



## Gaining Insight into Tinnitus through Sound Masking Apps vs. Conventional Audiometry: Lessons from Our Experience

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### Abstract

**Introduction:** Tinnitus is the sensation of hearing noise without any external source. A limited number of management techniques have received significant acknowledgment, such as tinnitus masking with hearing aids and sound apps. This research investigates the effectiveness of tinnitus retraining therapy (TRT) using traditional audiometers and sound masking apps to provide relief.

**Materials and Methods:** The prospective study involved patients aged 30-60 years who experienced continuous tinnitus. These patients underwent tinnitus matching using both conventional audiometers and sound masking apps. The device that provided a better match was then used for 30-minute tinnitus therapy sessions. Improvement was assessed using a 10-point visual analogue scale.

**Results:** The results indicated that tinnitus masking with both traditional audiometers and sound masking apps effectively reduced tinnitus handicap. More individuals were able to match their tinnitus using the apps. The effectiveness of tinnitus retraining therapy (TRT) was significantly correlated with the severity of tinnitus handicap, but not with age, gender, or hearing status, showing an average decrease in VAS score of 3.35.

**Conclusion:** TRT is effective in providing relief to tinnitus patients. Although immediate relief was observed, the potential for long-term benefit remains uncertain.

**Keywords:** Tinnitus; Conventional Audiometer; Sound Masking Apps; Tinnitus Retraining Therapy; Visual Analog Scale; Tinnitus Handicap Inventory

### Abbreviations

TRT: Tinnitus Retraining Therapy; VAS: Visual Analog Scale; THI: Tinnitus Handicap Inventory

### Introduction

Tinnitus is the sensation of hearing sound without any external source. Over 50 million people in the United States have reported experiencing tinnitus, with an estimated prevalence of 10% to 15% among adults [1]. Although there is no cure for tinnitus, various therapies have been studied and utilized to offer symptomatic relief. These therapies include education and counseling,

cognitive-behavioral therapy (CBT), medications, dietary changes and supplements, acupuncture, transcranial magnetic stimulation, and auditory therapies such as tinnitus masking. Tinnitus masking, which provides relief by inhibiting the perceived sound, employs hearing aids, sound generators, environmental enrichment devices like audio players or CD recordings, and sound masking apps on Android phones or tablets. Counselling is also crucial as an adjunct to tinnitus treatment, educating patients about tinnitus, the nature of hearing impairment, and sound therapy management to help reduce their perception of tinnitus. This study aims to evaluate the effectiveness of tinnitus masking using conventional audiometers and sound masking apps in providing relief to tinnitus patients.

## Materials and Methods

The prospective study focused on patients aged 30-60 years with continuous tinnitus and no neurological or behavioral issues. Patients with a history of tinnitus management within the past year, profound hearing loss in the tinnitus ear, or inability to follow treatment instructions were excluded from the study.

Patients meeting the inclusion and exclusion criteria underwent tinnitus matching using both conventional audiometers and sound masking apps. The device that best matched the patient's tinnitus, as reported by the patient, was used for tinnitus retraining therapy (TRT) for 30 minutes, three times a week, for one month. Subjective improvement with the chosen device was assessed using a 10-point visual analogue scale. As part of TRT, patients were educated about the basic knowledge of the auditory system and its function, the mechanism of tinnitus generation, the annoyance associated with tinnitus and how to alleviate the fear linked to the symptom. Hearing status was evaluated using a two-channel audiometer and classified according to WHO standards as normal (<26 dB), mild (26-40 dB), moderate (41-55 dB), severe (56-70 dB), and profound (>90 dB) hearing loss. The study considered the hearing loss of the ear experiencing tinnitus.

The Tinnitus Handicap Inventory – Hindi (THI-Hindi) was used to assess tinnitus handicap. The THI consists of 25 items with response options “no,” “sometimes,” and “yes,” corresponding to 0, 2, and 4 points respectively. The total score ranges from 0 to 100, with 0–16 indicating a slight handicap, 18–36 indicating a mild handicap, 38–56 and 58–76 indicating moderate and severe handicaps respectively and 78–100 indicating a catastrophic handicap. The Visual Analog Scale (VAS) was also used as an outcome measure, where participants rated their tinnitus reduction on a scale of 1 to 10. Statistical analysis was conducted using SPSS version 23.0. Descriptive statistics were presented as mean and standard deviation (SD). Inferential statistics included T-tests to compare tinnitus management outcomes between two groups and one-way ANOVA for three groups, with a p-value of less than 0.05 considered statistically significant.

## Results

The study involved 52 patients with a history of unilateral tinnitus, aged between 30 and 60 years. Among them, 7 were aged between 30–40 years, 22 were aged 41–50 years, and 23 were aged 51–60 years. The group consisted of 34 males and 18 females. Four-

teen patients had mild hearing loss (defined as more than 25 dB pure tone average (PTA) for frequencies of 0.5, 1, and 2 kHz), while 20 had normal hearing sensitivity. The remaining 18 patients had either moderate (15 patients) or severe (3 patients) hearing loss. According to THI scores before treatment, 24 patients had a slight handicap, 16 had a mild handicap, 7 had a moderate handicap, 4 had a severe handicap, and 1 had a catastrophic handicap.

The study found that 49 patients were able to match the frequency and loudness of their tinnitus using patterns in environmental enrichment devices, while 16 patients could only match their tinnitus using a conventional audiometer. Additionally, all 16 patients who matched their tinnitus with the conventional audiometer reported a better match using sound masking apps. However, three patients who could not match their tinnitus with environmental enrichment devices were also unable to do so with the audiometer.

The results following TRT did not show a significant correlation with age ( $p = 0.82$ ) or gender ( $p = 0.48$ ). Similarly, there was no significant correlation found between hearing status and the effectiveness of tinnitus therapy ( $p = 0.98$ ). However, there was a significant linear correlation between tinnitus retraining therapy and the degree of handicap ( $p = 0.000$ ), indicating that higher levels of handicap were associated with better results. On average, there was a 3.35-point decline in VAS scores on a scale of 10.

## Discussion

Only a limited number of management approaches have received widespread recognition for their effectiveness in reducing the impact of tinnitus on an individual's quality of life. These methods are typically considered suitable for individuals experiencing significant tinnitus. One such method is tinnitus masking, which was utilized in the study using both conventional audiometers and sound masking apps for matching tinnitus and managing tinnitus patients.

The study found that patients who perceived their tinnitus as complex tones or noises were only able to match their tinnitus using sound masking apps. In contrast, those who perceived their tinnitus as simple tones (16 patients) were able to match their tinnitus using both the conventional audiometer and sound masking apps. This discrepancy is attributed to the fact that the convention-

al audiometer allows matching only at octaves, whereas the use of sound masking apps enables more precise matching. Similar limitations of the audiometer were also noted by Mahboubi., *et al.* [2], Moore., *et al.* [3], and Santacruz., *et al.* [4], leading them to explore alternative tinnitus matching devices.

Consistent with our findings, Vasu Kumar Reddy., *et al.* [5] and Nemade and Shinde [6] also concluded that tinnitus therapy is an effective approach for reducing the perception of tinnitus. Our study demonstrated improvement in participants, with a mean decrease of 3.35 on VAS scale with tinnitus masking. In comparison, Nemade & Shinde [6] and Aazh., *et al.* [7] reported decreases of 3.6 and 3.2 respectively on the VAS scale in their studies.

The outcomes of TRT did not show a significant linear correlation with age or gender. This suggests that TRT can be beneficial regardless of the patient's age or gender. The study also found that the VAS results after tinnitus therapy were significantly correlated with the degree of handicap, a finding consistent with the results of Li., *et al.* [8]. However, there was no such correlation found between the severity of hearing loss and relief from tinnitus, which aligns with the findings of Pinto., *et al.* [9], Aithal., *et al.* [10], Tomita., *et al.* [11], Pinto., *et al.* [12] and Noroozian., *et al.* [13]. These studies also reported no impact of age and gender on the severity of tinnitus.

## Conclusion

The results showed that tinnitus retraining therapy, conducted with both conventional audiometers and sound masking apps, effectively reduced tinnitus handicap. A higher number of individuals were able to match their tinnitus using sound masking apps compared to conventional audiometers. Patients undergoing tinnitus masking experienced an average decline of 3.35 points in VAS scores on a scale of 10. There were no significant correlations found between age, gender, severity of hearing loss and the outcomes of post-tinnitus management scores. Though, significant correlation was observed between degree of tinnitus handicap and relief from tinnitus after TRT.

## Conflict of Interest

Authors declare no conflict of interest.

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