Specialised treatment based on cognitive behaviour therapy versus usual care for tinnitus: a randomised controlled trial


Summary

Background Up to 21% of adults will develop tinnitus, which is one of the most distressing and debilitating auditory problems. The absence of medical cures and standardised practice can lead to costly and prolonged treatment. We aimed to assess effectiveness of a stepped-care approach, based on cognitive behaviour therapy, compared with usual care in patients with varying tinnitus severity.

Methods In this randomised controlled trial, undertaken at the Adelante Department of Audiology and Communication (Hoensbroek, Netherlands), we enrolled previously untreated Dutch speakers (aged >18 years) who had a primary complaint of tinnitus but no health issues precluding participation. An independent research assistant randomly allocated patients by use of a computer-generated allocation sequence in a 1:1 ratio, stratified by tinnitus severity and hearing ability, in block sizes of four to receive specialised care of cognitive behaviour therapy with sound-focused tinnitus retraining therapy or usual care. Patients and assessors were masked to treatment assignment. Primary outcomes were health-related quality of life (assessed by the health utilities index score), tinnitus severity (tinnitus questionnaire score), and tinnitus impairment (tinnitus handicap inventory score), which were assessed before treatment and at 3 months, 8 months, and 12 months after randomisation. We used multilevel mixed regression analyses to assess outcomes in the intention-to-treat population. This study is registered with ClinicalTrials.gov, number NCT00733044.

Findings Between September, 2007 and January, 2011, we enrolled and treated 492 (66%) of 741 screened patients. Compared with 247 patients assigned to usual care, 245 patients assigned to specialised care improved in health-related quality of life during a period of 12 months (between-group difference 0.059, 95% CI 0.025 to 0.094; effect size of Cohen’s d=0.24; p=0.0009), and had decreased tinnitus severity (–8.062, –10.829 to –5.295; d=0.43; p=0.0001) and tinnitus impairment (–7.506, –10.661 to –4.352; d=0.45; p<0.0001). Treatment seemed effective irrespective of initial tinnitus severity, and we noted no adverse events in this trial.

Interpretation Specialised treatment of tinnitus based on cognitive behaviour therapy could be suitable for widespread implementation for patients with tinnitus of varying severity.

Funding Netherlands Organisation for Health Research and Development (ZonMW).

Introduction

16–21% of adults develop tinnitus at some point in their lifetime, manifesting as the perception of a noxious disabling internal sound without an external source.1 Although often not recognised by the general public, tinnitus is one of the most distressing and debilitating auditory disorders and affects almost all aspects of daily life.11 Cognitive impairments and negative emotions associated with tinnitus are especially bothersome for patients and their families.53

Because tinnitus is not objectified easily, and medical efforts at cure have been unsuccessful, the effective management of tinnitus complaints is often a lengthy and troublesome treatment process involving numerous disciplines.5 Evidence for a uniformly successful treatment of tinnitus is lacking, and present usual-care practices for tinnitus consist primarily of fragmented interventions, which often result in communication to patients that nothing can be done about the disorder and that they should learn to live with it.9 The absence of standardised practice presents difficulties in assessment, treatment, and identification of subsets of patients with differential clinical demands, and in comparisons of clinical and research outcomes.7

Two main treatment approaches for tinnitus exist. First, sound-based therapies, such as tinnitus retraining therapy, which involve masking of tinnitus at the sound percep­tion level in combination with structured counselling sessions.9 This approach, which is often based on Jastreboff’s neurophysiological model,10 aims to amelio­rate tinnitus distress through education and exposure to a neutral external sound. Through habituation to this neutral sound, which is expected to generalise to the threatening tinnitus sound, patients are expected to have diminished annoyance from tinnitus. Supporting evi­dence for the tinnitus retraining therapy approach is scarce, and most published reports derive from retro­spective and uncontrolled trials.4,11,12 The second main approach is cognitive behaviour therapy,11–15 Such treat­ment is a comprehensive form of psychotherapy aimed at...
modification of dysfunctional beliefs and behaviours. Typically, cognitive behaviour therapy includes psycho-education, relaxation, exposure techniques, and behavioural reactivation, often in combination with mindfulness-based training. Although treatment of tinnitus with such therapy can reduce distress and improve quality of life, large scale and well controlled trials are needed. The premise that the intensity of cognitive behaviour therapy could vary dependent on severity of tinnitus complaints has not been tested to our knowledge. We developed a new multidisciplinary protocol for treatment of tinnitus, including a stepped-care cognitive behaviour therapy approach with elements from tinnitus retraining therapy. Stepped care allows a framework for organisation of health services on the basis of individual needs of patients, with a gradual increase in the intensity of care at each level. In this randomised controlled study, we aimed to assess effectiveness of this specialised treatment protocol compared with care as usual.

Methods
Study design and participants
We undertook a two group, two step, randomised controlled trial at Adelante Department of Audiology and Communication (Hoensbroek, Netherlands), in adult patients with tinnitus, with follow-up assessments at 3, 8, and 12 months after randomisation (appendix). Patients with tinnitus who were referred to our centre were invited to an off-centre baseline assessment, after which they were randomly allocated to either usual care or specialised care. We postulated that specialised care would be more effective than usual care in terms of improvement of generic health-related quality of life and reduction of tinnitus severity, impairment, general negative affect, catastrophic misinterpretation, and tinnitus-related fear. Adult patients referred to our centre with a primary complaint of subjective tinnitus were eligible for inclusion. We excluded patients who were unable to read and write in Dutch, had health issues that impaired attendance or prevented participation (eg, terminal illness or physical disability), or had undergone treatment at our centre within 5 years before trial enrolment. Patients were assessed by an otolaryngologist to rule out pathological changes that needed immediate medical care. We obtained written informed consent before assessment and trial entry. The medical ethical board of the Rehabilitation Foundation Limburg reviewed and approved the study protocol (METC-SRL 11/09/2006).

Randomisation and masking
An independent research assistant, who was based outside of Adelante, Department of Audiology and Communication, randomly allocated patients by use of a computer-generated allocation sequence to usual care or specialised care in a 1:1 ratio after receipt of informed consent and baseline assessments. Randomisation was stratified by tinnitus severity (<47 vs ≥47 points on the tinnitus questionnaire [TQ]) and hearing impairment (pure tone average of <60 dB hearing level in worst ear). Within each of the four strata, patients were randomised in blocks of four patients. Patients and investigators were masked to treatment group allocation. Before trial enrolment, patients were informed that they would be allocated to one of two different treatments aimed at tinnitus management, with a client-centred, stepped-care approach. Patients were also aware that by giving their consent they would not be informed to which treatment they were allocated. Early in

Panel 1: Usual care treatment protocol

Step 1
Audiological diagnostics (105 min)
- Audiology assistant
  - Pure tone and speech audiometry, tympanometry (stapedial reflexes)
  - Tinnitus analyses: pitch mask frequency and minimum masking level
  - Uncomfortable loudness level measurement
  - Hearing aid check and optimisation (if present)
  - Questions about duration and location of the tinnitus
- Individual consult by clinical physicist in audiology
  - Audiological anamnesis
  - Assessment of audiometry and explanation
  - Information about tinnitus and hearing loss
  - Assessment of severity of complaints
  - Prescription hearing aid (when indicated by hearing loss)
  - Prescription tinnitus masker* (when indicated by patient)

Audiological rehabilitation (30 min)
- Audiology assistant
  - Check-up after 8 weeks of hearing aid use
  - Hearing aid check and optimisation

Audiological follow-up (40 min)
- Audiology assistant
  - Pure tone and speech audiometry, tympanometry (stapedial reflexes)
  - Uncomfortable loudness level measurement
  - Hearing aid check and optimisation (if present)
  - Tinnitus analyses: pitch mask frequency and minimum masking level
- Clinical physicist in audiology
  - Individual consult
  - Referral to social work (when indicated)

Step 2
Intake social work (60 min)
- Social worker
  - General inventory of complaints and use of hearing aids or maskers
  - Social work trajectory of maximum nine follow-up contacts (when indicated)

Follow-up social work (60 min)
- Social worker
  - Maximum nine contacts including counselling sessions, telephone contacts, extraneous appointments with third parties, house calls

*Sound-generators were prescribed when specifically asked for by the patient, and were adjusted to produce a small band noise around the pitch match frequency and slightly below the tinnitus masking level.
the intervention procedure detailed information about the
treatment received was unveiled, while the participants re-
mained masked to the content of the alternative treatment.

Procedures
Usual care and specialised care were provided with a
stepped approach (appendix). Step 1 and step 2 in usual
care and specialised care were completed by 8 months
and followed by a no-contact period of 4 months before
the last follow-up assessment at 12 months. Treatment in
step 2 lasted for up to 12 weeks in both treatment
approaches. Patients started step 2 within 4–6 weeks after
3 month assessment, depending on group-treatment
schedule. We used case record forms for every patient to

Panel 2: Specialised care treatment protocol

**Step 1**

**Audiological diagnostics (105 min)**

- Audiology assistant
  - Pure tone and speech audiometry, tympanometry
    (stapedial reflexes)
  - Tinnitus analyses: pitch mask frequency and minimum
    masking level
  - Uncomfortable loudness level measurement
  - Hearing aid check and optimisation (if present)
  - Tinnitus anamnesis using structured interview
  - Individual consult by clinical physicist in audiology (trained
    in tinnitus retraining counselling)*
  - Audiological anamnesis, assessment of audiometry
    and explanation
  - Information about tinnitus and hearing loss
  - Introduction to the neurophysiological model†
  - Reading materials and treatment rationale are provided
  - Explanation of treatment protocol in the first step and
    explanation of stepped-care approach
  - Prescription hearing aid (when indicated by
    hearing loss)
  - Prescription sound generator† (when indicated by
    patient)

**Audiological rehabilitation (30 min)**

- Audiology assistant
  - Check-up after 8 weeks of hearing aid or masking
device use
  - Hearing aid check or masking device optimisation

**Tinnitus educational session provided within the cognitive
behaviour therapy framework (120 min; maximum ten patients
with partners)**

- Psychology assistant
  - Tinnitus retraining therapy counselling elements
  - Extensive explanation of neurophysiological model
  - Fear avoidance discussion
  - General information about step 2 care is provided
  - Group discussion and remaining questions answered

**Intake psychology (extensive tinnitus specific and general
psychological diagnostic anamnesis; 60 min)**

- Clinical psychologist
  - When indicated by scores on tinnitus questionnaire and
    tinnitus handicap inventory, and by anamnesis,
treatment goals for step 2 are formulated in
    concordance with patient and planned in
    multidisciplinary team meeting

**Audiological follow-up (40 min)**

- Audiology assistant
  - Pure tone and speech audiometry, tympanometry
    (stapedial reflexes)
  - Tinnitus analyses: pitch mask frequency and minimum
    masking level
  - Uncomfortable loudness level measurement
  - Hearing aid check and optimisation (if present)
  - Clinical physicist in audiology (trained in tinnitus
    retraining counselling)
  - Individual consult*

**Multidisciplinary team meeting (10 min per patient)**

- All professionals involved in specialised care
  - All tinnitus patients are discussed and, when indicated
    by scores on tinnitus questionnaire/tinnitus handicap
    inventory and clinical view of psychologist,
multidisciplinary treatment goals for step 2 are
integrated in a plan of treatment

**Step 2**

**Group treatments (treatment intensity and group size varies
according to severity; 120 min per session over 12 weeks)**

- Clinical psychologist, movement therapist, physical therapist,
clinical physicist in audiology, social worker, speech therapist
- Group sessions (of 10–12 patients, 6–8 patients, or
3–4 patients, dependent on tinnitus severity level and
hearing level): cognitive behaviour therapy,
psychoeducation, cognitive restructuring, exposure
techniques, mindfulness-based elements, stress relief,
and attention redirecting techniques by means of
movement therapy, and applied relaxation
- Themed group counselling sessions (including partners)

**Individual trajectory if group treatment is contraindicated (60 min
per discipline per patient for up to 12 weeks)**

- Clinical psychologist, movement therapist
- Combination of cognitive behaviour therapy,
psychoeducation, cognitive restructuring, exposure
techniques, mindfulness-based elements, stress relief,
attention redirecting techniques by means of movement
therapy, and applied relaxation applied on individual
basis (with optional addition of a combination of
professionals involved in group treatments)

*Specifically, the counselling elements of tinnitus retraining therapy were part of
intervention, which aimed to educate patients about tinnitus and the neurophysiological
model. †Sound-generators were prescribed when specifically asked for by the patient and
were adjusted to produce a small band noise around the pitch match frequency and slightly
above hearing threshold, as measured with the small band noise of the sound generator.
Table 1: Demographic and baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Overall (n=492)</th>
<th>Usual care (n=247)</th>
<th>Specialised care (n=245)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (SD)</td>
<td>54·19 (11·54)</td>
<td>54·63 (12·02)</td>
<td>53·74 (11·05)</td>
</tr>
<tr>
<td>Sex, male (SD)</td>
<td>308 (63%)</td>
<td>150 (61%)</td>
<td>158 (65%)</td>
</tr>
<tr>
<td>Education (%)</td>
<td></td>
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<tr>
<td>Low (SD)</td>
<td>225 (46%)</td>
<td>117 (47%)</td>
<td>108 (44%)</td>
</tr>
<tr>
<td>Middle (SD)</td>
<td>136 (28%)</td>
<td>61 (25%)</td>
<td>70 (31%)</td>
</tr>
<tr>
<td>High (SD)</td>
<td>131 (27%)</td>
<td>70 (28%)</td>
<td>61 (25%)</td>
</tr>
<tr>
<td>Employed (SD)</td>
<td>263 (53%)</td>
<td>124 (50%)</td>
<td>139 (57%)</td>
</tr>
<tr>
<td>Duration of tinnitus (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 year (SD)</td>
<td>147 (30%)</td>
<td>81 (33%)</td>
<td>67 (27%)</td>
</tr>
<tr>
<td>1–5 years (SD)</td>
<td>191 (39%)</td>
<td>94 (38%)</td>
<td>98 (40%)</td>
</tr>
<tr>
<td>&gt;5 years (SD)</td>
<td>153 (31%)</td>
<td>73 (30%)</td>
<td>81 (33%)</td>
</tr>
<tr>
<td>Mild complaints (SD)</td>
<td>224 (46%)</td>
<td>112 (45%)</td>
<td>112 (46%)</td>
</tr>
<tr>
<td>Tinnitus sound (SD)</td>
<td>71 (14%)</td>
<td>24 (10%)</td>
<td>44 (18%)</td>
</tr>
<tr>
<td>Tinnitus in left ear (SD)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tinnitus in right ear (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous tinnitus (SD)</td>
<td>413 (84%)</td>
<td>206 (83%)</td>
<td>207 (85%)</td>
</tr>
<tr>
<td>Interval tinnitus (SD)</td>
<td>34 (7%)</td>
<td>7 (3%)</td>
<td>26 (11%)</td>
</tr>
<tr>
<td>Hearing aid (SD)</td>
<td>91 (19%)</td>
<td>45 (18%)</td>
<td>46 (19%)</td>
</tr>
<tr>
<td>Sound generator (SD)</td>
<td>93 (19%)</td>
<td>46 (19%)</td>
<td>47 (19%)</td>
</tr>
<tr>
<td>PTA right ear (SD)</td>
<td>29·74 (19·40)</td>
<td>30·30 (20·58)</td>
<td>29·18 (18·15)</td>
</tr>
<tr>
<td>PTA left ear (SD)</td>
<td>31·05 (20·64)</td>
<td>30·96 (20·25)</td>
<td>31·14 (21·06)</td>
</tr>
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<td>PTA bilateral (SD)</td>
<td>30·57 (17·60)</td>
<td>30·77 (17·85)</td>
<td>30·37 (17·38)</td>
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<tr>
<td>Health utilities index</td>
<td>0·635 (0·280)</td>
<td>0·641 (0·295)</td>
<td>0·629 (0·283)</td>
</tr>
<tr>
<td>Tinnitus questionnaire score</td>
<td>49·05 (18·85)</td>
<td>48·78 (19·23)</td>
<td>49·32 (18·49)</td>
</tr>
<tr>
<td>Tinnitus handicap inventory score</td>
<td>38·96 (22·98)</td>
<td>38·65 (23·19)</td>
<td>39·27 (22·60)</td>
</tr>
<tr>
<td>Hospital anxiety and depression scale</td>
<td>12·20 (8·04)</td>
<td>11·79 (8·03)</td>
<td>12·60 (8·05)</td>
</tr>
<tr>
<td>Tinnitus catastrophising scale score</td>
<td>21·11 (12·19)</td>
<td>21·36 (12·57)</td>
<td>20·86 (11·81)</td>
</tr>
<tr>
<td>Fear of tinnitus questionnaire score</td>
<td>7·35 (3·59)</td>
<td>7·31 (3·65)</td>
<td>7·19 (3·54)</td>
</tr>
</tbody>
</table>

Data are mean (SD) or n (%). PTA=pure-tone average for 1 kHz, 2 kHz, and 4 kHz.

Panel 2 shows the specialised care treatment protocol. Step 1 of specialised care consisted of multidisciplinary diagnostics and specific tinnitus retraining counseling, which were undertaken in a cognitive behaviour framework (including audiological rehabilitation when necessary). For patients with mild complaints this basic intervention was expected to be sufficient, and they were measured for follow-up only. When tinnitus was more severe (as measured at baseline and after psychological screening), patients entered step 2 of treatment, which consisted of three different 12-week group treatment options with levels of care dependent on tinnitus severity and hearing loss (panel 2). We assessed treatment fidelity in a post-hoc investigation of case record forms, attendance lists, and electronic databases, for a random sample of 40 patients per treatment group (usual care and specialised care), to verify whether both treatments were provided according to treatment protocols (adherence) and not influenced overly (contamination) by contrasting elements from the other treatment. The appendix shows specifics of the data collection.

Outcomes

Before randomisation, we assessed hearing impairment with pure tone audiometry and tinnitus severity with the TQ to provide data for stratification.

Panel 2 shows the specialised care treatment protocol. Step 1 of usual care was a standard audiological intervention. For patients with mild complaints, treatment ended after the first step but these patients remained in the trial for follow-up. When tinnitus was more severe (as measured at baseline and after audiological counselling), patients entered step 2 of treatment.

Articles
which contained 14 items and has good reliability and validity.27 The tinnitus catastrophising scale is an adapted version of the pain catastrophising scale28 and assesses catastrophic misinterpretations of the tinnitus sound with 13 items rated on a 5-point scale (0 is not at all, 4 is always). The tinnitus catastrophising scale has been tested with patients29 and internal consistency of the total score in our population was excellent (Cronbach’s α=94).

The fear of tinnitus questionnaire (FTQ) measures fear related to tinnitus. Some of the items on this questionnaire were derived from the Tampa scale for kinesiophobia and the pain anxiety symptoms scale.30,31 This questionnaire was pretested with patients30 and has 17 items rated on a true or false scale. Internal consistency of the total score in our population was excellent (Cronbach’s α=82). Adverse events were surveyed throughout the trial and at all assessments.

We gathered demographic data with a 5-item questionnaire to establish sex, age, duration of complaints, educational achievement, and adherence area.

**Statistical analysis**

We identified only one study6 about quality of life of tinnitus patients attending a specialised tinnitus centre.
Table 2: Primary and secondary outcomes at baseline and 3 months, 8 months, and 12 months after baseline.

<table>
<thead>
<tr>
<th></th>
<th>Baseline (n=247 in usual care; n=245 in specialised care)</th>
<th>3 months (n=194 in usual care; n=200 in specialised care)</th>
<th>8 months (n=161 in usual care; n=175 in specialised care)</th>
<th>12 months (n=161 in usual care; n=171 in specialised care)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary outcomes</strong></td>
<td></td>
<td></td>
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<tr>
<td>Health-related quality of life (HUI)</td>
<td></td>
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<tr>
<td>Usual care</td>
<td>0.641 (0.295)</td>
<td>0.640 (0.294)</td>
<td>0.634 (0.287)</td>
<td>0.631 (0.279)</td>
</tr>
<tr>
<td>Specialised care</td>
<td>0.628 (0.284)</td>
<td>0.620 (0.285)</td>
<td>0.656 (0.254)</td>
<td>0.681 (0.250)</td>
</tr>
<tr>
<td>Tinnitus severity (TQ)</td>
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<tr>
<td>Usual care</td>
<td>48.87 (19.22)</td>
<td>45.51 (19.65)</td>
<td>42.36 (19.62)</td>
<td>42.12 (19.81)</td>
</tr>
<tr>
<td>Specialised care</td>
<td>49.39 (18.50)</td>
<td>42.01 (19.81)</td>
<td>36.47 (17.48)</td>
<td>33.43 (16.89)</td>
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<tr>
<td>Tinnitus impairment (THI)</td>
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<tr>
<td>Usual care</td>
<td>38.72 (23.20)</td>
<td>37.38 (23.74)</td>
<td>34.14 (24.60)</td>
<td>33.51 (23.25)</td>
</tr>
<tr>
<td>Specialised care</td>
<td>39.25 (22.65)</td>
<td>34.75 (23.44)</td>
<td>28.85 (20.51)</td>
<td>26.45 (18.81)</td>
</tr>
<tr>
<td><strong>Secondary outcomes</strong></td>
<td></td>
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<tr>
<td>Negative effect (HADS)</td>
<td></td>
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<tr>
<td>Usual care</td>
<td>11.83 (8.03)</td>
<td>12.08 (7.85)</td>
<td>10.47 (8.55)</td>
<td>10.83 (8.03)</td>
</tr>
<tr>
<td>Specialised care</td>
<td>12.61 (8.07)</td>
<td>11.91 (7.96)</td>
<td>10.52 (7.21)</td>
<td>10.22 (7.01)</td>
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<tr>
<td>Tinnitus catastrophising (TCS)</td>
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<tr>
<td>Usual care</td>
<td>21.42 (12.56)</td>
<td>18.65 (11.76)</td>
<td>17.14 (11.54)</td>
<td>15.95 (11.79)</td>
</tr>
<tr>
<td>Specialised care</td>
<td>20.89 (11.83)</td>
<td>16.20 (11.65)</td>
<td>12.45 (10.30)</td>
<td>11.73 (9.91)</td>
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<tr>
<td>Tinnitus-related fear (FTQ)</td>
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<tr>
<td>Usual care</td>
<td>7.32 (3.66)</td>
<td>6.60 (3.70)</td>
<td>6.19 (4.06)</td>
<td>6.04 (4.00)</td>
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<tr>
<td>Specialised care</td>
<td>7.19 (3.54)</td>
<td>5.60 (3.87)</td>
<td>4.52 (3.30)</td>
<td>4.20 (3.16)</td>
</tr>
</tbody>
</table>

Data are mean (SD) and were based on all available patients. HUI = health utilities index. TQ = tinnitus questionnaire. THI = tinnitus handicap inventory. HADS = hospital anxiety and depression inventory. TCS = tinnitus catastrophising scale. FTQ = fear of tinnitus questionnaire.

Role of the funding source
The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. RFFC and JWSV had full access to the data; IHM, MAJ, and LJCA had insight into data upon request; all authors approved the final report; and RFFC had final responsibility for the decision to submit for publication.

Results
Table 1 shows baseline values of the study population and the figure shows the trial profile, including numbers of patients who dropped out and non-responders, with reasons if known. Non-response was defined as missed measurements at one or more follow-up assessments; participants leaving the trial permanently and informing investigators were regarded as having dropped out.

Of 741 participants screened for eligibility, 626 were invited for participation, and 492 completed baseline measurements and were randomised to the first step of treatment (247 allocated to usual care and 245 to specialised care). Randomisation and treatment allocation took place between September, 2007, and December, 2009, and follow-up was completed in January, 2011.

Numbers of participants who did not respond or dropped out did not differ between groups at any follow-up (α=0.01, p=0.20), as measured with logistic regression with missing/not-missing as the dependent variable, and group, baseline characteristics (age, sex, education, duration of complaints, tinnitus severity at baseline, and hearing loss) and scores on the HUI, the TQ, and the THI at the previous timepoint as independent variables. We noted a positive association...
between age and absence of response or dropout at 3 months (p=0·0162) and at 12 months (p=0·0070) after randomisation. All other predictors and time points did not reach significance (p>0·832).

86 (35%) of 247 patients in the usual care group and 74 (30%) of 245 patients in the specialised care group were lost to follow up by month 12. Reasons for non-response seemed unrelated to treatment content.

In the treatment fidelity check the inter-rater reliability between both independent raters for the identification of treatment (usual care vs specialised care) was excellent (Cohen’s κ=0·96), and good for the identification of step 2 treatment (κ=0·79) and specific treatment elements (κ=0·74). Correct classifications of treatment (usual care vs specialised care) for each of the observed elements occurred 97% of the time, supporting sufficient differentiation between treatments. About 88% of essential treatment elements (unique and not unique) occurred during the delivery of both treatments (mean 88·4% [SD 9·02] for usual care and mean 87·5% [12·6] for specialised care), indicating satisfactory protocol adherence. About 6% of the prohibited treatment elements occurred during treatment delivery (mean 4·6% [SD 2·6] in usual care and mean 8·1% [6·1] in specialised care), suggesting absence of contamination. Analysis of variance suggested no significant differences between usual care and specialised care in terms of protocol adherence and contamination (p>0·6079).

We noted significant improvements in favour of specialised care compared with usual care for all primary outcomes during follow-up (tables 2, 3, appendix). Health-related quality of life increased with specialised care compared with usual care at 8 months and 12 months (table 3). Tinnitus severity and impairment related to tinnitus were reduced by specialised care compared with usual care at all three follow-ups (table 3). Compared with usual care, specialised care reduced negative affect at 8 months and 12 months, and tinnitus catastrophising and fear related to tinnitus at all three follow-ups (table 3).

The difference between specialised care and usual care that occurred by 8 months seemed to persist to 12 months. Based on intention-to-treat analysis, the difference noted between treatment groups did not depend on tinnitus severity. Adverse events as a result of treatment or measurements did not occur.

### Discussion

Stepped-care tinnitus management, combining elements of tinnitus retraining therapy within a cognitive behaviour therapy framework, is more effective than is usual care for improvement of health-related quality of life and reduction of tinnitus severity and impairment. Moreover, specialised care generates greater improvements in general negative emotional states, tinnitus-related catastrophic thinking, and adverse events. Furthermore, the difference noted between treatment groups did not depend on tinnitus severity. Adverse events as a result of treatment or measurements did not occur.

#### Table 3: Estimated group difference for primary and secondary outcomes at 3 months, 8 months, and 12 months, based on intention-to-treat analysis

<table>
<thead>
<tr>
<th></th>
<th>Group difference (95% CI)*</th>
<th>p value</th>
<th>Effect size (absolute values)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health-related quality of life (HUI)*</td>
<td>-0·009 (0·056 to 0·039)</td>
<td>0·6420</td>
<td>0·04</td>
</tr>
<tr>
<td>3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 months</td>
<td>0·038 (0·005 to 0·071)</td>
<td>0·0258</td>
<td>0·18</td>
</tr>
<tr>
<td>12 months</td>
<td>0·059 (0·025 to 0·094)</td>
<td>0·0009</td>
<td>0·24</td>
</tr>
<tr>
<td>Tinnitus severity (TOI)*</td>
<td>-3·315 (-5·612 to -1·019)</td>
<td>0·0048</td>
<td>0·20</td>
</tr>
<tr>
<td>3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 months</td>
<td>-7·070 (-9·561 to -4·580)</td>
<td>0·0001</td>
<td>0·41</td>
</tr>
<tr>
<td>12 months</td>
<td>-8·062 (-10·829 to -5·295)</td>
<td>0·0001</td>
<td>0·43</td>
</tr>
<tr>
<td>Tinnitus impairment (THI)*</td>
<td>-4·257 (-7·065 to -1·449)</td>
<td>0·0031</td>
<td>0·32</td>
</tr>
<tr>
<td>3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 months</td>
<td>-7·626 (-10·713 to -4·539)</td>
<td>0·0001</td>
<td>0·52</td>
</tr>
<tr>
<td>12 months</td>
<td>-7·506 (-10·661 to -4·352)</td>
<td>0·0001</td>
<td>0·45</td>
</tr>
</tbody>
</table>

HUI=health utilities index. TQ=tinnitus questionnaire. THI=tinnitus handicap inventory. HADS=hospital anxiety and depression inventory. TCS=tinnitus catastrophising scale. FTQ=fear of tinnitus questionnaire. ¶99% CI for secondary outcomes. Because usual care was coded as 0 and specialised care was coded as 1, a negative group difference shows lower scores in usual care than specialised care at the follow-up measurements. Group difference values shown are group×time effects as shown in the appendix, in which time=0 for baseline, time=1 for 3 months, time=2 for 8 months, and time=3 for 12 months. Effect size was calculated by dividing the group difference values (ignoring their sign) by the square root of the average of residual variances at 3 months, 8 months, and 12 months giving a mixed regression version of Cohen’s d. †Adjusted for the main effects of hearing loss and tinnitus severity at baseline, and time (by use of dummy coding with baseline as reference category). ||Adjusted for the main effects of education, hearing loss, and time. $Adjusted for the main effects of age, duration, education, tinnitus severity at baseline, and time, and for interaction effects of time by education and by tinnitus severity at baseline. ¶¶Adjusted for the main effects of duration, hearing loss and tinnitus severity, time, and for interaction effects of time by duration and by tinnitus severity at baseline. §§Adjusted for the main effects of education, tinnitus severity at baseline, time, and for the interaction effects of time by education and by tinnitus severity at baseline. **Adjusted for the main effects of tinnitus severity at baseline, time, and for the interaction effects of time by tinnitus severity at baseline.
and tinnitus-related fear than does usual care. We showed the effectiveness of specialised care compared with usual care not only after the first 3 months of first-step treatment, but also after the more intensive second-step treatment approach ended and 4 months of no treatment. Notably, our findings were established even though patients with mild tinnitus complaints, receiving only first-step treatment, were included in all analyses.

Patients with mild or severe tinnitus seemed to benefit equally from specialised care compared with usual care. These findings support our main hypothesis that a stepped-care approach based on cognitive behaviour therapy with elements from tinnitus retraining therapy is effective in tinnitus management, both for mild forms of tinnitus and for more severe tinnitus.

Panel 3 shows a systematic review of present treatment approaches in management of tinnitus. Our combination of two main theoretical models and treatment approaches had not been studied previously. Two main treatment approaches have dominated the management of patients with tinnitus complaints. Tinnitus retraining therapy, with its focus on sound habituation, and cognitive behaviour therapy, with its focus on dysfunctional beliefs about tinnitus and associated safety behaviours, have been widely applied and studied. However, a combination of the two, although previously proposed, has to our knowledge never before been investigated in a randomised controlled trial of this scale.

Our study has several strengths, including a comparatively large sample size, masking of investigators to treatment assignment, assessment of treatment fidelity to strengthen internal validity, and delivery of treatments according to protocols. Other strengths were that no patients dropped out from step 2 of treatment, both generic and tinnitus-specific outcome measures showed consistent findings and, moreover, the differences between treatment groups over time were likely to be clinically relevant. The percentage of patients reporting clinically relevant changes after 12 months in health-related quality of life and in tinnitus severity was larger in the specialised care group than the usual care group.

Our study also has some limitations. Specialised care had several elements, and which of these elements contributed to the overall effectiveness is unknown. Future studies might adopt a dismantling approach, leaving out potentially redundant treatment components. Second, treatment was done in an outpatient clinic for audiological rehabilitation. Thus, whether our results can be generalised to other health-care settings or if generalisability is dependent on their similarity to the present setting is unclear. We are presently investigating implementation routes in both primary and secondary care.

In addition to the analyses reported presently, we are undertaking moderation and mediation analyses to provide additional information about underlying mechanisms of change, contributing to further refinement, tailoring, and increased effectiveness of the treatment. We also plan to report separate cost-effectiveness data for specialised care compared with usual care. Data were also collected with the tinnitus coping and cognitions list (TCCL) as specified in our trial protocol. The main reason for including this measure was to test the psychometric properties of this new measure in patients with tinnitus. The TCCL has considerable content overlap with the tinnitus catastrophising scale, and thus omission of this measure from the presented effect analyses should not affect our conclusions. We plan to report psychometric analyses separately.

Our findings provide firm evidence for an effective new treatment approach in management of tinnitus. The results are highly relevant for clinical practice because best practice for tinnitus has not been defined, and current treatment strategies are fragmented and costly. Delay of psychoeducation and effective treatment is expected to aggravate tinnitus complaints, thereby increasing psychological strain. Our findings could lead to consensus in policy about best practice in treatment of tinnitus, standard choices in referral trajectories, and the implementation of standardised tinnitus assessment and thereby more easily comparable outcomes.

**Panel 3: Research in context**

**Systematic review**

We searched various databases to identify relevant studies and review articles on tinnitus treatment in adults. Full details of the search are shown in the appendix. We identified 216 reports, and two reviewers (RFFC and DJWMS) independently assessed all studies for inclusion quality in this systematic review. We identified eight systematic reviews, nine randomised controlled trials, three follow-up or case-control studies, one non-randomised controlled trial, and one assessment of current practice that were relevant to our report.

**Interpretation**

The combination of two main theoretical models and treatment approaches that we used (cognitive behaviour therapy and tinnitus retraining therapy) was novel. Cognitive behaviour therapy for tinnitus seems the most promising approach in diminishing tinnitus-related distress and decreasing the main complaints of patients. The use of sound-generating devices, whether masking devices, wearable players, or hearing aids, even when combined with directive counselling sessions, have not been proven to be effective as a single treatment approach. Furthermore, as is the case in tinnitus retraining therapy-based approaches, effects seem modest at best. An integral treatment strategy might be best, with a standardised approach in diagnostics, treatment, and assessments because serial approaches (in random order) could lead to an unwanted increase of health-care use and costs. Moreover, a framework based on cognitive behaviour therapy in tinnitus management is advisable.

**Contributors**

The trial project members RFFC (principal investigator and main author), MAJ (project adviser and co-promoter), LJCA (project co-leader), and JWSV (project leader) designed the study and obtained funding. RFFC and DJWMS (project member and clinical audiology adviser) did the literature search for the systematic review and carried out the qualitative study for the development of the protocol of usual care. RFFC and DJWMS, in close collaboration with the specialised care professionals of Adelante, Department of Audiology and Communication, developed the specialised care protocol. Treatment manuals of usual care and specialised care were developed by RFFC and DJWMS, and MAJ and LJCA commented on drafts of the manuals. Further trial development and
Acknowledgments

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Tinnitus: the end of therapeutic nihilism

Tinnitus is a highly prevalent disorder. About 2% of the population are severely impaired in their quality of life because of chronic tinnitus.1 This disorder also has great socioeconomic effects—sick leave attributable to tinnitus is related to a three-fold increased risk of receiving a disability pension.2 Many different treatments are offered for tinnitus, but evidence for their efficacy is scarce3 and satisfaction of patients is low.4

In The Lancet, Rilana Cima and colleagues5 report the effectiveness of a stepped specialised care programme for tinnitus.5 247 patients were allocated usual care, and 245 patients were allocated specialised care, consisting of cognitive behaviour therapy enriched with elements of tinnitus retraining therapy. This report challenges and overcomes several prejudices. First and most important, the reported findings
overcome the idea that nothing can be done to treat tinnitus. After 12 months, the stepped specialised care programme was superior to usual care both in health-related quality of life measurements (between-group difference 0.059, 95% CI 0.025–0.094; effect size 0.24 on Cohen’s d; p=0.0009) and in tinnitus-specific questionnaires (tinnitus severity [–8.062, –10.829 to –5.295; 0.43; p<0.0001], and tinnitus impairment [–7.506, –10.661 to –4.352; 0.45; p<0.0001]). This finding is a clear statement against therapeutic nihilism.

Another prejudice is that non-pharmacological interventions cannot be investigated with the same methodological rigour as can pharmacological interventions, in double-blind, randomised controlled trials. Cima and colleagues show that this is not the case. In their randomised controlled trial both patients and assessors were masked, the interventions were highly standardised, and protocol adherence was verified. Tinnitus trials are especially challenging because of the heterogeneity of patients, the subjective nature of the phantom percept, and the absence of widely accepted standards for outcome measurement.6,7 The absence of effective tinnitus treatments and the absence of standards for proving their effectiveness are mutually dependent,8 and have hampered the development of standardised treatment algorithms.3,10 Cima and colleagues show how such a vicious circle can be broken. They dealt with the heterogeneity of tinnitus patients by stratifying them, and overcame the difficulties of outcome measurement by using two established tinnitus scales and a quality-of-life scale.7

The results of this trial are especially convincing and relevant for clinical practice since specialised care was not compared with a placebo group or a waiting list group, but with usual care. The nature of usual care was determined by a nationwide survey of institutions offering tinnitus treatment. Although the stepped care approach involved only a short intervention for most patients, specialised care was significantly better than usual care for the whole sample.

An essential feature of Cima and colleagues’ specialised care is its multidisciplinary approach. They integrated work done by audiologists, psychologists, speech therapists, movement therapists, physical therapists, and social workers. Although the exact format of the specialised care in this trial was developed by the investigators, it is not entirely new. It combines components of cognitive behaviour therapy and tinnitus retraining therapy, the most widely used treatment strategies in tinnitus treatment.11 Similar combinations have been proposed by other researchers,12 but they have frequently not been implemented by a multidisciplinary team and, as far as I am aware, have never been tested with such scientific rigour.3

As convincing as the results are, the proposed treatment aims at successful habituation to tinnitus. For future research, it should not be forgotten that most patients with tinnitus want a cure, which should be the ultimate goal of research efforts. Advances in the understanding of the pathophysiology of tinnitus13 have been increasingly translated into causally orientated treatment approaches. Moreover, differential diagnosis according to cause, perceptual characteristics, and comorbidities will be a requirement for further treatments aiming at cure and for the development of more specific treatments for different forms of tinnitus.14

Cima and colleagues’ study should not only set standards for tinnitus treatment and for future tinnitus trials, but should also be the first of many steps towards more effective and evidence-based treatments for this disorder.

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Comment

I have received consultancy, honoraria, travel, accommodation payments, or speakers’ fees from AstraZeneca, Merz, Novartis, Servier, Pfizer, ANM, and Magventure; research funding or equipment from AstraZeneca, Cemborne, Magventure, the American Tinnitus Association, the German Research Foundation, and the Tinnitus Research Initiative; and hold patents for the treatment of tinnitus with neuronavigated transcranial magnetic stimulation, with cyclobenzaprine and with naltrexone.