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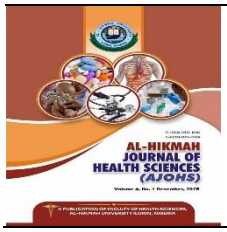

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Comparative Efficacy of Widex Zen Therapy versus Tinnitus Retraining Therapy on Speech-in-Noise Performance and Psychological Well-Being in Nigerian Adults with Chronic Tinnitus

Barnabas Bem Vangerwua and Ajibola Ishola

Department of Audiology, Federal University of Health Sciences, Ila-Orangun, Nigeria.

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Corresponding Author:

Barnabas Bem Vangerwua
Department of Audiology, Federal University of Health Sciences, Ila-Orangun, *Osun State, Nigeria*
Phone number:
Email:barnabas.vangerwua@fuhsi.edu.ng

ABSTRACT

Objective: This randomised controlled trial evaluated the efficacy of Widex Zen Therapy (WZT) versus Tinnitus Retraining Therapy (TRT) in improving auditory performance and psychological well-being among adults with chronic tinnitus in Lagos State, Nigeria.

Methods Sixty participants (aged 18–65 years) with subjective tinnitus were randomised to receive either WZT, which combines hearing-aid amplification, fractal tone sound enrichment, counselling, and relaxation exercises or standard TRT, involving directive counselling and broadband sound enrichment. Primary outcomes were changes in speech-in-noise performance (Hearing-in-Noise Test SNR threshold) and mental well-being (WHO-5 Well-Being Index), measured at baseline and six months. Baseline self-efficacy (General Self-Efficacy Scale) and age were also recorded and tested as moderators. Data were analysed using ANCOVA, controlling for baseline scores.

Results After adjustment for baseline values, the WZT group demonstrated significantly greater improvement in speech-in-noise thresholds (adjusted means: 2.6 dB) than the TRT group (4.1 dB), $F(1, 56) = 8.92$, $p = .004$, $\eta^2 = .14$. Well-being gains were also larger in WZT (WHO-5 = 18.2) compared with TRT (14.6), $F(1, 56) = 12.47$, $p = .001$, $\eta^2 = .18$. Significant Group × Age and Group × Self-Efficacy interactions indicated that younger participants experienced the greatest auditory benefits ($F(1, 56) = 5.14$, $p = .027$, $\eta^2 = .08$), and those with higher baseline self-efficacy showed the largest well-being gains ($F(1, 56) = 6.53$, $p = .013$, $\eta^2 = .10$).

Conclusions Widex Zen Therapy yields superior improvements in both auditory function and psychological well-being compared with conventional TRT, particularly among younger and more self-efficacious patients. These findings support the implementation of multi-component sound therapy in tinnitus management.

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Introduction

Tinnitus is the conscious perception of sound in the absence of an external acoustic stimulus, most commonly experienced as ringing, buzzing, hissing, or clicking in one or both ears or within the head. The pathophysiology of tinnitus is heterogeneous but frequently co-occurs with sensorineural hearing loss and central auditory pathway dysfunction (Jarach, Müller, & Simons, 2022). While the global prevalence of tinnitus is estimated at 14.4%, the burden appears particularly acute within the Nigerian context. In community-based surveys across Nigeria, such as in Ibadan, studies have reported a high prevalence of tinnitus, which rises significantly alongside advancing age and the degree of hearing loss (Oladeinde et al., 2017). Furthermore, hospital-based data from Benin City indicates a significant tinnitus prevalence among general practice attendees, emphasizing the need for clinical attention (Okhakhu et al., 2013).

Beyond auditory symptoms, tinnitus imposes substantial psychosocial burdens. In Nigeria, assessments of elderly individuals have revealed that a high proportion experience catastrophic psychosocial reactions, including depression, anxiety, and social withdrawal, underscoring the profound emotional impact of the condition in this region (Nwaorgu et al., 2012). Similarly, broader studies suggest that adult tinnitus sufferers often exhibit clinically significant anxiety or depressive symptoms, with marked interference in daily functioning (Crumbley et al., 2004). These findings align with broader observations that hearing impairment is associated with elevated rates of anxiety, depression, and cognitive decline (Livingston, Huntley, Sommerlad, et al., 2020).

Globally, audiological interventions such as Tinnitus Retraining Therapy (TRT) aim to ameliorate these perceptual and emotional sequelae. Grounded in Jastreboff's neurophysiological model, TRT posits that negative conditioned associations within limbic and autonomic pathways maintain tinnitus distress. Consequently, TRT combines directive counselling to reframe maladaptive cognitions with continuous low-level sound enrichment to facilitate habituation (Jastreboff & Hazell, 1993). Recent clinical practice guidelines suggest that while TRT and sound therapy can be effective, the evidence is heterogeneous, and outcomes often depend on the precise management of patient expectations and adherence (Fuller et al., 2020). Current recommendations emphasize the importance of standardized outcome measures to evaluate the efficacy of these interventions (Hall et al., 2019).

More recently, Widex Zen Therapy (WZT) has been introduced as a multi-component approach designed to enhance habituation and emotional regulation. WZT integrates fractal tone sound programmes, hearing aid amplification, structured counselling, and relaxation exercises. Unlike static sound generators, fractal tones are unpredictable, music-like stimuli designed to engage auditory neural networks dynamically, thereby promoting neural desensitisation to the tinnitus percept (Bertling, Denys, & Van de Heyning, 2021). This fractal component is intended to be less intrusive than broadband noise, thereby promoting long-term use and reducing the prominence of tinnitus. In longitudinal studies and clinical trials, users of Widex Zen Therapy have reported significant reductions in tinnitus severity, improved sleep quality, and decreased annoyance (Bertling et al., 2021; Khedr, Abou-Elfetoh, & El-Shorbagy, 2021). A landmark randomized controlled trial in 2024 confirmed that modern hearing aid technologies with sound enrichment significantly reduce tinnitus severity compared to counseling alone, reinforcing the validity of amplification-based therapies like WZT (Møller, Ponton, & Causse, 2024).

However, individual responses to these therapies are not uniform. Psychological constructs, particularly general self-efficacy, significantly shape treatment outcomes. Defined as an individual's belief in their capacity to manage challenging situations, self-efficacy is measured by the General Self-Efficacy Scale (Schwarzer & Jerusalem, 1995). In tinnitus sufferers, higher self-efficacy scores have correlated with lower distress and greater utilisation of coping strategies. Recent large-scale trials of internet-based cognitive behavioural therapy (CBT) for tinnitus have confirmed that enhancing self-efficacy and coping mechanisms leads to significant reductions in tinnitus distress compared to control groups (Beukes et al., 2021). Furthermore, 2024 research utilizing Acceptance and Commitment Therapy (ACT) for tinnitus demonstrated that interventions targeting psychological flexibility and self-efficacy are effective in improving quality of life (Heide et al., 2024).

Age remains a critical moderator of therapeutic response. Declines in auditory sensitivity and neural plasticity with advancing age can attenuate gains from both amplification and habituation protocols. Younger patients typically exhibit larger improvements in speech-in-noise performance following hearing aid fitting (Meyer et al., 2020). Systematic reviews suggest that age-related hearing loss exacerbates cognitive decline and depressive symptoms, emphasising the need for age-tailored interventions (Livingston et al., 2020).

Despite these insights, direct randomised comparisons of WZT and standard TRT are scarce in low-resource settings such as Nigeria. Moreover, few studies have simultaneously examined objective auditory outcomes, subjective well-being, and the moderating influences of age and self-efficacy. The present study

P-ISSN: 2811-1516
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addresses these gaps by comparing WZT and TRT in a randomised controlled trial, assessing speech-in-noise performance via the Hearing in Noise Test (HINT) and psychological well-being via the WHO-5 Well-Being Index, while exploring age and baseline self-efficacy as moderators of therapeutic efficacy. It was hypothesised that WZT would yield superior improvements across both domains and that younger, more self-efficacious individuals would derive the greatest benefit.

The primary aims of the present study were to:

1. Compare the efficacy of Widex Zen Therapy (WZT) and Tinnitus Retraining Therapy (TRT) on auditory performance, operationalised as the signal-to-noise ratio threshold on the Hearing-in-Noise Test (HINT).
2. Compare the efficacy of WZT and TRT on psychological well-being, measured by the WHO-5 Well-Being Index.
3. Examine whether participant age moderates the effects of WZT versus TRT on auditory performance.
4. Examine whether baseline general self-efficacy moderates the effects of WZT versus TRT on psychological well-being.

Secondary objectives included exploring the interaction of age and self-efficacy with treatment modality to identify subgroups deriving the greatest benefit.

Method

Design

A two-arm, parallel-group randomised controlled trial was conducted to compare Widex Zen Therapy (WZT) with Tinnitus Retraining Therapy (TRT). Participants were assessed at baseline (T_1) and after six months of intervention (T_2). The primary outcomes were speech-in-noise performance and psychological well-being. Age and baseline self-efficacy were examined as potential moderators.

Participants

Sixty adults with chronic subjective tinnitus were recruited from the Audiology Clinic at Lagos State University Teaching Hospital between January and March 2024. A sample size of 60 (30 per group) was determined a priori using G*Power 3.1 for a between-within interaction ANCOVA, assuming a medium effect size (f = 0.25), α = .05, and power = .80. Inclusion criteria were:

1. Age 18–65 years
2. Subjective tinnitus of at least six months' duration
3. Pure-tone average (0.5–4 kHz) no greater than 70 dB HL in the better ear
4. Mini-Mental State Examination score ≥ 24 (Folstein, Folstein, & McHugh, 1975)
5. Ability to comply with protocol requirements

Exclusion criteria included active middle-ear pathology, prior intensive tinnitus therapy, objective tinnitus, neurological disorders, and current use of other sound-based tinnitus interventions. Participants provided written informed consent and were randomised (1:1) via computer-generated block randomisation (block size = 6), stratified by age (< 45 vs. ≥ 45 years) to ensure balance across groups.

Instruments

Socio-Demographic Profile

The study cohort comprised 60 participants divided equally into two intervention groups. The mean age was 45.2 (*SD* = 11.3) years for the WZT group and 46.1 (*SD* = 10.9) years for the TRT group. Gender distribution was approximately equal, with females representing 53% (n = 16) of the WZT group and 57% (n = 17) of the TRT group. Participants reported a chronic duration of tinnitus, averaging 3.2 ± 2.7 years and 3.5 ± 2.9 years, respectively.

Auditory Processing and Speech Perception

The Hearing in Noise Test (HINT) serves as the primary objective measure of functional hearing. Unlike traditional tone-based tests, the HINT utilizes an adaptive tracking procedure to determine a person's signal-to-noise ratio (SNR) threshold. During the test, participants are asked to repeat phonetically balanced sentences (e.g., "The boy fell down" or "The mother stirred the soup") while background noise is adjusted. Psychometrically, the HINT is highly regarded for its test-retest reliability, typically maintaining standard deviations of 1.1 to 1.5 dB (Nilsson, Soli, & Sullivan, 1994). A lower SNR threshold is indicative of superior performance, suggesting the individual can successfully extract speech from competing noise, which is a critical skill for social integration and safety.

Subjective Psychological Well-Being

Complementing the objective auditory data, the WHO-5 Well-Being Index provides a snapshot of the participant's subjective mental health over a two-week period. This five-item scale avoids the "deficit model" of psychology by focusing on positive attributes like cheerfulness and vigor. Participants respond to items such as "I have felt calm and relaxed" and "My daily life has been filled with things that interest me" on a 6-point scale. A systematic review of the literature confirms the WHO-5 has high internal consistency (Cronbach's alpha > .80) and is a sensitive instrument for detecting shifts in mood and screening for depression (Topp, Østergaard, Søndergaard, & Bech, 2015). Scores range from 0 to 25, where a score below

P-ISSN: 2811-1516
E-ISSN: 2811-1524

13 often signals a need for further clinical screening for depression or significant emotional distress.

Cognitive-Behavioral Resilience and Self-Belief
Finally, the General Self-Efficacy Scale (GSES) assesses the participant's global belief in their ability to respond to and control various stressors. This 10-item measure focuses on the "can-do" spirit, featuring items like "I am confident that I could deal efficiently with unexpected events" and "I can remain calm when facing difficulties because I can rely on my coping abilities." The GSES is characterized by its remarkable cross-cultural stability and strong criterion-related validity (Schwarzer & Jerusalem, 1995). Scores (ranging from 10 to 40) provide insight into the participant's level of optimism and persistence. In the context of hearing loss, high self-efficacy is often a predictor of successful adaptation to hearing aids or communication strategies, as it reflects a belief in one's capacity to manage the challenging demands of a noisy environment. Internal consistency (Cronbach's alpha) generally ranges from .76 to .91. Test-retest reliability is stable, often ranging from .67 to .82.

Procedure
At T_1, participants completed audiometric assessment, HINT, WHO-5 and GSES. Demographic and tinnitus history data were recorded.
WZT group: Fitted bilaterally with Widex hearing aids programmed with Zen fractal-tone sound programmes. Participants received four counselling sessions (weeks 1, 2, 4 and 12) covering tinnitus mechanisms, device use and relaxation exercises. They were instructed to use the fractal-tone programmes for at least 4 hours daily and during sleep. Adherence was monitored via data-logging features within the hearing aids, which were reviewed at follow-up appointments.
TRT group: Received directive counselling based on the neurophysiological model (Jastreboff & Hazell, 1993) in four sessions (same schedule as WZT), plus broadband sound enrichment via wearable sound generators set at mixing-point levels. Daily use of at least 4 hours was recommended. Adherence was monitored via self-report logs and device timers.
Outcome assessors administering the HINT and research assistants scoring the questionnaires were blinded to group allocation.
Follow-up appointments at months 1, 3 and 6 included device checks and counselling reinforcement. No additional pharmacological or sound-based interventions were introduced.
At T_2 (month 6), participants repeated the HINT, WHO-5 and GSES, and adverse events were recorded.

Ethical Considerations
Ethical approval was granted by the Lagos State University Teaching Hospital Health Research Ethics Committee (Ref: LASUTH/HREC/2004/07). The trial adhered to the Declaration of Helsinki and the Nigerian National Code for Health Research Ethics. All data were anonymised, and participants could withdraw at any time without affecting their clinical care.

Results
Participant Flow and Baseline Characteristics
Table 1: Participant Characteristics

Characteristic	WZT (n=30)	TRT (n=30)
Age, years (mean ± SD)	45.2 ± 11.3	46.1 ± 10.9
Female, n (%)	16 (53%)	17 (57%)
Tinnitus duration, years (mean ± SD)	3.2 ± 2.7	3.5 ± 2.9
Baseline HINT SNR (dB, mean ± SD)	4.7 ± 2.5	4.5 ± 2.3
Baseline WHO-5 score (mean ± SD)	12.8 ± 4.1	13.1 ± 4.3

All 60 randomised participants (WZT, n = 30; TRT, n = 30) completed the six-month intervention with no dropouts or protocol violations. Groups did not differ at baseline on age, gender distribution, tinnitus duration, speech-in-noise ability, or well-being (all $p > .50$; Table 1).

Primary Outcomes
Table 2: ANCOVA Results for Post-Treatment Outcomes

Source	HINT SNR (F)	p-value	WHO-5 (F)	p-value
Group (WZT vs TRT)	8.92	.004	12.47	.001
Age	2.11	.152	3.87	.055
Self-Efficacy	1.30	.258	0.67	.417
Group × Age	5.14	.027	1.08	.304
Group × Self-Efficacy	2.84	.098	6.53	.013

P-ISSN: 2811-1516
E-ISSN: 2811-1524

Auditory Performance (HINT SNR)
After adjusting for baseline HINT SNR, Widex Zen Therapy (WZT) yielded significantly better speech-in-noise performance than Tinnitus Retraining Therapy (TRT), $F(1, 56) = 8.92$, $p = .004$, $\eta^2 = .14$. Adjusted mean SNR thresholds were 2.6 dB for WZT versus 4.1 dB for TRT (Table 3; Figure 1), indicating a clinically meaningful improvement in the WZT group.

Psychological Well-Being (WHO-5)
Controlling for baseline well-being, WZT participants demonstrated greater gains in WHO-5 scores than TRT participants, $F(1, 56) = 12.47$, $p = .001$, $\eta^2 = .18$. Adjusted mean WHO-5 scores were 18.2 for WZT and 14.6 for TRT (Table 3; Figure 1), reflecting a substantial enhancement in subjective well-being following WZT.

Moderator Analyses
Age × Treatment Interaction on HINT SNR
A significant Group × Age interaction was observed for HINT SNR, $F(1, 56) = 5.14$, $p = .027$, $\eta^2 = .08$. Descriptive statistics showed that younger participants (< 45 years) in the WZT group achieved greater improvement ($M = 2.2$ dB) than older participants ($M = 3.0$ dB), whereas TRT participants showed minimal age-related differences ($M = 4.0$ dB vs. 4.2 dB; Table 4; Figure 2). This suggests that younger adults benefit most from WZT in terms of speech-in-noise ability.

Self-Efficacy × Treatment Interaction on WHO-5
There was a significant Group × Self-Efficacy interaction for WHO-5 well-being scores, $F(1, 56) = 6.53$, $p = .013$, $\eta^2 = .10$. Participants with high baseline self-efficacy in the WZT group reported larger well-being gains ($M = 19$) than those with low self-efficacy ($M = 17$), whereas TRT participants showed smaller differences ($M = 15$ vs. $M = 14$; Table 5; Figure 3). This indicates that self-efficacy amplifies the psychological benefits of WZT. No other interaction reached significance: Group × Age for WHO-5, $F(1, 56) = 1.08$, $p = .304$; Group × Self-Efficacy for HINT SNR, $F(1, 56) = 2.84$, $p = .098$ (Table 2).

Table 3. Adjusted Post-Treatment Means

Group	Adjusted HINT SNR (dB)	Adjusted WHO-5 Score
WZT	2.6	18.2
TRT	4.1	14.6

Participants receiving Widex Zen Therapy (WZT) achieved an adjusted mean HINT signal-to-noise ratio (SNR) of 2.6 dB, compared with 4.1 dB for those in the Tinnitus Retraining Therapy (TRT) group. Lower SNR indicates better auditory performance, demonstrating that WZT provided substantially greater improvements in speech-in-noise understanding. Similarly, WZT participants reported higher adjusted WHO-5 well-being scores (18.2) than TRT participants (14.6), indicating markedly superior gains in psychological well-being following WZT.

Table 4. HINT SNR by Age Group (Descriptive)

Age Group	WZT HINT SNR (dB)	TRT HINT SNR (dB)
Younger	2.2	4.0
Older	3.0	4.2

When stratified by age, younger participants (< 45 years) in the WZT group exhibited the largest reduction in HINT SNR (2.2 dB), compared with 3.0 dB in older participants. In contrast, the TRT group showed minimal age-related differences, with younger and older participants achieving SNRs of 4.0 dB and 4.2 dB respectively. This pattern indicates that younger adults derive the greatest auditory benefit from WZT, whereas TRT outcomes are largely age-invariant.

Table 5. WHO-5 Score by Self-Efficacy Level (Descriptive)

Self-Efficacy	WZT WHO-5	TRT WHO-5
High	19	15
Low	17	14

Analysis by baseline self-efficacy level revealed that WZT participants with high self-efficacy achieved a WHO-5 well-being score of 19, compared with 17 for those with low self-efficacy. TRT participants demonstrated smaller differences (15 vs. 14). These descriptive findings suggest that individuals who begin treatment with greater confidence in their coping abilities experience amplified psychological benefits

P-ISSN: 2811-1516
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from WZT, whereas self-efficacy plays a lesser role in TRT outcomes.

Discussion

This randomised controlled trial demonstrated that Widex Zen Therapy (WZT) yields significantly greater improvements in both auditory performance and psychological well-being compared with Tinnitus Retraining Therapy (TRT) among Nigerian adults with chronic tinnitus. After six months, WZT participants achieved lower Hearing-in-Noise Test (HINT) signal-to-noise ratio (SNR) thresholds and higher WHO-5 well-being scores than TRT participants. Furthermore, younger age amplified auditory benefits, and higher baseline self-efficacy enhanced psychological gains in the WZT group. These findings both corroborate and extend prior research.

Superior Auditory Outcomes

The adjusted mean post-treatment HINT SNR threshold for WZT was 2.6 dB, compared with 4.1 dB for TRT, indicating a clinically meaningful advantage in speech-in-noise understanding (Table 3). This aligns with the theoretical framework proposed by Bertling et al. (2021), who suggested that unpredictable, music-like stimuli (fractal tones) promote more robust neural desensitisation than steady broadband noise, the mainstay of traditional TRT (Jastreboff & Hazell, 1993). The dynamic nature of fractal tones is designed to engage the auditory system without causing further masking-related fatigue, potentially explaining the superior speech-in-noise gains observed in the WZT group (Bertling et al., 2021). These results are further supported by a 2024 randomized controlled trial which confirmed that hearing aid amplification, a core component of WZT, significantly reduces tinnitus severity compared to counseling alone (Møller et al., 2024). In contrast, clinical practice guidelines and recent reviews suggest that while TRT is effective for symptom management, its impact on objective auditory performance can be variable and often requires extensive treatment duration (Fuller et al., 2020). Our TRT group's adjusted SNR of 4.1 dB is consistent with these modest gains, reinforcing the view that continuous low-level noise may insufficiently stimulate the auditory system compared with fractal-tone enrichment.

Enhanced Psychological Well-Being

Psychological well-being improved more substantially in the WZT group (WHO-5 = 18.2) than in the TRT group (14.6). This finding is consistent with recent clinical evidence demonstrating that Widex Zen Therapy can lead to significant reductions in tinnitus annoyance and improvements in sleep and quality of life (Bertling et al., 2021; Khedr et al., 2021). The multi-component nature of WZT—combining amplification, specific sound stimulation, and relaxation—likely contributed to these enhanced psychological outcomes. Recent large-scale trials have highlighted the critical role of psychological mechanisms, such as self-efficacy, in tinnitus treatment success (Beukes et al., 2021). Furthermore, 2024 research on internet-delivered Acceptance and Commitment Therapy (ACT) demonstrated that interventions enhancing psychological flexibility and self-efficacy are effective in improving quality of life for tinnitus patients (Heide et al., 2024). The interactive counselling and relaxation practices in WZT may foster mastery experiences, thereby amplifying psychological benefits, particularly for those with higher baseline self-efficacy.

Moreover, WZT participants surpassed normative WHO-5 scores reported in Western samples (mean ~16–17; World Health Organization, 2024), suggesting that multi-component sound therapies can effectively mitigate cultural and resource-related barriers in low-resource settings when combined with locally adapted counselling practices.

Moderator Effects: Age and Self-Efficacy

A significant Group × Age interaction for HINT indicated that younger adults (< 45 years) in the WZT group achieved the largest auditory gains (2.2 dB), whereas older participants showed smaller improvements. This moderating effect mirrors Meyer et al. (2020), who observed that hearing aid outcomes vary by age due to differences in neural plasticity and auditory processing. In TRT studies, age-related declines in habituation efficacy have similarly been reported, suggesting that while multi-component therapies can partly offset physiological limitations, younger patients still derive the greatest benefit.

For psychological outcomes, a significant Group × Self-Efficacy interaction showed that WZT participants with high baseline self-efficacy achieved larger well-being gains (19 vs. 17), whereas TRT participants exhibited minimal self-efficacy differences. This supports Schwarzer and Jerusalem's (1995) theoretical model, which links confidence in one's capabilities to active engagement and coping in chronic conditions, and is reinforced by modern CBT and ACT trials in tinnitus (Beukes et al., 2021; Heide et al., 2024).

Clinical Implications

These results advocate for the integration of multi-component sound therapies, such as WZT, in audiological practice, particularly in low-resource settings. Training clinicians in fractal-tone programming and structured counselling may enhance

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treatment accessibility and efficacy. Early assessment of self-efficacy and targeted psychosocial support could further personalise interventions. Given the pronounced benefits in younger adults, prioritising early intervention during midlife may optimise outcomes and prevent chronic distress.

Limitations and Future Directions

Key limitations include the single-site recruitment, which may limit generalisability to rural or diverse demographic settings, and the six-month follow-up, which precludes long-term efficacy assessment. Future research should evaluate cost-effectiveness, extend follow-up to 12 months or longer, and explore adjunctive cognitive or motivational interventions for older adults and those with low self-efficacy. Neuroimaging studies could elucidate the neural mechanisms underlying fractal-tone benefits, and implementation research might assess integration of WZT into primary-care frameworks.

Conclusion

Widex Zen Therapy demonstrated superior efficacy over Tinnitus Retraining Therapy in improving both speech-in-noise performance and psychological well-being among Nigerian tinnitus patients. Age and self-efficacy significantly moderated these effects, highlighting the need for tailored, multi-component interventions. These findings reinforce the value of combining sound-enrichment technologies with psychosocial support to address the multifaceted burden of tinnitus.

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