

Clinical efficacy of tinnitus retraining therapy and cognitive behavioural therapy in the treatment of subjective tinnitus: a systematic review

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Abstract

Objective: This study aimed to compare the outcomes of two frequently employed interventions for the management of tinnitus: tinnitus retraining therapy and cognitive behavioural therapy.

Method: A systematic review of literature published up to and including February 2013 was performed. Only randomised control trials and studies involving only human participants were included.

Results: Nine high-quality studies evaluating the efficacy of tinnitus retraining therapy and cognitive behavioural therapy were identified. Of these, eight assessed cognitive behavioural therapy relative to a no-treatment control and one compared tinnitus retraining therapy to tinnitus masking therapy. Each study used a variety of standardised and validated questionnaires. Outcome measures were heterogeneous, but both therapies resulted in significant improvements in quality of life scores. Depression scores improved with cognitive behavioural therapy.

Conclusion: Both cognitive behavioural therapy and tinnitus retraining therapy are effective for tinnitus, with neither therapy being demonstrably superior. Further research using standardised, validated questionnaires is needed so that objective comparisons can be made.

Key words: Tinnitus; Cognitive Behavioral Therapy; Therapy

Introduction

Tinnitus can be defined as the perception of sound in the absence of external auditory stimulation. This condition affects 10–15 per cent of the UK population, its incidence is increasing because of increased headphone usage and increased awareness;¹ there is no current cure. Characteristics of the perceived sound(s) can vary. For example, one person may experience whistling or humming sounds, whereas another may hear more complex sounds such as music. The sound can be intermittent or constant, unilateral or bilateral, and associated or not with hearing loss.² Tinnitus is typically subjective (i.e. heard only by the affected individual) and rarely objective (i.e. heard by an examiner either with or without an assistive listening device; 1 per cent of presentations).¹ Objective tinnitus is typically caused by an internal stimulus, such as a vascular abnormality. The pathophysiology of tinnitus is poorly understood, but the neurophysiological model of tinnitus, as postulated by Jastreboff and Jastreboff in 2003, states that multiple systems in the brain are involved, with the auditory system playing a secondary role. This model, based on neurophysiology and

behavioural neuroscience, is fundamental to tinnitus retraining therapy.³

Tinnitus retraining therapy

Tinnitus retraining therapy is a habituation technique for reducing the impact of tinnitus on an individual's life. It involves manipulating the limbic, autonomic and auditory systems so as to reduce the response to the abnormal stimulus. The goal is to decrease the sensations (via the central auditory system), emotions (via the limbic system) and behaviour (via the autonomic system) associated with tinnitus.^{3–5} Three steps are involved: taking a full patient history including daily activities; using assistive devices with wide-band noise to divert attention away from tinnitus; and psychological therapy via counselling. The benefits of assistive devices depend on factors including the severity of tinnitus (0–4 scale), the use of hearing aids, and the presence or absence of hyperacusis.⁴ These factors are described in more detail in [Table I](#).

The counselling component of tinnitus retraining therapy is highly directive and structured, and is accompanied by protocols such as a specific follow

TABLE I
 PROTOCOL FOR TINNITUS TREATMENT*

Severity	Criteria	TRT treatment recommendation
0	Tinnitus is a minimal problem; it is mild, present for < 2 months or short term; the patient has no significant hearing loss or hyperacusis	Basic directive counselling & sound therapy without a need for wearable sound generators or hearing aids; requires fewer follow ups
1	Tinnitus is a significant problem or bothersome; no significant hearing loss or hyperacusis	Directive counselling & sound therapy, involving a table-top sound machine & a wearable sound generator set at 'mixing' or blending point
2	Hearing loss, with tinnitus is a significant subjective problem; no hyperacusis or prolonged worsening of symptoms after sound exposure	Directive counselling & combination instruments (hearing aids & sound generator)
3	Hyperacusis is a significant problem; tinnitus or hearing difficulties are irrelevant; no prolonged worsening of tinnitus or hyperacusis after sound exposure	Directive counselling & wearable sound generator or combination instruments
4	Hyperacusis is the dominant complaint; tinnitus or hyperacusis worsens following exposure to sound	Relatively uncommon, most difficult to treat, slow response to treatment; directive counselling with sound generator

*Taken from Jastreboff and Jastreboff.³ TRT = tinnitus retraining therapy

up and initial review.⁶ It is usually given 4–6 times in an 18-month period. This differs from other counselling approaches. For example, cognitive behavioural therapy (CBT) uses a short-term (8–10 weekly sessions) collaborative approach in which the patient and clinician identify and challenge negative thoughts.^{4,7,8}

Cognitive behavioural therapy

Cognitive behavioural therapy is one of the most extensively researched areas of psychology.⁹ It was originally used to treat depression; however, it is now used for other disorders including anxiety, panic attacks and tinnitus.^{10–14} The concept of CBT involves changing the patient's attitude to the disease that affects them so as to reduce symptom severity. The fundamental aim of CBT is to reduce the behaviours associated with tinnitus. This involves the therapist considering the patient's fears of tinnitus as a hypothesis which needs to be tested. This is done by first understanding how the thoughts associated with tinnitus are linked, and then modifying these thoughts and behaviours.^{15–19} Techniques used to achieve this objective include discussing evidence for and against the patient's beliefs, intentional manipulation to change the patient's thoughts, and providing relaxation techniques to use when the tinnitus is at its worst. In counselling sessions, these techniques are used by a trained psychotherapist or clinical audiological scientist.

There are many other types of treatment for subjective tinnitus, with varying reliability. However, there is a lack of evidence to support the efficacy of one type over another.^{20–22} No treatment is used in clinical practice unless the patient's tinnitus severely impacts their quality of life, for example, by causing secondary depression and anxiety. Treatments not based on psychotherapy include medication, nutrient supplements, surgery, electrical stimulation and providing external sounds. Their efficacy and side-effect profiles vary, and in some instances are unknown. Thus, it is of great clinical importance to review the two main treatments for tinnitus: tinnitus retraining therapy and CBT.

Methods

A systematic literature review was undertaken to evaluate the efficacy of tinnitus retraining therapy and CBT in the treatment of tinnitus. A thorough methodology was employed to identify high-quality clinical evidence regarding both types of therapy. The methodology used was consistent with the systematic review recommendations of the Cochrane Back Review Group, and similar to those of the Agency for Health Care Policy and Research ('AHCPR') 1994 Back Guidelines and the National Institute of Occupational Safety and Health.²³

Literature search

A search of two relevant databases, Medline (using Ovid) and the Web of Science, up to and including February 2013 was performed using the search terms 'tinnitus' AND 'tinnitus retraining therapy' and 'tinnitus' AND 'cognitive behaviour therapy'. These databases were selected because they include journals that publish on subjects ranging from biomedical science to general science. The search was restricted to papers published in the English language. The first search term retrieved 2481 studies and the second retrieved 88 studies.

Studies were included if they involved human participants with tinnitus presenting as their main symptom; tinnitus was diagnosed; where tinnitus retraining therapy was used, protocols were implemented as outlined by Jastreboff and Jastreboff (Table I); had a randomised, controlled design; and participants were aged 16 years or older. Studies were excluded if they had fewer than 10 participants; patients presented with pulsatile tinnitus and delusional auditory hallucination; they were animal studies; or there was a high rate of participant drop out (> 25 per cent).

After discarding studies with non-human participants, a total of 14 studies remained (4 for tinnitus retraining therapy and 10 for CBT). These studies were critically appraised using evidence-based guidelines for the categorisation of medical studies. No

TABLE II
HIERARCHY OF EVIDENCE ON THE EFFECTIVENESS OF HEALTHCARE INTERVENTIONS*

Potential bias type	Definition & indicators of bias
Selection	Systematic differences between intervention & control groups. Those determining participant eligibility should have no previous knowledge of the treatment assignment. Allocation into treatment groups should be performed by a randomisation process conducted independently of the recruitment team, & with controls to ensure that the randomisation process cannot be decoded. Selection processes liable to bias include: Ia – Evidence from meta-analysis of randomised controlled trials Ib – Evidence from at least one randomised controlled trial IIa – Evidence from at least one controlled study without randomisation IIb – Evidence from at least one other type of quasi-experimental study III – Evidence from non-experimental descriptive studies, such as comparative studies, correlation studies & case-control studies IV – Evidence from expert committee reports or opinions or clinical experience of respected authorities, or both
Performance	Systematic differences in care provided other than the intervention being evaluated. The blinding of those providing & receiving care can protect against performance bias. Whilst blinding is desirable, it should be noted that not all interventions can be provided in this way (for example, it is obvious to the patient whether they have been interviewed by a care coordinator or not)
Attrition	Systematic differences in withdrawals from the trial across follow up. This form of bias may threaten the validity of the study if one group deviates from the designated treatment or individuals withdraw from one of the treatment groups Systematic differences in outcome assessment. Blinding of the treatment allocation from those assessing the study outcomes (as well as the participants themselves) can limit detection bias, although this is not always possible if participants are aware of their treatment allocation. Bias may also arise through the selective reporting of study results

*Based on criteria developed by the Centre for Reviews and Dissemination.

additional articles were identified in the bibliographies of reports selected in the initial review. Other studies unrelated to the treatment of tinnitus were removed before appraisal by a format similar to the Agency for Health Care Policy and Research Back Guidelines. This left nine potential papers for critical appraisal.

Critical appraisal

The validity of systematic reviews can be defined as the degree to which their design and conduct are likely to prevent systematic errors of bias.^{23,24} The four sources of systematic errors that might arise when evaluating the efficacy of tinnitus retraining therapy and CBT are described in detail in Table II. A simplistic approach was used to assess the validity of studies included in the review, based on criteria suggested in the Cochrane Handbook.²³ Each paper was assessed and rated according to the level of bias risk, as summarised in Table III; any study classified as having a high bias risk was not reported in the literature

TABLE III
CRITERIA FOR ASSESSING THE VALIDITY OF STUDIES INCLUDED IN A SYSTEMATIC REVIEW

Risk of bias	Relationship to individual criteria	Definition
Low	Plausible bias unlikely to significantly alter the results	All criteria met
Moderate	Plausible bias that raises some doubt about the results	One or more criteria partially met
High	Plausible bias that significantly weakens confidence about results	One or more criteria not met

review because its conclusions would be significantly weakened by the methodology used. All studies were scored according to the recommendations of the Cochrane Back Review Group. Scoring criteria are shown in Table IV. Inclusion required a score of 6 to ensure consistency with the Cochrane Back Review Group. All studies scored 6 or above. The final decision about inclusion for all study types was based on the overall quality of the literature retrieved; consequently, a flexible approach was used.

Data analysis

Assessment of the data retrieved from all included studies showed that quantitative analysis would be inappropriate owing to the significant degree of

TABLE IV
CRITERIA FOR EVIDENCE-SCORING PAPERS

Criteria	Score
Evidence Level	
– I	2
– II	1
– III–IV	0
Sample size (<i>n</i>)	
– 0–9	Discarded
– 10–19	1
– 20–29	2
– ≥ 30	3
Clinical relevance	
– No	Discarded
– Limited	0
– Yes	1
Drop out < 20%	1
Patients not previously given TRT or CBT	1

TRT = tinnitus retraining therapy; CBT = cognitive behavioural therapy

heterogeneity. Therefore, data was subjected to a qualitative analysis.

Results

Study selection

Of the 14 studies identified in the literature search, 9 met the evidence-scoring criteria for inclusion into the review (Table V). Studies that involved animals, did not follow the strict protocols of tinnitus retraining therapy or lacked acceptable outcome measures were excluded. The nine selected studies were scored for validity and strength of evidence. All scores were consistent with those of the Cochrane Back Review Group.

Excluded studies

Both excluded CBT studies had a high drop-out rate (Table VI). All three excluded tinnitus retraining therapy study exclusions failed to adhere to the strict protocols listed by Jastreboff and Jastreboff.³ In fact, they used a modified version of the original tinnitus retraining therapy methodology described in Table I.

Assessment of bias

All selected studies were randomised controlled trials, and no significant risk of bias was identified. However, the risk of bias was unclear in three studies.^{10,11,14}

Adverse effects

No adverse effects related to treatments were reported in any of the selected studies.

Sensitivity of analysis

One study included a biofeedback technique combined with CBT.¹⁶ Therefore, a careful analysis of this study's results was made.

Other factors

Factors that may affect the validity of a study include the gender, age, socioeconomic status and cultural diversity of participants. In one study, 95 per cent of participants were male and all had a military

**TABLE V
VALIDITY AND STRENGTH OF EVIDENCE SCORES***

Study	Validity risk	Score	Intervention type
Andersson <i>et al.</i> ¹⁰	Low	6	CBT
Henry & Wilson ¹¹	Low	6	CBT
Henry <i>et al.</i> ⁴	Low	6	TRT
Kaldo <i>et al.</i> ¹²	Low	6	CBT
Kröner-Herwig <i>et al.</i> ¹³	Low	6	CBT
Kröner-Herwig <i>et al.</i> ¹⁴	Low	6	CBT
Rief <i>et al.</i> ¹⁵	Low	6	CBT
Weise <i>et al.</i> ¹⁶	Low	6	CBT
Zachriat & Kröner-Herwig ¹⁷	Low	6	CBT

*A higher score indicates stronger evidence. CBT = cognitive behavioural therapy; TRT = tinnitus retraining therapy

**TABLE VI
STUDIES EXCLUDED UPON FURTHER ANALYSIS**

Study	Topic	Reason for exclusion
Abbott <i>et al.</i> ¹⁸	CBT	High drop-out rate
Andersson <i>et al.</i> ¹⁹	CBT	High drop-out rate
Caffier <i>et al.</i> ²⁰	TRT	Modified TRT technique
Goebel <i>et al.</i> ²¹	TRT	Modified TRT technique
Schmitt & Kröner-Herwig ²²	TRT	Modified TRT technique

CBT = Cognitive behavioural therapy; TRT = tinnitus retraining therapy

background.⁴ Although it is possible that these factors have no effect on treatment success, different cultural groups and genders are likely to have different ideologies which can skew results, especially for CBT.

Characteristics of selected papers

The selected studies used heterogeneous units; therefore, quantitative analysis using common statistical programs such as the Statistical Package for the Social Sciences ('SPSS') or Statistical Analysis System ('SAS') would be inappropriate. Outcome measures for each of the studies are shown in Table VII.

Efficacy of tinnitus therapy

Studies using CBT and tinnitus retraining therapy show that these therapies are beneficial for treating tinnitus. The results varied because of the different validated questionnaires used. Each study into CBT compared

**TABLE VII
OUTCOME MEASURES***

Study	Outcome measures
Andersson <i>et al.</i> ¹⁹	Four, i.e. depression, anxiety, tinnitus reaction & sleep
Henry & Wilson ¹¹	Eight self-report questionnaires pre-treatment, post-treatment & at 12-month follow up
Henry <i>et al.</i> ⁴	Three validated tinnitus questionnaires: Tinnitus Handicap Inventory, Tinnitus Handicap Questionnaire & Tinnitus Severity Index
Kaldo <i>et al.</i> ¹²	Four self-report questionnaires pre-treatment, post-treatment & at 12-month follow up
Kröner-Herwig <i>et al.</i> ¹³	Audiological (tinnitus sensation level), self-monitoring & self-report questionnaires
Kröner-Herwig <i>et al.</i> ¹⁴	Audiological (tinnitus sensation level), psychometric questionnaires & self-monitoring questionnaires
Rief <i>et al.</i> ¹⁵	Psychometric questionnaires & a daily tinnitus diary documenting audiological symptoms
Weise <i>et al.</i> ¹⁶	Tinnitus diary, psychometric questionnaires & global tinnitus annoyance questionnaire
Zachriat & Kröner-Herwig ¹⁷	Self-monitoring diary, psychometric questionnaires & diagnostic interview of psychiatric disorders ('DSM-III-R')

*All studies used at least one form of standardised, validated questionnaire.

this therapy with a control group and used at least one validated questionnaire. In contrast, the tinnitus retraining therapy study used three validated questionnaires and compared this therapy with tinnitus masking therapy. Both tinnitus masking therapy and tinnitus retraining therapy were beneficial. Assessment of tinnitus masking therapy using the validated Tinnitus Handicap Questionnaire showed a significant improvement in tinnitus severity within three months, but no significant improvement after six months. Tinnitus retraining therapy was slower to improve symptoms than tinnitus masking therapy, but had a significantly better effect after six months. The Tinnitus Handicap Questionnaire showed that tinnitus was improved by 1118 points after tinnitus retraining therapy and by 300 points after tinnitus masking therapy. Only one study into CBT used the Tinnitus Handicap Questionnaire.¹¹ It showed a significant reduction in the level of tinnitus-associated stress but not in subjective tinnitus loudness or depression; however, this was not shown quantitatively. Quality of life scores showed a significant improvement in tinnitus in all eight CBT studies. However, subjective tinnitus loudness was not improved by CBT and was not addressed in the tinnitus retraining therapy study. Improvements in depressive symptoms and general mood were evaluated in six of the CBT studies but not in the tinnitus retraining therapy study. There was significant reduction in depression scores for CBT intervention groups relative to controls; however, there was no significant effect in two studies with low baseline depression scores.^{14,16} One study showed an improved quality of life score after 6 months of CBT, but this decreased at 12 months.¹⁴

Discussion

This systematic literature review aimed to determine whether tinnitus retraining therapy and CBT are effective in the management of tinnitus, and which treatment technique can produce the best outcomes. Since this review specifically assessed subjective tinnitus, the outcome measures were subjective; tinnitus loudness and quality of life were the primary outcome measures. Questionnaires were used to assess primary outcomes in all studies. These assessed the loudness of tinnitus perception and how tinnitus affects the patients' quality of life. Questionnaires on depression and anxiety were used only in CBT studies.

Cognitive behavioural therapy

This review found that CBT is ineffective in reducing the loudness of subjective tinnitus. A common explanation is that the treatment is unlikely to directly or indirectly improve the pathophysiology of subjective tinnitus. The model for CBT is that it modifies the patient's response to tinnitus, for example, by reducing the behaviour associated with sensing tinnitus, and not the tinnitus itself. However, CBT was reported to be beneficial when used as part of a holistic approach.

Although, CBT did not reduce the loudness of tinnitus, it improved the patient's behavioural response to the sounds. Thus, patient scores showed mood and quality of life improvements. The study by Weise *et al.* contained the most participants ($n = 111$) and showed the greatest improvement on quality of life and depression via a global tinnitus annoyance questionnaire.¹⁶

Tinnitus retraining therapy

Only one study used the original, standardised approach for tinnitus retraining therapy. It comprised a large number of participants ($n = 123$), with very few dropping out ($n = 5$). This study showed that tinnitus retraining therapy of varying duration is beneficial for treating tinnitus of varying severity, and is more beneficial for treating severe tinnitus than mild-to-moderate tinnitus. Furthermore, 12 months of tinnitus retraining therapy was more effective than 3 and 6 months of therapy. In this study, tinnitus masking therapy was more effective than tinnitus retraining therapy in the short term (3–6 months), but this was reversed at 12 months and significantly so at 18 months. Thus, tinnitus retraining therapy should be used as a long-term therapy.

Tinnitus retraining therapy vs cognitive behavioural therapy

It was difficult to compare these interventions because different standardised questionnaires had been used in different studies. However, it is clear that both types of intervention have important roles in managing subjective tinnitus. It is currently impossible to determine which is the more effective treatment because of the distinct lack of research into tinnitus retraining therapy and the absence of standard units for quantitative analysis.

Conclusion

This systematic literature review shows that both CBT and tinnitus retraining therapy can reduce the negative impact of subjective tinnitus by improving patients' quality of life. However, the loudness of subjective tinnitus is not improved by CBT and has not been assessed for tinnitus retraining therapy. Furthermore, studies using the original tinnitus retraining therapy model and homogeneous outcome measures are lacking. Therefore, there is a need for more randomised controlled trials of tinnitus retraining therapy to enable a quantitative analysis of CBT vs tinnitus retraining therapy to be made.

Implications for research

For tinnitus retraining therapy, there is a significant lack of research that adheres to the protocols used by its founder. It is not advisable to include modified tinnitus retraining therapy methods in literature reviews because the validity of results will be compromised relative to those of tinnitus retraining therapy.

Furthermore, the number of validated questionnaires should be restricted to increase homogeneity in outcome measures. Longer follow up would also be beneficial because variations in the effects of therapy on tinnitus can continue for up to 18 months.

Implications for clinical practice

The loudness of subjective tinnitus is not improved by CBT and has not been assessed following tinnitus retraining therapy. However, both CBT and tinnitus retraining therapy significantly reduce the negative impact of subjective tinnitus on patients' quality of life. Tinnitus retraining therapy and CBT cannot currently be effectively compared, with good validity; however, tinnitus retraining therapy is significantly more effective in treating tinnitus than tinnitus masking therapy.

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