated, multimodal approach to tinnitus assessment and management, representing a promising advancement in personalized tinnitus care.

Keywords: Tinnitus, tinnitus diagnosis, multimodal management

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INTRODUCTION

Tinnitus is the perception of a continuous or intermittent sound in the absence of external acoustic stimulation¹. Tinnitus is a highly prevalent condition, affecting more than 740 million adults worldwide, with over 120 million individuals experiencing bothersome symptoms that substantially impair their quality of life². Around 16%-30% of the adult population in India suffers from tinnitus³. As per the systemic review and meta-analysis of 767 publications, the pooled prevalence of any tinnitus amongst adult was 14.4 %³. 16% of total tinnitus population need medical assistance³. Tinnitus results in severe sleep disturbance, depression, anxiety, negative impact on mental health, irritability, impacting social life. The Psychological problems arising from bothersome tinnitus may result in suicidal tendencies in patients⁴. Overall tinnitus has a demoralizing impact on the quality of life. The typical causes of tinnitus include various ear diseases, cardiovascular diseases, head and neck trauma, the pharmacological side effects of a drug, noise pollution, etc. The prolonged exposure to loud noise results in an increased prevalence of tinnitus.

Etiology:

Tinnitus is a multifactorial and heterogeneous clinical condition with a wide range of underlying causes. Identifying a single etiological factor responsible for tinnitus is often challenging because its development is influenced by multiple interacting physiological, neurological, and psychological mechanisms. Several risk factors have been associated with the onset and persistence of tinnitus, including advancing age, prolonged exposure to excessive noise, and varying degrees of hearing loss⁵. Psychological conditions such as stress, anxiety, and depression can exacerbate tinnitus perception and increase its impact on quality of life. Certain systemic diseases, including cardiovascular and metabolic disorders, may also contribute to tinnitus. In addition, exposure to ototoxic substances and the use of specific medications with ototoxic potential can damage the auditory system, leading to tinnitus. Somatosensory factors, such as disorders affecting the cervical spine or temporomandibular joint, may also trigger or modulate tinnitus in some individuals. Consequently, a comprehensive clinical evaluation is essential to identify contributing factors and guide personalized management strategies⁶⁻⁹.

Hypothesis:

Tinnitus is a symptom rather than a distinct disease and is believed to arise from a complex interaction between peripheral auditory dysfunction and maladaptive central nervous system processing. Although the exact pathophysiology of subjective tinnitus remains incompletely understood, several mechanisms have been proposed. The prevailing hypotheses involve abnormal spontaneous neural activity, increased central auditory gain, maladaptive neuroplasticity, and impaired inhibitory

neural networks, which result in the persistent perception of sound in the absence of an external acoustic stimulus. The principal pathophysiological models include cochlear, dorsal cochlear nucleus, auditory cortex, and somatosensory mechanisms.

Cochlear Pathophysiology:

Damage to cochlear hair cells caused by ageing, excessive noise exposure, ototoxic medications, or other insults reduces normal auditory input[5]. This differentiation results in abnormal spontaneous activity within auditory nerve fibres and altered neurotransmission, which may initiate tinnitus perception.

Dorsal Cochlear Nucleus Pathophysiology:

Reduced cochlear input induces hyperactivity, increased spontaneous firing rates, and enhanced neural synchrony within the dorsal cochlear nucleus. Loss of inhibitory neurotransmission and increased neuronal excitability contribute to the generation and maintenance of tinnitus-related neural activity⁵.

Auditory Cortex Pathophysiology:

Reduced peripheral auditory input triggers maladaptive cortical plasticity, leading to reorganization of the tonotopic map and increased neuronal synchrony within the auditory cortex. This enhanced cortical excitability, together with abnormal interactions involving attention, memory, and emotional processing networks, contributes to the conscious perception and persistence of tinnitus⁵.

Somatosensory Pathophysiology:

The dorsal cochlear nucleus receives afferent input from the cervical spine, temporomandibular joint, and craniofacial musculature. Abnormal somatosensory input resulting from musculoskeletal dysfunction may alter auditory neuronal activity, thereby initiating or modulating tinnitus⁵. This mechanism explains why some patients can change the loudness or pitch of their tinnitus through jaw movements, neck movements, or pressure on specific muscles.

Collectively, these mechanisms are not mutually exclusive and may coexist in individual patients. The heterogeneity of tinnitus pathophysiology highlights the need for comprehensive clinical assessment and personalized therapeutic approaches.

Current Challenges in Tinnitus Diagnosis and Management:

Although several hypotheses have been proposed to explain the pathogenesis of tinnitus, its exact underlying mechanism remains incompletely understood. The proposed mechanisms involve different anatomical and physiological pathways; however, patients typically experience similar clinical symptoms, including the perception of sound in the absence of an external acoustic stimulus. This complexity has resulted in several challenges in the diagnosis and management of tinnitus.

1. Absence of FDA-Approved Pharmacological Treatment:

Currently, no drug has been approved by the U.S. Food and Drug Administration (FDA) specifically for the treatment of subjective tinnitus. Various pharmacological agents, including herbal preparations, neuroprotective drugs, antidepressants, anxiolytics, and multivitamin supplements, are used primarily to alleviate associated symptoms such as anxiety, depression, sleep disturbances, and stress rather than treating tinnitus itself. Their clinical efficacy remains inconsistent, and none has demonstrated universal therapeutic benefit.

2. Lack of Standardized Evaluation and Treatment Protocols:

The assessment and management of tinnitus vary considerably among healthcare providers and institutions. There is no universally accepted protocol for tinnitus evaluation, counselling, psychoacoustic assessment, or treatment selection. This lack of standardization contributes to variations in clinical outcomes and makes it difficult to compare the effectiveness of different therapeutic approaches across studies¹⁰.

3. Limitations of Existing Diagnostic Techniques:

Conventional tinnitus assessment is primarily performed using a clinical audiometer, which was originally designed for hearing evaluation rather than precise tinnitus characterization. Existing audiometers have limited frequency resolution, allowing pitch matching only at discrete octave or inter-octave frequencies. Most devices are restricted to frequencies up to 8 kHz, despite many patients perceiving tinnitus at higher frequencies. Furthermore, loudness matching is typically performed in 5 dB increments, limiting the precision measurements. These technical limitations reduce the accuracy and reproducibility of tinnitus assessment.

4. Inaccurate Tinnitus Matching Affects Therapeutic Outcomes:

Accurate determination of tinnitus pitch and loudness is essential for personalized sound-based interventions, including tinnitus retraining therapy (TRT), sound masking therapy, and customized acoustic stimulation. Imprecise psychoacoustic matching may lead to inappropriate sound therapy settings, reducing treatment effectiveness, patient satisfaction, and long-term clinical outcomes².

5. Limited Availability of Specialized Tinnitus Care:

Successful tinnitus management often requires multidisciplinary care involving audiologists, otolaryngologists, psychologists, and trained tinnitus therapists. In India, there is a shortage of professionals with expertise in tinnitus retraining therapy (TRT), cognitive behavioural therapy (CBT), and specialized tinnitus counselling. Consequently, access to evidence-based tinnitus management remains limited, particularly in rural and underserved regions.

6. Inadequate Patient Awareness and Counselling:

Limited public awareness regarding tinnitus and its management remains a significant challenge. Many patients expect immediate symptom relief and become discouraged when improvement is gradual. Structured patient education and standardized counselling are fundamental components of tinnitus management, as they improve understanding of the condition, reduce anxiety, enhance treatment adherence, and promote realistic expectations regarding therapeutic outcomes.

Need for novel treatment modality:

Tinnitus remains one of the most challenging and least understood disorders in audiology and otology. Although considerable research has been conducted over the past several decades, its precise pathophysiology remains incompletely understood, making tinnitus a significant unmet clinical need. It is a complex psychoacoustic condition in which both the perceptual characteristics of the tinnitus sound (such as pitch and loudness) and the patient's psychological response play crucial roles in determining symptom severity and quality of life.

Despite advances in clinical practice, many patients remain dissatisfied with the currently available diagnostic methods and treatment options. The absence of objective biomarkers and the limited precision of conventional tinnitus assessment often result in inaccurate characterization of tinnitus. Consequently, treatment strategies may not be adequately individualized, leading to variable clinical outcomes. Repeated consultations, inconsistent therapeutic responses, and prolonged symptom persistence frequently cause frustration, loss of confidence in healthcare services, unnecessary expenditure of time and financial resources, and an increased risk of anxiety, depression, and reduced quality of life.

A major unmet need in tinnitus management is the availability of a precise and reliable tinnitus matching system capable of accurately characterizing the psychoacoustic properties of tinnitus, including pitch and loudness. Accurate tinnitus matching would enable clinicians to better understand each patient's tinnitus profile and facilitate the development of personalized multimodal management approach.

The novel tinnitus matching device and multi-modal management approach:

Subjective tinnitus accounts for more than 99% of all tinnitus cases and is characterized by the perception of sound in the absence of an external acoustic stimulus. A major challenge in its clinical management is that the perceived tinnitus sound is entirely subjective; consequently, patients are often unable to accurately describe or reproduce its acoustic characteristics for clinicians. Precise characterization of tinnitus psychoacoustic parameters, particularly pitch and loudness, is essential for accurate diagnosis, individualized assessment, and the delivery of effective personalized sound therapy.

To address these longstanding challenges, the Indian Institute of Technology Bombay (IIT Bombay) has developed a novel, integrated solution comprising the MyTMD (Tinnitus Matching Device) and an IoT-enabled multimodal tinnitus management software platform¹¹. MyTMD is an innovative electronic medical device designed to enable clinicians to perform highly precise tinnitus pitch and loudness matching, thereby improving the accuracy and reproducibility of tinnitus assessment.

The accompanying IoT-based software provides a comprehensive platform for personalized tinnitus management, progress monitoring, and remote follow-up.

Together, these technologies offer a one-stop, evidence-driven solution for precise tinnitus assessment and personalized multimodal management, with the potential to improve clinical outcomes, standardize tinnitus care, and enhance the quality of life of individuals living with tinnitus Figure 1,2.

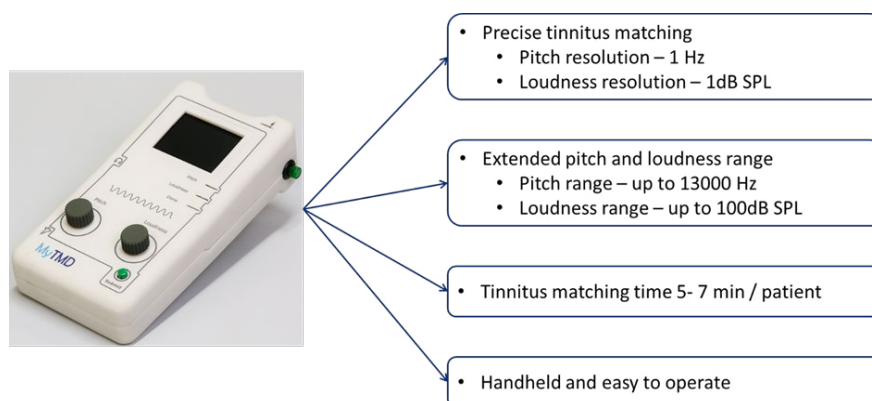


Figure 1: MyTMD – Precise tinnitus matching device.

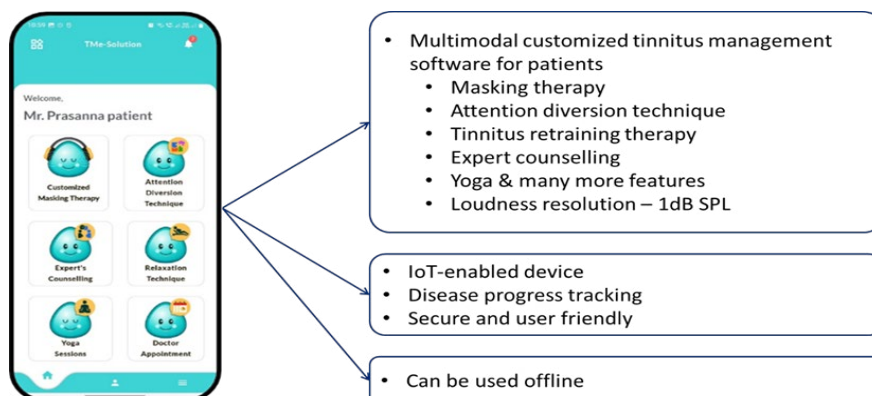


Figure 2: TMe-solution - Tinnitus management software for patients.

Aim: The aim of study was to evaluate efficacy and Safety of a Novel Tinnitus Matching Device – MyTMD with Multimodal Software – TMe-solution in Subjective Tinnitus.

MATERIALS & METHODS

The study was a multi-centre open label study conducted

in the ENT outpatient department. A total of 43 patients were included in the study over a duration of 8 weeks. However three patients dropped out after enrolled in the study. A total of 40 patients completed the study. Patients were selected based on predefined inclusion and exclusion criteria, as summarized in Table 1,2.

Table 1: Inclusion criteria.

Inclusion Criteria
1. Age 18 to 65 years
2. Idiopathic moderate to severe and severe tinnitus patient
3. Tinnitus due to Meniere's disease
4. Tinnitus with moderate to severe Sensorineural hearing loss
5. Chronic stable tinnitus of at least 3 months duration which is a. Not pulsatile b. Unilateral or bilateral c. Mild tinnitus (based on the TQ score)
6. Willing to give written informed consent to participate in the study

Table 2: Exclusion criteria.

Exclusion Criteria	
1.	Anatomic cause of tinnitus (e.g. vestibular schwannoma, tumour, middle-ear pathology)
2.	DSM-V psychiatric disorders, other than depression or anxiety disorder (such as bipolar disorder, dementia, addiction, personality disorders)
3.	Depression or anxiety disorder which was already present before tinnitus
4.	Cognitive impairment (assessed with standard 'cognitive functioning battery test' questionnaires) or coping problems (CISS-21)
5.	Active ear diseases that needs further attention according to research team
6.	Pregnancy or breast-feeding
7.	Active suicide thoughts or attempts
8.	Underlying malignancies, whenever life expectancy is lower than 2 years
9.	Other implantable electronic devices that potentially could interfere with DBS, e.g. cochlear implants, auditory brainstem implants or cortical implants
10.	Patients with ICD, pacemakers
11.	Any medical condition that may preclude the patient from coming for follow up
12.	Participation in new (< 1 month) tinnitus management or treatment
13.	Current participation in tinnitus research involving an intervention

Forty-three patients were enrolled in the study; however, 40 patients completed the study. The mean age of the patients was 47.90 years. Male to female ration was balanced among the enrolled patients (21 women versus 22 men). 28 patients had unilateral tinnitus, while 15 patients had bilateral tinnitus. 5 patients (11.6%) reported exposure to occupational noise.

No significant findings were observed on otoscopic examination in any patient, and no adverse effects were reported during the study. The patients enrolled in the study had bothersome tinnitus of at least 3 months' duration, which was non-pulsatile, unilateral or bilateral, and moderate to severe in intensity, as determined by the Tinnitus Handicap Inventory (THI) score. All the patients were asked to revisit the clinical trial centre for efficacy

and safety assessment at day 30 and day 60. The tinnitus management software was used by the patient two times a day (one use had to be before going to sleep) for a minimum duration of 15-20 minutes and up to a maximum time of use of 90 minutes per day. Attention diversion was for a maximum time period of 60 minutes per day. Patients were evaluated at baseline (day 0), day 30, and day 60. The primary assessment parameter was the change in the Tinnitus Handicap Inventory (THI) score at the end.

Patient enrolment procedure

Age and Gender:

Forty-three patients were enrolled in the study; however, 40 patients completed the study Figure 3 and Table 3,4

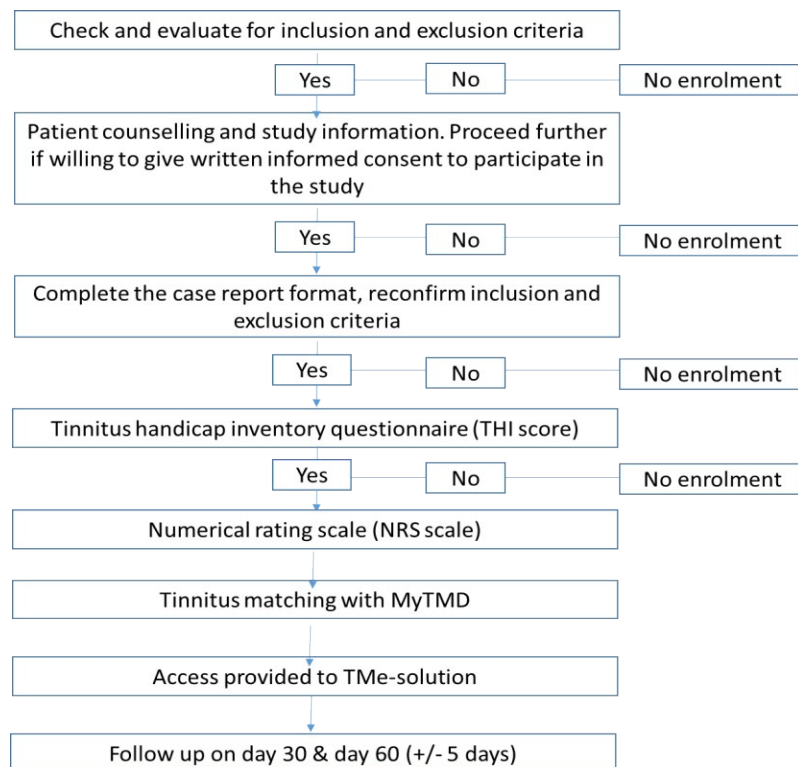
**Figure 3:** Patient enrolment procedure.

Table 3: Average age of enrolled patients.

Average age of enrolled patients					
	Centre 1	Centre 2	Centre 3	Center 4	Average age
Age	51.52	45.81	39.5	47.45	47.9

Table 4: Centre wise Gender %.

Gender %									
Centre 1		Centre 2		Centre 3		Center 4		Average age	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
58.8	41.2	45.5	54.5	75	25	36.4	63.6	51.2	48.8

RESULTS

The mean age of the patients was 47.90 years (Table 3). Male to female % was balanced among the enrolled patients (Table 4) male 51.2 % female 48.8% .There was a 57.09% reduction in THI scores at end of 60 days as compared to the baseline (Figure 4 & 5). THI scores decreased significantly from Day 0 to Day 30 ($p < 0.001$). There was a further significant reduction from Day 30 to Day 60 ($p < 0.001$). The overall improvement from Day

0 to Day 60 was highly significant ($p < 0.001$). There was significant reduction in tinnitus severity score. There was 85.43 % reduction in the response “Yes” at the end of 60 days (Figure 6). There was statistically significant reduction in tinnitus severity score at all centres (Figure 6). In the NRS scale there was progressive reduction in ear full ness (reduction 56.19 %), tinnitus loudness (reduction 69.29%), degree of annoyance (reduction 67.85%) and duration (reduction 70.22%) (Figure 7).

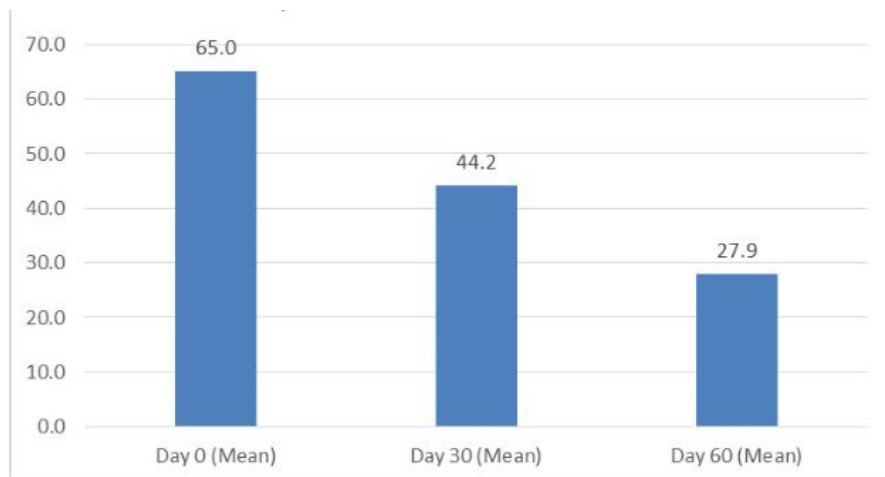


Figure 4: Overall THI score.

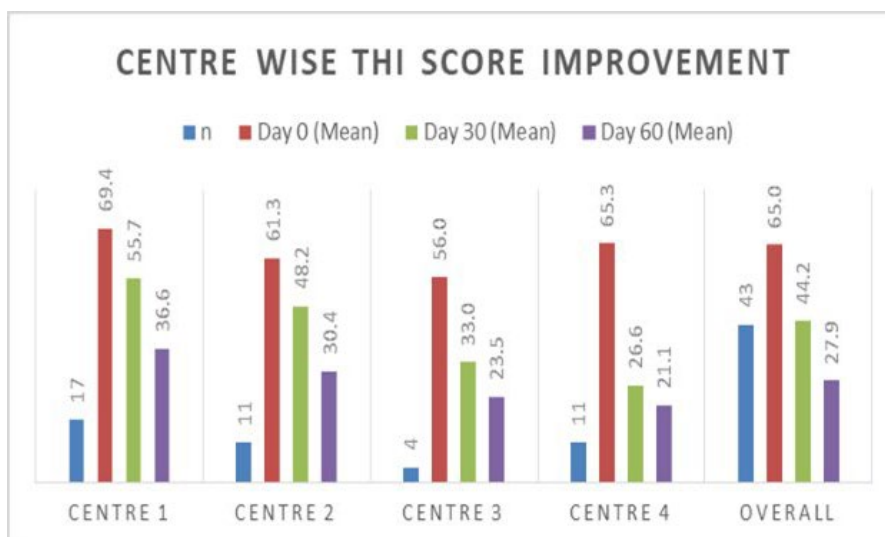


Figure 5: Centre wise THI score.



Figure 6: Centre wise and overall tinnitus severity score (TSS).

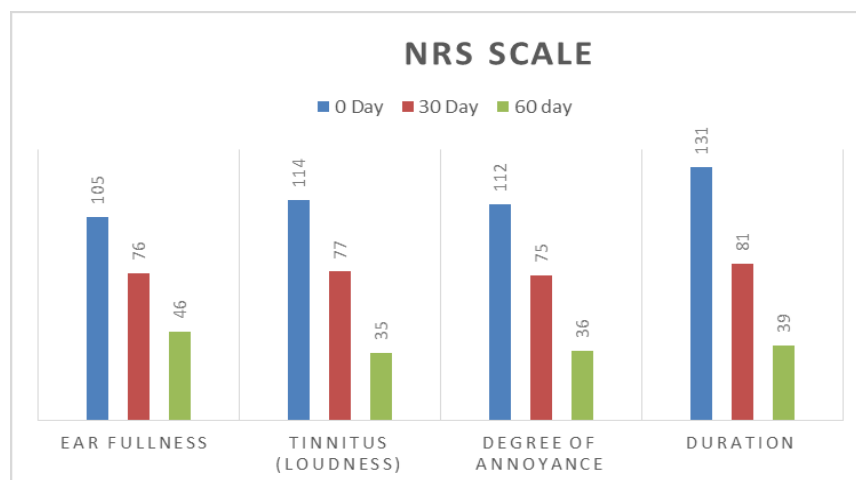


Figure 7: Numerical Rating Scale (NRS scale).

DISCUSSION

Tinnitus is one of the most prevalent auditory disorders and may persist throughout an individual's lifetime. Although it is often described as a symptom rather than a disease, chronic tinnitus can have a profound impact on quality of life and is frequently associated with anxiety, depression, sleep disturbances, hyperacusis, impaired concentration, and emotional distress. Despite considerable advances in understanding its underlying pathophysiological mechanisms, tinnitus remains a significant scientific and clinical challenge, and its management continues to be largely symptomatic¹².

At present, there is no pharmacological treatment that has consistently demonstrated efficacy for chronic tinnitus, although several therapeutic targets are under investigation. Current evidence supports a multimodal management approach, with the strongest evidence favouring the combination of sound therapy and cognitive behavioural therapy (CBT)-based counselling. However, the effectiveness of these interventions is often limited by the heterogeneous nature of tinnitus, variations in patient characteristics, and the lack of standardized treatment protocols.

Several non-pharmacological interventions are currently employed for tinnitus management, including sound

masking therapy, Tinnitus Retraining Therapy (TRT), attention diversion techniques, CBT, relaxation therapy, and counselling. Studies have shown that combining sound therapy with behavioural interventions such as TRT, CBT, attention diversion, and relaxation techniques provides greater symptom relief than individual therapies alone, particularly when sound therapy is customized according to the patient's psychoacoustic tinnitus characteristics¹³⁻¹⁷.

Despite these advances, existing treatment options have several limitations. Patient satisfaction remains suboptimal, and the cost of conventional sound masking devices often limits their accessibility. Furthermore, the availability of trained audiologists and psychologists capable of delivering specialized TRT and CBT is limited, particularly in resource-constrained settings. Conventional tinnitus maskers also commonly generate broadband or high-frequency noise that may be uncomfortable for prolonged use and may not provide individualized sound therapy tailored to the patient's tinnitus profile.

To address these challenges, the Tinnitus Management Software (TMe-Solution) has been developed as a comprehensive digital platform that integrates precise tinnitus matching with multimodal tinnitus management¹². The software generates a customized tinnitus masker based on each patient's psychoacoustic tinnitus characteristics, enabling personalized sound therapy while avoiding unnecessary exposure to non-individualized masking sounds. In addition, the platform incorporates structured Tinnitus Retraining Therapy, CBT-based interventions, attention diversion strategies, counselling, and relaxation techniques within a single integrated system.

By providing personalized and comprehensive tinnitus management through a single platform, TMe-Solution has the potential to improve treatment accessibility, enhance patient adherence, and reduce overall treatment costs. Patients participating in the present study reported progressive habituation to their tinnitus, improved ability to ignore the tinnitus perception, and a significant improvement in their overall quality of life. The integration of customized sound therapy with evidence-based behavioural interventions within one platform represents a promising and cost-effective approach for the long-term management of chronic subjective tinnitus.

The results of two months multi centre study have indicated a trend towards reduction of symptoms of tinnitus. There was statistically significant reduction in tinnitus severity score at all centres. In the NRS scale there was progressive reduction in ear full ness (reduction 56.19 %), tinnitus loudness (reduction 69.29%), degree of annoyance (reduction 67.85%) and duration (reduction 70.22%).

CONCLUSION

The management of chronic subjective tinnitus remains a significant clinical challenge, and many patients continue to experience limited benefit and dissatisfaction with currently available treatment options. The novel tinnitus matching device (MyTMD) is a non-invasive medical device designed to provide precise and individualized tinnitus matching based on the patient's psychoacoustic characteristics. When integrated with the Tinnitus Management Software (TMe-Solution), it delivers a comprehensive, personalized treatment approach through a single Internet of Things (IoT)-enabled platform.

The TMe-Solution combines customized sound therapy with evidence-based interventions, including Tinnitus Retraining Therapy (TRT), cognitive behavioural therapy (CBT), attention diversion techniques, counselling, and relaxation strategies. By tailoring therapy to the patient's specific tinnitus profile, the platform facilitates habituation, improves treatment adherence, and enhances accessibility to multimodal tinnitus care.

The findings of the present study demonstrate that the integrated MyTMD and TMe-Solution platform is a safe, effective, and practical approach for the management of subjective tinnitus. The observed reduction in tinnitus severity and improvement in patients' quality of life suggest that this personalized multimodal treatment strategy has the potential to address several limitations of conventional tinnitus management. Larger multicentre randomized controlled trials with longer follow-up are warranted to further establish its long-term clinical effectiveness and generalizability.

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REFERENCES

1. Jastreboff PJ, Hazell JW. A neurophysiological approach to tinnitus: clinical implications. *Br J Audiol.* 1993;27(1):7-17.
2. Jarach CM, Lugo A, Scala M, Van Den Brandt PA, Cederroth CR, Odone A, Garavello W, Schlee W, Langguth B, Gallus S. Global prevalence and incidence of tinnitus: a systematic review and meta-analysis. *JAMA Neurol.* 2022;79(9):888-900.

3. Thirunavukkarasu K, Geetha C. One-year prevalence and risk factors of tinnitus in older individuals with otological problems. *Int Tinnitus J*. 2013;18(2):175-81.
4. Makar SK, Mukundan G, Gore G. Treatment of tinnitus: a scoping review. *Int Tinnitus J*. 2017;21(2):144-56.
5. Makar SK. Etiology and pathophysiology of tinnitus: a systematic review. *Int Tinnitus J*. 2021;25(1):76-86.
6. Hoffman HJ, Reed GW. Epidemiology of tinnitus. *Tinnitus: Theory Manag*. 2004;16:41.
7. Hofmann E, Behr R, Neumann-Haefelin T, Schwager K. Pulsatile tinnitus: imaging and differential diagnosis. *Dtsch Arztebl Int*. 2013;110(26):451.
8. Henry JA, Dennis KC, Schechter MA. General review of tinnitus. *J Speech Lang Hear Res*. 2005;48(5):1204-35.
9. Folmer RL, Martin WH, Shi Y. Tinnitus: questions to reveal the cause, answers to provide relief. *J Fam Pract*. 2004;53(7):532.
10. Kleinjung T, Langguth B. A venue for future tinnitus treatments. *Otolaryngol Clin N Am*. 2020;53(4):667-83.
11. Milind VKirtane, Arpit Sharma, Sangeeta P Varty, Nishita Mohandas¹, Neeleshkumar Pandit and Maryam Shojaei Baghini, Effectiveness of Precise Tinnitus Matching and IoT- based Personalized Multimodal Management in the Tinnitus Patients in India. *Int Journal of Clinical Skills* (2024) 18(3), 255-263
12. Blazer DG, Tucci DL. Hearing loss and psychiatric disorders: a review. *Psychol Med*. 2019;49(6):891-7.
13. Sladen DP, Frisch CD, Carlson ML, Driscoll CL, Torres JH, Zeitler DM. Cochlear implantation for single-sided deafness: a multicenter study. *The Laryngoscope*. 2017;127(1):223-8.
14. Shekhawat GS, Searchfield GD, Stinear CM. Role of hearing aids in tinnitus intervention: a scoping review. *J Am Acad Audiol*. 2013;24(08):747-62.
15. Hoare DJ, Adjamian P, Sereda M, Hall DA. Recent technological advances in sound-based approaches to tinnitus treatment: a review of efficacy considered against putative physiological mechanisms. *Noise and Health*. 2013;15(63):107-16.
16. Jastreboff PJ, Jastreboff MM. Tinnitus retraining therapy (TRT) as a method for treatment of tinnitus and hyperacusis patients *J Am Acad Audiol*. 2000;11(03):162-77.
17. Zenner HP, Vonthein R, Zenner B, Leuchtweis R, Plontke SK, Torka W, Pogge S, Birbaumer N. Standardized tinnitus-specific individual cognitive-behavioral therapy: a controlled outcome study with 286 tinnitus patients. *Hear Res*. 2013;298:117-25.