# Internet-based intervention for tinnitus: Outcome of a single-group open trial

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Internet-based intervention for tinnitus: Outcome of a single-group open trial

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Abstract

Background: Managing chronic tinnitus is challenging and innovative ways to address the resulting health-care burden are required. Internet-based cognitive behavioural therapy (iCBT) for tinnitus shows promise as a cost-effective treatment option. The feasibility and effectiveness of iCBT in the United Kingdom (UK) are yet to be explored. Furthermore, it is not known if iCBT can be supported by an Audiologist rather than a Psychologist.

Purpose: This study aimed to determine the feasibility of guided iCBT using Audiological support on tinnitus distress and tinnitus related comorbidities. Furthermore, it aimed to establish the feasibility of iCBT for tinnitus distress in the UK, by determining recruitment, attrition and compliance rates. Lastly it aimed to identify which aspects of the protocol require refinement for subsequent clinical trials.

Research Design: A single-group open trial design was implemented. This study would serve as a pre-requisite study, to identify barriers, prior to undertaking effectiveness trials.

Study Sample: Participants consisted of 37 adults (18 males, 19 females), with an age range of between 50-59 years. The mean pre-intervention tinnitus severity rating was 56.15 (SD 18.35) which is categorised as “severe tinnitus” as measured by the Tinnitus Functional Index. Five participants withdrew during the study and 29 of the remaining participants completed the post-intervention questionnaire.

Intervention: The guided iCBT intervention ran over an eight-week period and consisted of 16 obligatory modules and 5 optional modules. The intervention was designed to be interactive, interesting and stimulating. A key element was the provision of support from an Audiologist throughout the programme.

Data Collection and Analysis: Online questionnaires were used throughout the study. These were administered at baseline and post-intervention to determine attrition and compliance rates and to facilitate sample size estimates for further clinical trials. Outcome measures for
tinnitus severity, hearing handicap, insomnia, cognitive functioning, hyperacusis, anxiety, depression and life satisfaction were used to investigate the effects of iCBT with Audiological support. In addition, a weekly questionnaire was incorporated to monitor change in tinnitus distress while undertaking the intervention.

**Results:** Feasibility was established using an Audiologist to support this guided iCBT intervention, as a significant change post-intervention was found for tinnitus severity, as measured by the Tinnitus Functional Index and the Tinnitus Handicap Inventory screening version. The attrition rate was 22% and compliance was variable. Although these results were based on a small sample, they provide encouraging evidence for the feasibility of delivering iCBT treatment for tinnitus symptoms with Audiology support in the UK.

**Conclusions:** An internet-based intervention of tinnitus appears to be feasible in the UK when using Audiological support. Randomised controlled trials to further investigate the effectiveness of iCBT for tinnitus in the UK are required.

**Keywords**

Tinnitus, tinnitus treatment, e-Health, internet-intervention, cognitive behavioural therapy

**Abbreviations**

CBT: Cognitive Behavioural Therapy
CFQ: Cognitive Failures Questionnaire
CONSORT: Consolidated Standards of Reporting Trials
CSQ-8: Client satisfaction questionnaire
DMC: Data monitoring committee
GAD-7: Generalized anxiety Disorder
HCPC: Health and Care Professions Council
HHIA-S: Hearing Handicap Inventory for Adults - Screening Version
HQ: Hyperacusis Questionnaire
iCBT: Internet-based Cognitive Behavioural Therapy Intervention
ISI: Insomnia Severity Index
PHQ-9: Patient Health Questionnaire
RCT: Randomized Control Trial
RCI: Reliable Change Index
SPIRIT: Standard Protocol Items, Recommendations for Interventional Trials
SPSS: Statistical Package for Social Sciences
SWLS: Satisfaction with Life Scales
TFI: Tinnitus Functional Index
THI-S: Tinnitus Handicap Inventory - Screening Version
UK: United Kingdom
WCI: Weekly check-in control group

Introduction

Experiencing tinnitus can lead to adverse consequences such as insomnia, anxiety, and depression, which may negatively affect relationships and the ability to work (Langguth, 2011). Despite extensive research, a cure for tinnitus is still to be found (Henry et al, 2014). Managing tinnitus and its comorbidities places a burden on health care systems (Maes et al, 2013) and has significant health economic cost implications (Martinez et al, 2015). There are added concerns that health organisations will be under-resourced in the future, especially considering that the incidence of significant tinnitus has been increasing over the last 10 years (Martinez et al, 2015). A further concern regarding tinnitus management in the United Kingdom (UK) is that many who experience tinnitus remain without access to tinnitus treatment as they are not always referred for treatment by their General Practitioner (El-Shunnar et al, 2011). For those that are referred, both the structure and provision of tinnitus services throughout the UK is variable, leading to inequality in tinnitus care (Hoare et al, 2015). Cognitive behavioural therapy (CBT), a psychological intervention aimed at altering maladaptive responses to tinnitus through behavioural modifications, has the most evidence of effectiveness at reducing tinnitus distress (Hesser et al, 2011). Despite positive outcomes associated with the use of CBT for tinnitus, there remains limited accessibility, largely due to a shortage of trained clinicians to provide CBT for tinnitus (Baguley et al, 2013). There are thus various obstacles to effectively manage tinnitus in the UK.
One potential solution to overcome current barriers is using the Internet to deliver treatment. Numerous studies have shown promise using Internet-based interventions in various fields such as pain, psychological conditions and health problems (Andersson, 2014). An advantage of Internet interventions is having materials to refer to in written form, which serves to aid information retention. This is beneficial, as information recall can be poor when provided verbally in clinics (Reese and Smith, 2006). An internet-based system also enables patients to be actively involved in their own treatment, which in turn leads to them deriving more benefit from the treatment (James, 2013). Further benefits include facilitating adjustment behaviours, providing an easily accessible clinician, as well as complementary information sources that can be absorbed at a pace that suits patient needs, in the comfort of their own homes (Andersson and Titov, 2014). It could provide accessible treatment to those who are in remote geographical areas. There may, however, be barriers such as poor computer skills or lack of Internet availability. Encouragingly, it is estimated that 87.9% of people in the UK have Internet access (Office of National Statistics, 2016), and so hopefully these barriers should decrease over time.

Internet-based CBT for tinnitus (iCBT) has been studied in Sweden, Germany and Australia (e.g. Andersson et al, 2002; Kaldo et al, 2008; Abbott et al, 2009; Nyenhuis et al, 2013; Jasper et al, 2014; Weise et al, 2016). A meta-analysis of internet-delivered CBT for tinnitus showed that it is an effective form of intervention for both reducing tinnitus distress and associated depression (Andersson, 2015). These trials have been developed and supported by experienced Clinical Psychologists, who are accustomed to applying CBT techniques to address psychological distress, anxiety, depression and insomnia that often co-occur with tinnitus. Audiologists, on the other hand, play a significant role in most models of tinnitus
healthcare provision, particularly in the UK (Henry et al, 2005). The advantages of having the
Audiological community deliver tinnitus treatment include their understanding of the
auditory system, using their expertise to address comorbidities such as hearing handicap and
hyperacusis that often co-occur with tinnitus (Nelson and Chen, 2004), as well as
incorporating their skill in counselling potentially anxious patients presenting with hearing-
related or balance disorders (Searchfield and Baguley, 2011). Audiologists are, however,
traditionally not trained explicitly in CBT techniques unless additional training is undertaken.
This lack of experience applying CBT techniques may affect the way support is offered to
those undertaking an iCBT intervention. In the UK context, delivering iCBT via an
Audiologist would be optimal, but providing this form of support for an iCBT intervention
needs to be established. To date, previous research has not determined whether delivering
iCBT for tinnitus by a non-Psychological professional is feasible.

The efficacy and feasibility in terms of recruitment, attrition, and compliance of iCBT in the
UK are yet to be explored. Moreover, applying the same iCBT programme that has been used
in previous trials, would not account for cultural differences. Therefore, iCBT, suitable for a
UK population was developed using a format that may be more appealing to a UK
population. The iCBT programme used in Europe was based on downloadable text-based
information and worksheets developed by Andersson and Kado (2004). This text has been
simplified and the presentation has been modified by adding videos, diagrams, and quizzes,
to ensure it is appealing, interactive and responsive to mobile devices (Beukes et al, 2016). A
feasibility study was considered an important pre-requisite to identify barriers and guide
planning of randomised controlled trials, as suggested by the Medical Research Council
framework for the evaluation of complex interventions (Campbell et al, 2000).
The specific objectives of this study were determining the feasibility of guided iCBT using Audiological support on tinnitus distress and tinnitus related comorbidities. Additionally, the study aimed to establish the feasibility of iCBT for tinnitus in the UK, by determining recruitment, attrition and compliance rates. Lastly an aim was to refine this iCBT intervention and the protocol for implementation during subsequent randomised control trials.

**Method**

**Design**

A single-group open trial design was implemented to evaluate the feasibility of iCBT prior to undertaking an effectiveness study. The same protocol as for the effectiveness trial was followed, without including a control group and long-term evaluation (see Beukes et al, 2015 for this protocol). The CONSORT-eHealth guidelines were used (Eysenbach et al, 2011).

**Recruitment**

Recruitment was UK-wide, using a variety of approaches. Recruitment strategies incorporated social media, flyers, emails, forums, and newsletters, which were distributed to tinnitus charities, tinnitus support groups, tinnitus forums and Audiology departments for a two-month period prior to the study commencing. Those interested were directed to the study website (www.tacklingtinnitus.co.uk version 3) where they could read more about the study and register interest in partaking in the study.

**Participants**

Participant’s eligibility for the study was as follows:

*Inclusion criteria:*
Adults, aged 18 years and over, living in the UK, with the ability to read and type in English;

Access to a computer, the internet and the ability to email

Suffering from tinnitus for a minimum period of three months

Exclusion criteria:

- Reporting any major medical or psychiatric conditions
- Reporting pulsatile, objective or unilateral tinnitus, which have not been investigated medically or tinnitus still under medical investigation
- Tinnitus as a consequence of a medical disorder
- Undergoing any tinnitus therapy concurrent to participation in this study.

Participants who had registered on the study website were invited to participate (n=44). Of those invited, 37 provided online consent, completed the online questionnaire and were eligible to participate. Participants with a range of TFI scores were included, including two who had scores below 26, which is considered to be “mild” tinnitus. The reason for this was to assess what criteria should be set for the TFI in subsequent clinical trials.

Assessments

Aspects that were assessed included attrition rates and compliance in completing outcome questionnaires. Table 1 provides details of all the questionnaires used to determine the feasibility of iCBT with Audiological support, on the effect of iCBT on tinnitus and its comorbidities. Online questionnaires were used throughout the study. Psychometric properties have been established for this format for some of the questionnaires used, e.g. the GAD-7 and PHQ-9 (van Ballegooijen et al, 2016). Although psychometric properties have
not been established for online use for all the questionnaires, previous research has found comparable results in terms of psychometric properties between computer and paper questionnaire delivery (Thoren et al, 2012). All the measures were completed pre- and post-intervention.

**Pre-intervention assessments**

The initial assessment consisted of an eligibility screening questionnaire and relevant self-reported outcome measures, related to areas which may be affected by tinnitus. Outcome measures for tinnitus severity, hearing handicap, insomnia, cognitive functioning, hyperacusis, anxiety, depression and life satisfaction were thus selected, as seen in Table 1. The TFI was selected as the main outcome measure, over more established tinnitus outcome measures, as it has been specifically developed to measure tinnitus severity and assess responsiveness to treatment (Meikle et al, 2012). Although further validations are still required, the TFI is increasingly being used internationally and is being validated for these purposes (see Henry et al, 2014; Rabau et al, 2014; Fackrell et al, 2015). As a secondary tinnitus measure, the screening version of the Tinnitus Handicap Inventory (THI) was used, as scores are comparable (r=0.9) with the full version of the THI (Newman et al, 2008).

All instruments were used with the permissions of the copyright holders, and agreements were set up for those that are not freely available to use, such as the TFI and ISI.

A two-staged selection procedure was followed:

I. An online screening questionnaire, which included health and mental health-related questions and standardised outcome measures as shown in Table 1.
II. A telephone interview during which the researcher rechecked eligibility, and provided
the opportunity for potential participants to ask any questions related to the study.

Assessments during the intervention
Throughout the programme, participants were monitored weekly by means of the Tinnitus
Handicap Inventory, Screening version (THI-S), which consists of a 10-item questionnaire

Post-intervention assessments
Following completion of the eight-week iCBT intervention, the same outcome measures were
administered, again in the form of an online questionnaire. A telephonic interview was
scheduled to discuss progress and provide the opportunity for participants to discuss their
experiences undertaking the intervention. Reminders and encouragement were provided
throughout for participants who had not completed questionnaires or worksheets on time.
There were three reminders that were automatically and electronically sent on the three
consecutive days following the release of the questionnaire. Further reminders were sent if
required to a maximum of seven, as well as a reminder phone call, over a period of three
weeks.

Intervention
An interactive intervention was developed using a cognitive-behavioural theoretical
framework, based on a CBT self-help programme by Andersson and Kaldo (2004). This
intervention includes key CBT techniques, such as negative automatic thought analysis,
cognitive restructuring, imagery and exposure techniques. It applies the principles of CBT
such as goal setting, structure, active participation relapse prevention and a set time-frame for
the therapy (Beck, 2011). Audiological principles found to be effective for tinnitus such as sound enrichment; hearing tactics and advice for sound sensitivity were also included. The content of the intervention was tailored to include both obligatory and optional modules, as shown in Table 2. A responsive web-based treatment platform was designed in-house at Linkoping University, Sweden, complying with a high level of data security and encrypted communications (Vlaescu et al., 2015). Key principles to maximise effectiveness, compliance, and retention rates were incorporated, as recommended by Dziura et al. (2013). The treatment format included a mixture of videos, quizzes, diagrams, pictures, worksheets and solutions to common problems, all provided free of charge for participants to work through online. There was also the option of downloading or printing the content and worksheets for those who preferred to read offline and/or read a printed version of the content. There were, therefore, various ways in which participants could access the information to suit different preferences. Participants were encouraged to record the effectiveness of techniques practised, using online worksheets provided for this purpose. These worksheets were tailored to the nature of the particular module and provided the opportunity for participants to indicate how they approached techniques, how effective these techniques were and in which situations they were practised.

Therapist
A key element of this intervention was ensuring it was guided, whereby participants had access to a clinician throughout the programme. To maintain consistency with the standard approach of tinnitus therapy being delivered within the audiology community in the UK, an experienced Audiological Scientist, registered with the Health and Care Professions Council (HCPC), and appropriately trained to Masters Level in Audiology, undertook the role of supporting the participants. The therapist was experienced in managing tinnitus patients in a
clinical setting and had a suitable understanding of CBT principles. Supervision was provided by a Clinical Psychologist (specialised in tinnitus treatment) throughout the intervention. The therapist’s role was to conduct the telephonic interviews, introduce weekly modules, provide feedback, answer queries, provide guidance, support and encourage engagement. This feedback was provided using an encrypted messaging system within the intervention and by telephone when required. Having Audiology support for an iCBT intervention is unique to this study, as Psychologists have guided participants in previous studies.

**Ethical considerations**

The Faculty of Science and Technology Research Ethics Panel (FREP) of Anglia Ruskin University (FST/FREP/14/478) granted ethical approval for this study. The research was conducted in accordance with the tenets of the Declaration of Helsinki. Participation was voluntary and all participants provided informed consent online. A full explanation of every step of the study was provided and participants were able to withdraw at any stage without penalty. A protocol was established to ensure the security of participants’ confidentiality when using the web-portal, complying with European guidelines for Internet studies. Participants’ data were anonymised and unique reference codes used.

**Data Analysis**

The Statistical Package for Social Sciences (SPSS) version 20.0 was used for statistical analysis. An intention-to-treat paradigm for analysis was followed, by which statistical analysis was performed on everyone allocated to the treatment programme, and not only those who complete the treatment programme. Missing data analysis was performed using Little's MCAR test to determine the best method to use for missing data analysis (Little, 1988). In addition, data would also be analysed for completers only. If there was no
difference in results, intention-to-treat data was reported. Paired sample $t$-tests were used to compare pre- and post-treatment scores with a significance level of 0.05. Effect sizes (Cohen’s d) were calculated by dividing the differences in pre- and post- intervention means by the pooled standard deviations.

Partial correlations were performed, to determine the relationship between post-treatment scores while controlling the effects of additional variables. There were six variables considered, namely initial TFI score, level of education, employment type, tinnitus duration, age, and gender. During each correlation, five variables were partialled out.

The reliable change index (RCI; Jacobson and Truax, 1991) was used as a means of calculating clinical significance for the TFI. This was calculated using the pretreatment standard deviation, and a test-retest reliability coefficient of 0.78, as reported in the validation study (Meikle et al, 2012). The internal data monitoring committee had access to the data and ensured correct interpretation and analysis thereof.

**Results**

**Participant Characteristics**

The demographic profile of the participants (Table 3) demonstrated that a range of participants with different educational and employment backgrounds, as well as varying tinnitus experiences were drawn to the study. Participants were spread across the UK, with the majority based in England and a few in Wales, Scotland, and Northern Ireland.

**Participant flow**

Figure 1 shows the study profile. Of the 37 participants who started the study, two developed major health complaints and were given the option to transfer to a subsequent study to
provide time for recuperation. A further three withdrew, one due to login and navigation difficulties and two as they no longer required the intervention. One of the participants that withdrew had a low initial TFI score of 24 and felt that his tinnitus was not significant enough to require this level of support. Those that completed the intervention (n=32) together with the three that withdrew were invited to complete the post-treatment questionnaire (n=35). Of these, 29 completed the post-treatment questionnaire, yielding a completion rate of 82.9%. The attrition rate included five who withdrew and four who did not complete the post-intervention questionnaires, leading to a rate of 22% during the study. The extent to which participants actively engaged and interacted with the resources provided by this iCBT intervention was highly variable. An average of 14.8 of the modules were read with an average login of 19.7 times during the intervention. Participants completed an average of 74% of the worksheets.

The therapist spent at least 10 minutes at the end of each week providing written feedback to each participant on the work done. Written feedback was also provided during the week as and when worksheets were completed. The therapist reported that using written therapeutic input was an effective way of supporting participants. There were 413 tailored messages to individual participants (12.9 per user, of the 32 who completed), with a minimum of one message per week. These messages added encouragement to maintain involvement and provided feedback on worksheets completed. Group e-mails were sent on a weekly basis to introduce the new modules. For those that were not logging on, the therapist telephoned them to find out if they could be assisted. In many cases participants who were not engaging explained this was due to a bout of ill health or lack of time. All written and telephone contact was approached in a professional, constructive and motivating way. This format appeared to work well and participants valued the guided feedback.
Statistical analysis

Missing data was missing “completely at random” ($\chi^2 = 12.37$, DF = 9, $p = 0.19$), demonstrating that there was no relationship between missing and observed data. Due to this random distribution, imputing missing values was undertaken, using the Markov Chain Monte Carlo approach. Results were compared to per protocol results. As there were no differences when comparing results of completers only or using intention-to-treat data, the latter’s pooled results will be reported. The mean pre- and post-treatment scores, the level of significance and statistical results for the various outcome measures used are shown in Table 4.

For both tinnitus questionnaires, there was a significant improvement post-intervention, underlined with a large effect size for the change in TFI score. Further analysis of the subcategories of the TFI indicated that there was a significant change in all eight categories of the TFI. There was a mean difference of 19.04 in the pre-post scores for the TFI. The RCI indicated a change of 23.86 in the TFI score was required post-intervention to be considered clinically significant. This was reached by 38% of participants (n=14).

The pre-treatment scores for many of the secondary outcome measures were below the level of clinical significance. Post-treatment improvements would, therefore, be unlikely. Only the ISI showed a significant change post-intervention, with the mean severity changing from “subthreshold significance” to “non-significant” results. This change represented a large-sized effect. No significant changes were found for questionnaires related to hearing handicap, hyperacusis, satisfaction with life, anxiety, depression and cognitive failures.
Possible outcome predictors

Partial correlations were calculated to determine which pre-intervention factors may be correlated to the post-treatment TFI score, whilst controlling for the effects of additional variables. There was a significant positive correlation between pre- and post-intervention TFI scores \([r(31)= .533, p=0.001]\). No correlation was found between post-intervention TFI outcome and level of education, employment status, duration of having tinnitus, age or gender. The only factor, therefore, possibly predicting greater post-treatment outcome, is higher pre-treatment TFI scores, although further randomised controlled trials with larger sample sizes are required to validate this finding.

Weekly monitoring

The THI-s was used to monitor change in tinnitus distress while undertaking the intervention, on a weekly basis. Some participants omitted to complete the weekly questionnaire some weeks (up to \(n=12\)), despite reminders. Overall there was a reduction in tinnitus handicap over time as seen in Figure 2. Comparing the results on a week-by-week basis, there was a significant difference found for the results of the THI-s between weeks 5 to 6 \([t=2.37 (25)=0.003]\) using paired sample t-tests. When comparing the beginning weeks of the intervention to the final weekly score of the THI-s, there were significant differences between weeks 1 through to 5, compared to week 8. This indicates that there needs to be a six-week time frame of intervention in order to start having a positive effect.

Satisfaction ratings

Participants rated their satisfaction of the intervention on a 1-5 Likert scale. Overall ratings were high with a rating of 85.8\% (mean score of 4.29 (SD=0.28). Feedback, on the whole, was positive, with comments such as “Thanks so much to you and the team, it is so great to
be doing something positive and taking control rather than just grinning and bearing my tinnitus which I had been doing until now.” During post-intervention phone calls participants shared how they valued having had the opportunity to participate and how much the intervention has helped.

Sample size calculations for further clinical trials

From these results, sample size requirements can be established for further clinical trials. Calculations indicated that 19 participants are required per group, based on achieving a significant between-group change of 19.04 points at a significance level of 0.05 and effect size of 0.9, when using G*Power version 3.1.6. Additional participants will, however, need to be recruited to account for possible drop-outs. This will ensure that the required power is achieved.

Discussion

Feasibility of iCBT in the UK

The aim of this study was to evaluate the feasibility of an Internet-based CBT treatment for tinnitus in the UK, using Audiologist support in an open trial design with 37 participants. This study forms an essential pre-requisite prior to undertaking large scale RCTs. When using an Audiologist to support iCBT, tinnitus severity was lowered as measured by all subscales of two tinnitus outcome measures. The Audiologist’s field of expertise was considered an advantage in addressing both tinnitus and hearing related concerns often contributing to the tinnitus. Although not directly comparable, the effect size indicated in this study is in line with that or similar open trials using an iCBT paradigm by Kaldo-Sandström et al (2004) and Kaldo et al (2013) who obtained medium effect sizes (Cohen’s $d = 0.56$ and 0.58
respectively) when using the Tinnitus Reaction Questionnaire (Wilson et al, 1991). Using an Audiologist instead of a Psychotherapist, therefore, appears feasible. Previous internet-based studies for depression, anxiety and social phobia have found comparable results, regardless of whether the therapist was a clinician or a technical assistant (Robinson et al, 2010; Titov et al, 2009 and Titov et al, 2010).

The RCI indicated that a difference of 23.96 for the TFI scores was required to be considered a clinically significant change. In this study, only 38% or participants achieved this. This RCI value is similar to the meaningful difference found by Fackrell et al, (2015) studying a group of research volunteers, although it differs from the 13 point difference indicated by Meikle et al (2012) studying a clinical population. This may be partly due to the population for our study and the Fackrell study both including research volunteers.

As tinnitus may be associated with various comorbidities, secondary outcome measures for hearing disability, anxiety, depression, insomnia, quality of life, cognitive failures and hyperacusis were included in this study. Results indicate an effect only on the ISI. There were no treatment effects seen on the outcome measures for hearing handicap, depression, anxiety, cognitive failures, hyperacusis, and satisfaction with life. Possible contributing factors may be related to the pre-treatment scores being low for these outcome measures and therefore unlikely to show a change post-intervention. This may in part be secondary to the feasibility study sample size, and a larger sample may be required before concrete conclusions can be drawn. A further explanation may be that the Audiologist may not have the expertise of a Psychologist at clarifying psychological concepts such as cognitive restructuring, and the approach may have differed. Further controlled trials are required to fully investigate the effects of the intervention on these secondary outcome measures. Participants were monitored.
on a weekly basis. Results indicated that it takes about 6 weeks of iCBT before reductions in tinnitus severity are experienced.

In terms of recruitment feasibility, take-up rates for the study were low. Musiat et al (2014) found that perceptions in the UK of computerised interventions were poor as more acceptance was found for face-to-face interventions. Acceptance rates appear to be higher where a culture of internet intervention is more established. For instance, Kaldo et al (2004) found that an internet programme for tinnitus was rated as acceptable as individual or group therapy. To improve recruitment rates, working on the public perceptions of such interventions within the UK will be required.

One concern about internet-delivered treatments is the possibility of a high dropout rate, especially in unguided interventions without therapist support (Eysenbach, 2005). In previous iCBT studies for tinnitus, attrition rates have varied greatly, between 5-57%, with the largest being due to methodological shortcomings in a study in Australia by Abbott et al (2009). Attrition rates for the present study fell within the middle of this range at 22%, however, the within-group design may have inflated these. Attrition rates within this region are on par with that found for traditional group-based CBT treatments for tinnitus (Kaldo et al, 2008), which is encouraging. Ensuring post-intervention questionnaire completion should be a key element in improving attrition in further trials. Arranging appointments for post-intervention telephone interviews may also improve these rates. Overall these attrition rates indicate the feasibility of iCBT within the UK and an effectiveness trial is warranted.

In terms of compliance, there was variability of engagement in the programme. Despite regular therapeutic encouragement, some participants struggled to engage with the intervention. Barriers to engagement included time constraints, work pressures, and poor
health. Bendelin et al (2011) reported that a key factor to successful outcomes with internet interventions is for participants to take responsibility and identify the link between their efforts and the resulting success. Donkin and Glozier (2012) investigated what influences persistence in online interventions. They found those that persisted could identify with the programme, were intrinsically motivated due to values about task completion and being able to see improvements and a sense of feeling in control. Although protocols were followed to mimic interventions provided with Psychotherapist support, it is possible that feedback from an Audiologist, as opposed to a Psychotherapist, may have contributed to the variability in engagement. Exploring and comparing the nature of this feedback is therefore of importance.

**Refining the protocol for further clinical trials**

An intervention such as this may be a useful supplement for standard clinical tinnitus care in the UK. As such it is essential to determine for which populations of those with tinnitus this may be a suitable intervention. Besides the initial pre-intervention TFI score, there were no significant predictors of post-treatment TFI scores, for educational level, employment status, tinnitus duration, age or gender. Inconclusive results have been found regarding characteristics that may affect outcomes for internet interventions, and previous studies have also suggested that gender, age, educational level, and computing skills do not affect the outcome (Andersson et al, 2009).

From the present study, it appears as though initial TFI scores may be an important factor in determining the outcome, although results require verification with larger samples. This is in line with findings that significant levels of tinnitus distress are required to serve as motivation to complete CBT programmes (Kaldo et al, 2013). This has implications for the inclusion criteria. If severity is mild, participants may not feel the need to commit to such a
A score of 26 or higher was suggested by Meikle et al, (2012) to be indicative of tinnitus requiring clinical intervention. Of the two participants with TFI scores lower than 26, one withdrew, expressing that their tinnitus was not severe enough to undergo an intervention. The other participant continued to participate and found great benefit from the study. However, for this participant, post-treatment scores were higher than his baseline scores. Due to his positive experience of the intervention, this was attributed to having filled in his initial questionnaire in a guarded manner. From this experience, we suggest that a telephone interview should be used to help decide whether initial scores were too guarded. The inclusion criteria of TFI score of 26 or higher would be recommended for further trials.

It is important to reach the intended population of those with significant levels of tinnitus who are not well supported. As the recruitment was largely through tinnitus support group networks, most of those who participated have tried various therapies in the past, which would have influenced their impressions of interventions. There are many who have tinnitus and have not received much intervention, and these people need to be targeted with wider recruitment strategies.

**Strengths and limitations of the study**

This study is of preparatory value for future iCBT controlled trials in the UK. Using an adapted intervention specifically for a UK population was a strength of the study. Keeping in line with current tinnitus management in the UK, using an Audiologist to deliver the treatment, was a further advantage. Further strengths lie in the comprehensive nature of the study, investigating the effects of the intervention on tinnitus and relating to areas that may be affected by tinnitus.
There were, however, some limitations which need to be considered for the planned randomised control trial. Baseline measurement may not have been stable, as test-retest effects were not accounted for. Furthermore, no control group was present, placebo effects cannot be discounted, and need to be considered during result interpretation. For the initial assessment demographical questions were not specific enough as questions related to age and tinnitus duration were categorised into broad groups. This questionnaire needs to be adjusted to ensure more accurate information is obtained during future studies. The recruitment strategy also requires improving to reach the target population of those with distressing tinnitus that are not well supported. This may be achieved by having a wider recruitment strategy by advertising in health magazines, local newspapers, and various Internet forums. Lastly, to improve attrition, scheduling post-intervention phone calls, should be introduced, as this may also serve as a motivator to encourage post-intervention questionnaire completion. One important aspect of feasibility that was not explored was participant’s willingness to be randomised. Exploring this aspect will be important during future randomised control trials.

**Future directions**

This study has provided encouraging results which need to be further explored in a randomised control trial. More research is required to determine the effect of the therapist variable (i.e. Psychotherapist versus Audiological Professional) on treatment outcomes. The longer term effects of this intervention as well as participants’ experiences with this intervention, should be established.

**Conclusions**
The use of an internet-based intervention for tinnitus in a UK population has been shown to be feasible. This study has been of value to identify sample size, possible barriers and refine the protocol for subsequent randomized controlled trials. Further research should focus on effectiveness trials.

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**Acknowledgements**

The authors wish to thank all participants and organisations that promoted and supported this study. We would also like to thank Linköping University for hosting the web portal and their webmaster, George Vlaescu, for technical assistance provided.

**Author’s contributions**

GA, VM. DB and PA conceived this study. GA developed the Swedish original iCBT intervention for tinnitus together with Viktor Kaldo, EB developed this version for a UK population, carried out the study, collected the data and drafted the manuscript. All authors critically revised and approved the manuscript.


Advertisements
Tinnitus and hearing charities, tinnitus support groups, Audiology departments. Those interested to find out more and register on the project’s website.

Online Screening
Demographics and baseline measurements completed by n=37

Telephone interview
n=37 to check eligibility and recap what the study involved

Intervention
n=37 included in a single group for the 8 week iCBT tinnitus intervention

Post-treatment questionnaires
n=35 invited to complete (excluded the n=2 transfers, included all drop-outs)

Included in result analysis
n=29 completed post-treatment questionnaires and were included in analysis

Study registrations
n=44 interested and invited to register and gave consent

Incomplete questionnaires
n=7 who registered did not complete the screening

No exclusions
n=2 were accepted despite low TFI scores (<26) to check the validity of the inclusion criteria

Drop-outs during the intervention
n=2 no longer required intervention as tinnitus had improved (Initial TFI scores were: 23.6 & 52.8)
n=1 found login and site navigation difficult

Transfers to the next study
n=2 unable to proceed due to medical issues

Non responders: n=6
- n=4 from treatment group
- n=2 from drop-out group
Figure 2: Weekly check-in scores over the eight-week treatment period
Overall there was a reduction
Table 1. Study outcome measures used pre- and post-intervention

<table>
<thead>
<tr>
<th>Outcome Measures delivered at enrolment and close out</th>
<th>Range of scores</th>
<th>Levels of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinnitus Functional Index (TFI; Meikle et al, 2012)</td>
<td>0-100</td>
<td>&gt;25 = mild</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26-50 = significant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50+ = severe</td>
</tr>
<tr>
<td>Tinnitus Handicap Inventory-Screening (THI-s; Newman et al, 2008)</td>
<td>0-40</td>
<td>&gt;6 tinnitus handicap</td>
</tr>
<tr>
<td>Hearing Handicap Inventory-Screening (HHI-s; Newman et al, 1991)</td>
<td>0-40</td>
<td>0-8 = 13% probability of HI, 10-24 = 50% probability of mild-moderate HI, 26-40 = 84% probability</td>
</tr>
<tr>
<td>Insomnia Severity Index (ISI; Bastien et al, 2001)</td>
<td>0-28</td>
<td>0–7 = Not clinically significant 8–14 = Subthreshold insomnia 15–21 = Clinical insomnia (moderate severity) 22–28 = Clinical insomnia (severe degree)</td>
</tr>
<tr>
<td>Cognitive Failures Questionnaire (CFQ; Broadbent et al, 1982)</td>
<td>0-100</td>
<td>Higher scores indicate more difficulties</td>
</tr>
<tr>
<td>Hyperacusis Questionnaire (Hyper. Q; Vernon, 1987)</td>
<td>0-42</td>
<td>&gt;28 strong hypersensitivity</td>
</tr>
<tr>
<td>Patient Health Questionnaire (PHQ-9; Spitzer et al, 1999)</td>
<td>0-28</td>
<td>5-9 = mild depression 10-14 = moderate 15-19 = moderately severe 20-18 = severe depression</td>
</tr>
<tr>
<td>Generalised Anxiety Disorder (GAD-7; Spitzer et al, 2006)</td>
<td>0-21</td>
<td>0-4 = minimal anxiety 5-9 = mild anxiety 10-14 = moderate anxiety 5-21 = severe anxiety</td>
</tr>
<tr>
<td>Satisfaction with Life Scales (SWLS; Diener et al, 1985)</td>
<td>0-35</td>
<td>0-9 = Extremely dissatisfied 10-14 = Dissatisfied 15-19 = Below average</td>
</tr>
<tr>
<td>satisfaction</td>
<td>20-24= Average satisfaction</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25-29= High satisfaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-35= highly satisfied</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Components involved in the intervention

<table>
<thead>
<tr>
<th>Obligatory modules</th>
<th>Optional modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Intervention outline</td>
<td>- Sound enrichment</td>
</tr>
<tr>
<td>- Tinnitus overview</td>
<td>- Sleep guidelines</td>
</tr>
<tr>
<td>- Progressive relaxation in six phases</td>
<td>- Concentration tips</td>
</tr>
<tr>
<td>- Positive imagery</td>
<td>- Sensitivity to sound</td>
</tr>
<tr>
<td>- Reinterpretation of tinnitus</td>
<td>- Hearing tactics</td>
</tr>
<tr>
<td>- Focus exercise</td>
<td></td>
</tr>
<tr>
<td>- Identifying negative thoughts</td>
<td></td>
</tr>
<tr>
<td>- Cognitive restructuring</td>
<td></td>
</tr>
<tr>
<td>- Exposure to tinnitus</td>
<td></td>
</tr>
<tr>
<td>- Summary</td>
<td></td>
</tr>
<tr>
<td>- Future planning</td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Demographic characteristics of the participants

<table>
<thead>
<tr>
<th>DEMOGRAPHICAL INFORMATION</th>
<th>Mean (SD) or number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18 (48.6%)</td>
</tr>
<tr>
<td>Female</td>
<td>19 (51.4%)</td>
</tr>
<tr>
<td><strong>Average Age Range</strong></td>
<td></td>
</tr>
<tr>
<td>50-59 years (SD= 1.32)</td>
<td></td>
</tr>
<tr>
<td>Range 18-80 years</td>
<td></td>
</tr>
<tr>
<td><strong>Tinnitus duration</strong></td>
<td></td>
</tr>
<tr>
<td>3-12 months: 4 (10.8%)</td>
<td></td>
</tr>
<tr>
<td>1-5 years: 16 (43.2%)</td>
<td></td>
</tr>
<tr>
<td>5-10 years: 6 (16.2%)</td>
<td></td>
</tr>
<tr>
<td>10+ years: 11 (29.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Location of tinnitus</strong></td>
<td></td>
</tr>
<tr>
<td>Both ears 17 (45.9%)</td>
<td></td>
</tr>
<tr>
<td>Head/unsure: 7 (18.9%)</td>
<td></td>
</tr>
<tr>
<td>Left ear: 7 (18.9%)</td>
<td></td>
</tr>
<tr>
<td>Right ear: 6 (16.2%)</td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of tinnitus</strong></td>
<td></td>
</tr>
<tr>
<td>Constant: 22 (59.5%)</td>
<td></td>
</tr>
<tr>
<td>Most of the time: 14 (37.8%)</td>
<td></td>
</tr>
<tr>
<td>Without hearing aids: 1 (2.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Seen a GP/ ENT due to tinnitus</strong></td>
<td>35 (94.6%)</td>
</tr>
<tr>
<td><strong>Previous treatment for tinnitus received</strong></td>
<td>16 (43.2%)</td>
</tr>
<tr>
<td><strong>Read up about tinnitus</strong></td>
<td>34 (91.9%)</td>
</tr>
<tr>
<td><strong>Hearing loss reported</strong></td>
<td>26 (70.3%)</td>
</tr>
<tr>
<td><strong>Hearing aids used</strong></td>
<td>10 (27%)</td>
</tr>
<tr>
<td><strong>Highest Educational level</strong></td>
<td>School: 11 (29.7%)</td>
</tr>
<tr>
<td></td>
<td>College/ vocational training: 10 (27%)</td>
</tr>
</tbody>
</table>
Undergraduate degree 14 (37.8%)
Postgraduate degree: 2 (5.4%)

<table>
<thead>
<tr>
<th>Employment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager/Professional:</td>
<td>10 (27%)</td>
</tr>
<tr>
<td>Skilled tradesman/ technical</td>
<td>5 (13.5%)</td>
</tr>
<tr>
<td>Homemaker/Service occupation</td>
<td>4 (10.8%)</td>
</tr>
<tr>
<td>Retired</td>
<td>16 (43.2%)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>16 (5.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Working less due to tinnitus</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopped working</td>
<td>8 (21.6%)</td>
</tr>
<tr>
<td>Reduced hours</td>
<td>1 (2.7%)</td>
</tr>
</tbody>
</table>
Table 4: Pre- and post-intervention comparisons for the various outcome measures using corrected values from the intention-to-treat data

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Pre-Intervention Mean (SD)</th>
<th>Post-Intervention Mean (SD)</th>
<th>Level of significance</th>
<th>Effect size, Cohen's $d$</th>
<th>$t$-test (significant *)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFI</td>
<td>56.15 (18.35)</td>
<td>37.35 (19.49)</td>
<td>Pre: severe</td>
<td>1.18</td>
<td>$t(36)=6.26$; $p = 0.001^*$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post: significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THI-S</td>
<td>22.49 (7.69)</td>
<td>13.55 (9.31)</td>
<td>Pre&amp;Post: Tinnitus handicap</td>
<td>0.38</td>
<td>$t(36)=7.91$; $p = 0.001^*$</td>
</tr>
<tr>
<td>HHIA-S</td>
<td>15.14 (12.42)</td>
<td>12.87 (10.06)</td>
<td>Pre&amp;Post:</td>
<td>0.06</td>
<td>$t(36)=1.32$; $p=0.197$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50% probability of hearing handicap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAD-7</td>
<td>7.59 (5.28)</td>
<td>5.56 (4.74)</td>
<td>Pre&amp;Post: Mild anxiety</td>
<td>0.10</td>
<td>$t(36)=3.74$ $p=0.068$</td>
</tr>
<tr>
<td>Measure</td>
<td>Pre (SD)</td>
<td>Post (SD)</td>
<td>Pre&amp;Post:</td>
<td>t(36)</td>
<td>p</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-------</td>
<td>---</td>
</tr>
<tr>
<td><strong>PHQ-9</strong></td>
<td>7.35 (6.37)</td>
<td>5.68 (4.89)</td>
<td>Mild depression</td>
<td>0.37</td>
<td>t(36)=1.73; p=0.085</td>
</tr>
<tr>
<td><strong>ISI</strong></td>
<td>11.73 (5.27)</td>
<td>7.04 (4.81)</td>
<td>Pre: subthreshold insomnia</td>
<td>1.20</td>
<td>t(36)=5.54; p=0.001*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post: no significant insomnia</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SWLS</strong></td>
<td>16.12 (6.76)</td>
<td>17.45 (7.43)</td>
<td>Below average satisfaction</td>
<td>0.28</td>
<td>t(36)=-1.22; p=0.249</td>
</tr>
<tr>
<td><strong>Hyper. Q</strong></td>
<td>19.22 (10.06)</td>
<td>16.23 (9.68)</td>
<td>Subthreshold hyperacusis</td>
<td>0.29</td>
<td>t(36)=1.71; p=0.103</td>
</tr>
<tr>
<td><strong>CFQ</strong></td>
<td>36.14 (15.22)</td>
<td>34.4 (15.04)</td>
<td>Lower range of cognitive problems</td>
<td>0.16</td>
<td>t(36)=0.68; p=0.502</td>
</tr>
</tbody>
</table>