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A Preliminary Analysis of the Clinical Effectiveness of Audiologist-Delivered Cognitive Behavioral Therapy Delivered via Video Calls for Rehabilitation of Misophonia, Hyperacusis, and Tinnitus

Hashir Aazh,[a,b] Anahita Najjari,[a] and Brian C. J. Moore[a,c]

[a] Hashir International Specialist Clinics & Research Institute for Misophonia, Tinnitus and Hyperacusis, London, United Kingdom [b] Faculty of Engineering and Physical Sciences, University of Surrey, United Kingdom [c] Cambridge Hearing Group, Department of Psychology, University of Cambridge, United Kingdom

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ABSTRACT

Purpose: Cognitive behavioral therapy (CBT) is a key intervention for management of misophonia, hyperacusis, and tinnitus. The aim of this study was to perform a preliminary analysis comparing the scores for self-report questionnaires before and after audiologist-delivered CBT via video calls for adults with misophonia, hyperacusis, or tinnitus or a combination of these.
Method: This was a retrospective cross-sectional study. The data for 37 consecutive patients who received CBT for misophonia, hyperacusis, or tinnitus from a private institute in the United Kingdom were analyzed. Self-report questionnaires taken as part of routine care were as follows: 4C Questionnaires for tinnitus, hyperacusis, and misophonia (4C-T, 4C-H, and 4C-M, respectively), Tinnitus Impact Questionnaire (TIQ), Hyperacusis Impact Questionnaire (HIQ), Misophonia Impact Questionnaire (MIQ), Sound Sensitivity Symptoms Questionnaire (SSSQ), and Screening for Anxiety and Depression in Tinnitus (SAD-T). Responses were also obtained to other questionnaires related to tinnitus, hyperacusis, insomnia, and anxiety and mood disorders. A linear mixed-model method was used to assess the changes in response to the questionnaires pretreatment and posttreatment.
Results: Pretreatment–posttreatment comparisons showed that scores for the 4C-T, 4C-H, 4C-M, TIQ, HIQ, MIQ, SSSQ, and SAD-T improved, with effect sizes of 1.4, 1.2, 1.3, 2.6, 0.9, 0.7, 0.9, and 1.4, respectively (all $p < .05$).
Conclusions: This preliminary analysis suggests that CBT via video calls may be effective in reducing the impact of misophonia, hyperacusis, and tinnitus. However, this study did not have a control group, so its results need to be interpreted with caution.

Misophonia is characterized by reduced tolerance to one or more specific sound(s) or stimuli associated with such sounds (Swedo et al., 2022). Common triggers include but are not limited to sounds associated with oral functions, nasal sounds, nonoral/nasal sounds produced by people, and sounds produced by objects or sounds generated by animals (Hansen et al., 2021; Swedo et al., 2022). Misophonia can limit the individual's social life and lead to functional impairment, worse general health status, and poorer quality of life compared to the general population (Dibb & Golding, 2022; Holohan et al., 2023; Jakubovski et al., 2022; Möllmann et al., 2023). About 18% of the U.K. population are estimated to have symptoms of misophonia that can have a significant impact on their life (Vitoratou et al., 2023). Individuals with misophonia often exhibit emotional problems, avoidance behaviors, perfectionism, cognitive distortions, anxiety disorders, and

Correspondence to Hashir Aazh: info@hashirtinnitusclinic.com. ***Disclosure:*** *Hashir Aazh is the director of Hashir International Specialist Clinics & Research Institute for Misophonia, Tinnitus and Hyperacusis Ltd, whose data are used for this study. The other authors have declared that no competing financial or nonfinancial interests existed at the time of publication.*

depression (Dibb & Golding, 2022; Guetta et al., 2022; Jakubovski et al., 2022; Paunovic & Milenković, 2022; Remmert et al., 2022; Rosenthal et al., 2022; Siepsiak et al., 2022; Wang et al., 2022; Yektatalab et al., 2022). Several case reports suggest that cognitive behavioral therapy (CBT) can be effective in alleviating the effect of misophonia on the patient's life (Bernstein et al., 2013; McGuire et al., 2015; Roushani & Mehrabizadeh Honarmand, 2021). Group CBT has also been shown to be effective in helping patients to manage their misophonia (Ghorbani et al., 2022; Jager et al., 2021).

Hyperacusis is the perception of certain everyday sounds, such as domestic noise or noise in public places, as too loud or painful in such a way that it causes significant distress and impairment in social, occupational, recreational, and other day-to-day activities (Aazh et al., 2014, 2016; Fagelson & Baguley, 2018). A systematic review reported that the prevalence of hyperacusis in the general population varies across studies from less than 1% to 17% (Ren et al., 2021). Individuals with hyperacusis often exhibit high levels of stress, poorer mental and physical health, and lower quality of life than the general population (Fackrell et al., 2022; Manohar et al., 2023; Sacchetto et al., 2022). CBT has been shown to be an acceptable treatment for hyperacusis from the perspective of patients (Aazh, Bryant, & Moore, 2019). Several studies reported that CBT delivered in face-to-face sessions reduces the impact of hyperacusis on the patient's life and improves the associated symptoms of anxiety and depression (Aazh & Moore, 2018a; Juris et al., 2014; Nolan et al., 2020).

Tinnitus is the perception of sound in the absence of acoustic stimuli external to the body. Tinnitus can lead to emotional distress, cognitive dysfunction, autonomic arousal, behavioral changes, and functional disability, in which case it is called tinnitus disorder (De Ridder et al., 2021). The prevalence of tinnitus in the adult population is estimated to be about 14% (Jarach et al., 2022). Patients with tinnitus disorder often exhibit symptoms of anxiety, depression, insomnia, suicidal and self-harm ideations, and have poor quality of life (Aazh, Baguley, & Moore, 2019; Aazh & Moore, 2017a, 2018c; Asnis et al., 2018; Bhatt et al., 2017; Boecking et al., 2021; Salazar et al., 2019). Several randomized controlled trials (RCTs) and uncontrolled retrospective clinical studies reported that CBT is acceptable and effective for the management of tinnitus, whether delivered by psychologists or audiologists (Aazh, Bryant, & Moore, 2019; Aazh & Moore, 2018a, 2018b; Barry & Marks, 2023; Beukes et al., 2018; Cima et al., 2012).

To sum up, several studies support the efficacy of CBT for the rehabilitation of patients with misophonia, hyperacusis, and tinnitus (Aazh & Allott, 2016; Aazh, Bryant, & Moore, 2019; Aazh & Moore, 2018a, 2018b; Cima et al., 2012; Jager et al., 2021; Jüris et al., 2014; Martinez-Devesa et al., 2010; Schroder et al., 2017). However, the method of delivering CBT in all these studies was largely via face-to-face sessions. The effectiveness of audiologist-delivered CBT for misophonia, hyperacusis, and tinnitus delivered via video calls has not, to our knowledge, been reported.

During the COVID-19 pandemic, demand for telehealth increased considerably (Wosik et al., 2020). Audiologist-delivered CBT given via video calls seems to be acceptable to most patients with tinnitus (Aazh et al., 2021). However, it is important to assess whether CBT delivered by audiologists via video calls is effective for the management of misophonia, hyperacusis, and tinnitus. The aims of this study were (a) to compare responses to self-report questionnaires before and after CBT delivered by audiologists via video calls to adults with misophonia, hyperacusis, and tinnitus and (b) to assess factors related to the treatment outcome.

Method

Ethical Approval

All participants agreed that their anonymized data could be used for service improvement and research purposes. Informed consent was waived because routine clinical data were analyzed retrospectively. The study was approved by the University of Surrey Ethics Committee (Project ID: FHMS 21–22 147 EGA).

Study Design and Patients

The study was conducted at Hashir International Specialist Clinics & Research Institute for Misophonia, Tinnitus and Hyperacusis (for brevity, from now on Hashir International Institute [HII]), Guildford and London, United Kingdom. The study population comprised 37 consecutive patients who received a full course of CBT for misophonia, hyperacusis, tinnitus, or some combination of these, delivered by audiologists via video calls, during 2021–2022 at HII. Demographic data for the patients and the outcomes of their self-report questionnaires were imported from records held at the clinic.

As a part of history taking, each patient was asked: (a) if they had been prescribed any drugs for a psychiatric condition or if they were undergoing any form or therapy in addition to CBT; (b) if they had ever received a diagnosis of mental illness (denoted History of Mental Health Problems, HMH); and (c) if they had ever seen a mental health professional (denoted Seen Mental Health professional, SMH). Parental mental health was assessed using a question adopted from the questionnaire for Adverse

Childhood Experiences (Anda et al., 2006; Felitti et al., 1998). The question was, "While you were growing up during the first 18 years of life, did your parent(s) have depression or mental illness?" (Felitti et al., 1998). The response alternatives were "yes" or "no." The test–retest reliability for this question is moderate (Cohen's $\kappa = .48$, $SE = 0.052$, 95% confidence interval [CI] [0.37, 0.58]; Dube et al., 2004).

Diagnosis of Misophonia, Hyperacusis, and Tinnitus

The diagnosis of clinically significant misophonia, hyperacusis, and/or tinnitus was based on a clinical interview conducted by audiologists specialized in the management of those disorders. The criteria described by Aazh, Hayes, et al. (2024) and Aazh, Moore, et al. (2023) were used for the diagnosis of misophonia and hyperacusis. In short, for a positive diagnosis of misophonia and/or hyperacusis, the person's sound intolerance should adversely affect their day-to-day activities, or their mood, or their ability to rest and relax, or the person should use avoidance behaviors or rituals to cope with the sounds that bother them. A sensitivity to certain sounds without this having a significant impact on their day-to-day life was not sufficient for a diagnosis of hyperacusis or misophonia. A positive diagnosis of hyperacusis required the person to perceive some sounds as too loud, uncomfortable, or painful, their main complaint not being related to decreased tolerance to typical misophonia trigger sounds (i.e., oral and nasal sounds or repetitive sounds made by humans or machines). In contrast, a positive diagnosis of misophonia required the person to perceive misophonia trigger sounds as disgusting, offensive, or annoying, their primary reaction to such sounds not being aural pain or physical discomfort due to excessive loudness. In addition, for a positive diagnosis of hyperacusis or misophonia, the person's sound intolerance should not be better explained by their general attitude toward noise and environmental noise pollution (e.g., noise from neighbors, nearby airports, traffic, workshops, internal plumbing, air conditioning). This was intended to differentiate hyperacusis and misophonia from noise sensitivity, which is known as a personality trait (Kishikawa et al., 2006). Finally, the person's sound intolerance symptoms should not be better explained by other underlying medical or psychosocial conditions.

Clinically significant tinnitus, also known as tinnitus disorder (De Ridder et al., 2021), was diagnosed if the person showed at least one of the first four characteristics listed next in addition to Characteristic 5:

1. Tinnitus interrupts some day-to-day tasks or activities.
2. Tinnitus adversely affects mood.
3. Tinnitus adversely affects resting, relaxing, or sleeping.
4. The person uses avoidance behaviors or rituals to cope with their tinnitus.
5. The effect on the person's activities, mood, or behaviors is related to the experience of tinnitus and is not better explained by other underlying medical or psychosocial conditions.

Self-Report Questionnaires

Several self-report questionnaires were completed during the assessment session before the start of the treatment and again at the end of the last session. The self-report measures used can be divided into two distinct groups: (a) disease-specific questionnaires for misophonia, hyperacusis, and tinnitus, and (b) mental health questionnaires. Table 1 lists the disease-specific questionnaires, which include the 4C Questionnaires for tinnitus, hyperacusis, and misophonia (4C-T, 4C-H, and 4C-M, respectively; Aazh, Kartsonaki, & Moore, 2024); Tinnitus Impact Questionnaire (TIQ; Aazh, Hayes, et al., 2023); Hyperacusis Impact Questionnaire (HIQ; Aazh et al., 2022); Misophonia Impact Questionnaire (MIQ; Aazh, Moore, et al., 2023); Sound Sensitivity Symptoms Questionnaire (SSSQ; Aazh et al., 2022); Tinnitus Handicap Inventory (THI; Newman et al., 1996); Hyperacusis Questionnaire (HQ; Khalfa et al., 2002); Inventory of Hyperacusis Symptoms (IHS; Greenberg & Carlos, 2018); and Visual Analog Scale (VAS; Maxwell, 1978).

Table 2 summarizes the questionnaires assessing constructs (mainly mental illness) that are related and/or coexist with misophonia, tinnitus, and hyperacusis. These include the Screening for Anxiety and Depression in Tinnitus (SAD-T; Aazh et al., 2022), Generalized Anxiety Disorder Questionnaire (GAD-7; Spitzer et al., 2006), Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001), Short Health Anxiety Inventory (SHAI; Abramowitz et al., 2007), The Mini-Social Phobia Inventory (Mini-SPIN; Connor et al., 2001), Obsessive Compulsive Inventory–Revised (OCI-R; Foa et al., 2002), Panic Disorder Severity Scale-Self Report (PDSS-SR; Houck et al., 2002), Penn State Worry Questionnaire–Abbreviated (PSWQ-A; Hopko et al., 2003), and Insomnia Severity Index (ISI; Bastien et al., 2001). Table 2 also shows the cutoff scores for the psychological questionnaires, as recommended by the U.K. mental health system (Improving Access to Psychological Therapies, 2011). These cutoff scores were used in the present study.

All of these questionnaires were completed as part of the routine care at HII. Patients completed these questionnaires online without involvement of their audiologist.

Table 1. The table shows the number of items, scoring, and internal reliability (as measured via Cronbach's alpha) of the disease-specific self-report questionnaires used in the study.

Name	Number of items	Scoring	Cronbach's alpha
4C Questionnaires for tinnitus, hyperacusis, or misophonia (4C-T, 4C-H, 4C-M, respectively)	4	Total score ranges between 0% and 100%. Higher scores indicate more confidence in managing their symptoms.	.91 for 4C-T Not reported for 4C-H and 4C-M
Tinnitus Impact Questionnaire (TIQ)	7	Total score ranges between 0 and 21. TIQ score < 5 = no impact, TIQ score of 5 or 6 = mild impact, TIQ score of 7 or 8 = moderate impact, and TIQ score ≥ 9 = severe impact.	.89
Hyperacusis Impact Questionnaire (HIQ)	8	Total score ranges between 0 and 24. HIQ score > 11 shows presence of clinically significant hyperacusis impact.	.93
Misophonia Impact Questionnaire (MIQ)	8	Total score ranges between 0 and 24.	.94
Sound Sensitivity Symptoms Questionnaire (SSSQ)	5	Total score ranges between 0 and 15. SSSQ scores ≥ 5 shows presence of sound tolerance problems.	.87
Tinnitus Handicap Inventory (THI)	25	Total score ranges between 0 and 100. THI score ≤ 16 shows no handicap, scores between 18 and 36 show mild handicap, scores between 38 and 56 show moderate handicap, and scores ≥ 58 show severe tinnitus handicap.	.93
Hyperacusis Questionnaire (HQ)	14.	Total score ranges between 0 and 42. HQ scores ≥ 22 shows presence of hyperacusis handicap.	.88
Inventory of Hyperacusis Symptoms (IHS)	25	Total score ranges from 25 to 100. IHS score ≥ 56 shows the presence of hyperacusis.	.96
Visual Analog Scale of Tinnitus Loudness, Annoyance and Effect on Life (VASL, VASA, and VASE, respectively)	3	0–10	Not reported

Table 2. Summary of information about the items, scoring, and internal reliability (as measured via Cronbach's alpha) of questionnaires assessing mental illness and insomnia that may be related to and/or coexist with misophonia, tinnitus, and hyperacusis.

Name	Number of items	Scoring	Cronbach's alpha
Screening for Anxiety and Depression in Tinnitus (SAD-T)	4	Total score ranges between 0 and 12. SAD-T score ≥ 4 shows possible anxiety and/or depression.	.91
Generalized Anxiety Disorder Questionnaire (GAD-7)	7	The total score ranges between 0 and 21. GAD-7 score ≥ 8 indicates anxiety.	.92
Patient Health Questionnaire (PHQ-9)	9	The total score ranges between 0 and 27. PHQ-9 score ≥ 10 indicates presence of depression. The response to item 9 of the PHQ-9 is denoted SUI (expressing suicidal or self-harm ideation).	.89
Short Health Anxiety Inventory (SHAI)	18	The total score ranges between 0 and 54. SHAI score ≥ 18 indicates presence of health anxiety.	.96
Mini-Social Phobia Inventory (Mini-SPIN)	3	The total score is between 0 and 12. Mini-SPIN score ≥ 6 indicates social phobia.	.94
Obsessive Compulsive Inventory–Revised (OCI-R)	18	Total scores range from 0 to 72. OCI-R score ≥ 21 indicates presence of OCD.	.81
Panic Disorder Severity Scale-Self Report (PDSS-SR)	7	The total score is between 0 and 28. PDSS-SR score ≥ 8 indicates presence of panic disorder.	.92
Penn State Worry Questionnaire–Abbreviated (PSWQ-A)	8	The total score is between 8 and 40. PSWQ-A score ≥ 23 indicates presence of anxiety.	.89
Insomnia Severity Index (ISI)	7	The total score ranges from 0 to 28. ISI score ≥ 8 indicates presence of insomnia.	.74

Audiologist-Delivered CBT

Audiologist-delivered CBT sessions were performed online using video calls. The therapy program involved 14 one-to-one sessions. The first 10 sessions were weekly. Then the gap between sessions increased to 2 weeks, 1 month, 3 months, and 6 months. Each session lasted between 45 and 60 min. The self-report questionnaires described earlier were administered prior to the first CBT session and at the final session (Session 14), which acted as a 6-month follow-up.

The content of the intervention was consistent with the key CBT theories and methods (Beck, 2011; Greenberger & Padesky, 2015). However, unlike general CBT methods, the strategies used in these 14 sessions were fine-tuned to address the issues that were specific to the distress caused by the tinnitus, hyperacusis, and misophonia (Aazh, Landgrebe, et al., 2019; Aazh & Moore, 2022). Table 3 summarizes the actions taken during each CBT session. The actions needed to be adjusted based on the patient's needs. Throughout, the principle of guided discovery (Todd & Freshwater, 1999) was employed, in that the patient made discoveries with the help of careful questioning from the audiologist rather than the audiologist giving information and advice.

Training of Audiologists

The CBT was delivered by three qualified audiologists who specialized in rehabilitation of misophonia, hyperacusis, and tinnitus. They attended a 1-year training course based on CBT. The course included (a) lectures, practical training, and multiple-choice assessment (26 hr of Continuing Professional Development [CPD] or Continuing Education Units [CEU] points for lectures, 18 hr of CPD/CEU points for clinical supervision/case study sessions, 1 hr of CPD/CEU points for multiple-choice tests); (b) directed self-study (85 hr of reading and working through the provided/recommended course materials to complete the case studies and written assignments); and (c) self-directed study (20 hr of general reading around the subject and contributing to an online discussion forum). After attending the course, the audiologists received ongoing coaching and clinical supervision from the first author and another clinical supervisor, during which they could discuss their difficult patients and receive feedback and additional informal training when indicated.

Data Analysis

The data were anonymized prior to conducting statistical analyses. The statistical analyses were performed

Table 3. Illustration of the general structure of the cognitive behavioral therapy (CBT) program and summary of the tasks performed in each of the CBT sessions.

Session	Actions taken in each session
Session 1	Rapport building and getting to know the patient. Misophonia/hyperacusis/tinnitus education. Enhancing patient's motivation for CBT.
Session 2	Creating a CBT formulation, which is a model demonstrating how the patient's thought process and their emotional and behavioral reactions to tinnitus or the trigger sounds (in the case of hyperacusis or misophonia) create a vicious cycle of distress. Discussing the formulation. Encouraging the patient to list their avoidance and ritualist behaviors and to plan to modify them.
Session 3	CBT education: patients learning theoretical underpinnings of CBT and its relevance to the management of misophonia/hyperacusis/tinnitus. Introducing the Diary of Thoughts and Feelings (DTF): This helps the patient to learn how to identify and modify their tinnitus/sound-related erroneous thoughts and consequential emotions. SEL: This is an acronym for a CBT exercise (*Stop–Expose–Learn*) in which the patient is encouraged to *Stop* avoidance behaviors and rituals, *Expose* themselves to tinnitus and/or trigger sounds, and *Learn* from it.
Session 4	Review DTF. Review and escalate SEL.
Session 5	Explore thoughts on DTF. Identify the patient's key troublesome negative thoughts, also known as "*hot thoughts*." Review and escalate SEL.
Session 6	Educate on thought distortions. Identify thought distortions in DTF. Review and escalate SEL.
Session 7	Introduce counterstatements. Review and escalate SEL.
Session 8	Review counterstatements. Review and escalate SEL.
Session 9	Create list of negative thoughts and corresponding counterstatements. Review and escalate SEL.
Session 10	Introduce KKIS: This is an acronym for a CBT exercise (Know, Keep on, Identify & Substitute) in which the patient learns to Know in what circumstances they need to do CBT, practice Keeping on and not to be afraid of experiencing the negative emotions, Identify and analyze their thoughts and if they are irrational, then Substitute them with alternative thoughts, which are known as counterstatements.
Session 11	Review KKIS. Progress review.
Session 12	Review KKIS and problem solving.
Session 13	Review KKIS and problem solving. How to manage setbacks.
Session 14	Final review. CBStyle: learn how to integrate CBT into lifestyle.

Note. This was used as a general guide and was adjusted based on the needs of individual patients.

using R software. To account for the non-independence of observations inherent in repeated-measures data, and to address the unbalanced design and missing data, a linear mixed-model (LMM) approach was adopted.

Diagnostic groups with a sample size of two or less, as noted in Table 4, were excluded from the LMM analyses. Fixed-effects factors in the analysis were time (pre-/posttreatment), diagnostic category for categories with a sample size of three or more (denoted diagnosis: tinnitus = T, misophonia = M, and tinnitus with hyperacusis = TH), Drug (psychiatric medication or psychological therapies in addition to CBT; yes/no), and gender (male/female). A random intercept for patients was included to account for within-subject correlations in the random-effects design matrix.

All continuous outcomes from each questionnaire were analyzed using LMMs with maximum-likelihood estimation, implemented in the lme4 package (Bates et al., 2015). A Gamma generalized linear mixed model was used to meet the normality assumption for the PDSS-SR questionnaire. Statistical significance was defined as a p value $< .05$. Effect sizes (ESs) were reported using Hedges' g to correct for small sample sizes, with small ($g = 0.2$), medium ($g = 0.5$), and large ($g = 0.8$) effects (Hedges & Olkin, 2014). The Satterthwaite adjustment was applied to compute the degrees of freedom (Keselman et al., 1999). Significant main effects of diagnosis led to post hoc pairwise comparisons with Bonferroni adjustments for multiple comparisons.

In the present study, only the main effects were analyzed due to the extensive number and type of questionnaires administered and the relatively small sample sizes for certain groups. Interaction effects like Time × Diagnosis or Time × Diagnosis × Drug, as well as random slopes, were not included due to these constraints.

ESs are reported solely for pretreatment/posttreatment comparisons. Some of the patients did not complete all of the self-report questionnaires due to time constraints. The number of patients included in each analysis (n) is reported wherever indicated.

Results

Characteristics of the Study Population

The average age of the patients was 45.4 years (SD = 17 years, range: 17–78 years), and 46% were male. Among the patients, 38.5% were either taking psychiatric medication or undergoing psychological therapies in addition to CBT. A history of diagnosed mental illness was present for 73% of patients, and 78% had seen mental health professionals. While they were growing up during the first 18 years of life, 65% reported that one or both of their parents had depression or mental illness. Based on scores for the THI and TIQ, 93% and 95% of patients with tinnitus (with or without hyperacusis/misophonia) had some level of tinnitus handicap, respectively. Based on scores for the SAD-T screening questionnaire, 89% of patients had symptoms of anxiety and/or depression. Using two more comprehensive questionnaires, namely, the PHQ-9 and GAD-7, 78% and 80.5% of patients had symptoms of depression and anxiety, respectively. Based on their responses to Question 9 of the PHQ-9, 62% of patients expressed suicidal ideations. Sleep disturbances as measured via the ISI were reported by 81% of patients. Based on the clinical interview, 33% had tinnitus only (T), 3% had hyperacusis only (H), 24% had misophonia only (M), 35% had tinnitus combined with hyperacusis (TH), and 5% had tinnitus combined with hyperacusis and misophonia (THM).

Noncompletion Rate

During 2021–2022, 41 patients enrolled in the treatment but only 37 completed the course, giving a completion rate of 90%. Among the four patients who did not complete their treatment, two had tinnitus and hyperacusis, one had tinnitus, and one had misophonia. For 3/4, the reason for discontinuing the therapy was that they felt that they did not need any further help as they were managing their symptoms well or their tinnitus/hyperacusis was no longer a priority for them due to other health or social circumstances. One patient completed 12 sessions but was lost to follow-up at Sessions 13 and 14, for reasons unknown to us.

Pre–Post Comparisons for Questionnaires

Table 4 shows the mean scores for the questionnaires before and after treatment for each diagnostic group. When only one patient fell in a given diagnostic group, the score for the individual patient is reported. The T, M, and TH groups had more than two patients, so the pre–post comparisons and post hoc analyses were focused on them.

Table 5 compares the proportion of patients with abnormal scores for the self-report measures for groups T, M, and TH. Compared to groups T and M, group TH had the highest proportion of patients with abnormal scores for measures of hyperacusis (HQ, HIQ, SSSQ), depression (PHQ-9), generalized anxiety (GAD-7, PSWQ, SAD-T), and health anxiety (SHAI). Patients in group TH also had the highest incidence of suicidal ideations, history of mental illness, and parental mental illness in their childhood. Group M had the highest proportion of patients with abnormal scores for measure of misophonia (MIQ), social anxiety (Mini-SPIN), and obsessive–compulsive disorder (OCD; OCI-R). Group M had the

Table 4. Sample size, mean, and standard deviation for the self-report questionnaires for each diagnostic category.

	T		H		M		TH		THM	
Questionnaire	***n***	***M* (*SD*)**	***n***	***M* (*SD*)**	***n***	***M* (*SD*)**	***n***	***M* (*SD*)**	***n***	***M* (*SD*)**
4C - Tinnitus										
Pre	12	11.5 (8.9)	0	NA	0	NA	11	19.7 (17.8)	0	NA
Post	12	56.5 (33.1)	0	NA	0	NA	11	49 (34)	0	NA
4C - Hyperacusis										
Pre	0	NA	1	0	0	NA	7	13 (5.7)	0	NA
Post	0	NA	1	22	0	NA	7	27 (11)	0	NA
4C - Misophonia										
Pre	0	NA	0	NA	9	16.7 (5.3)	0	NA	0	NA
Post	0	NA	0	NA	9	26.1 (7.4)	0	NA	0	NA
TIQ										
Pre	8	17.5 (3.2)	0	NA	0	NA	11	16 (4.6)	1	19
Post	8	4.4 (4.5)	0	NA	0	NA	11	5.2 (5.5)	1	7
HIQ										
Pre	8	8 (6.9)	1	22	9	8.8 (8.2)	11	18.5 (6.9)	1	21
Post	6	2.2 (3.1)	1	5	8	4.1 (3.3)	9	6.6 (7.3)	1	13
MIQ										
Pre	8	1.6 (2.1)	1	0	9	17.8 (5.6)	11	7.4 (7.5)	1	17
Post	6	1.0 (2.4)	0	NA	9	9.2 (8.3)	8	3.2 (4.7)	1	14
SSSQ										
Pre	11	3.7 (3.5)	1	11.0	9	3.4 (1.6)	13	10.4 (5.1)	2	13 (2.8)
Post	9	1.4 (1.8)	1	5.0	8	2.2 (1.4)	9	3.3 (3.4)	1	1.00
SADT										
Pre	11	8.5 (3.9)	1	7	9	5.9 (3.5)	13	10 (2.5)	2	6.5 (0.7)
Post	10	1.8 (2.2)	1	0	8	3.6 (3.5)	10	3.8 (3.2)	1	2
THI										
Pre	12	80.5 (15)	0	NA	0	NA	13	65.8 (16.5)	2	64 (11.3)
Post	9	30.7 (28)	0	NA	0	NA	9	27.6 (21.8)	1	44
HQ										
Pre	11	17.1 (9.9)	1	33	9	21.7 (10)	13	24 (11)	2	21.5 (4.9)
Post	7	10.3 (6.4)	0	NA	7	18 (5.7)	9	16.4 (11)	1	18
ISI										
Pre	12	22.1 (4.8)	1	4	9	6.7 (5.0)	13	17.2 (8.0)	2	10 (8.5)
Post	9	9. 6 (7.7)	0	NA	6	5.8 (4.1)	8	7.4 (7.8)	1	2.00
VASL										
Pre	12	7.8 (1.6)	0	NA	0	NA	13	7.2 (2.0)	2	9 (1.4)
Post	9	6.1 (2.3)	0	NA	0	NA	9	4.1 (2.8)	1	8.00

(*table continues*)

Table 4. *(Continued).*

Questionnaire	T		H		M		TH		THM	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
VASA										
Pre	12	8.5 (1.2)	0	NA	0	NA	13	8.1 (2.0)	2	8 (1.4)
Post	9	4.7 (2.6)	0	NA	0	NA	9	3.9 (3.0)	1	8
VASE										
Pre	12	8.4 (1.7)	0	NA	0	NA	13	8.1 (2.1)	2	8 (0)
Post	9	3.6 (3)	0	NA	0	NA	9	3.9 (3.7)	1	8
GAD-7										
Pre	12	13.3 (7.5)	1	11	8	10.9 (6.1)	13	16.5 (3.5)	2	10 (1.4)
Post	9	4.8 (4.5)	0	NA	5	9.0 (6.0)	9	8.0 (4.9)	2	6.5 (6.4)
PHQ-9										
Pre	12	15.4 (7.1)	1	10	8	8.4 (5.6)	13	18.5 (5.2)	2	9 (2.8)
Post	9	4.8 (4.6)	0	NA	7	5.3 (4.5)	9	7.2 (6.7)	2	7.5 (4.9)
SHAI										
Pre	12	18.2 (6.7)	1	20	8	17.2 (9.1)	13	24.2 (9.8)	2	14 (11.3)
Post	7	14.4 (7.7)	0	NA	6	14.7 (10.2)	8	20.3 (9.9)	1	7.0
Mini-SPIN										
Pre	11	3.4 (3.3)	1	3	8	4.4 (2.9)	13	3.5 (3.3)	2	4.5 (3.5)
Post	6	1.2 (1.5)	0	NA	5	3.0 (3.5)	8	2.4 (3.1)	1	0.00
OCI-R										
Pre	11	13.4 (12.5)	1	13	8	18.8 (14.4)	13	13.1 (8.5)	2	14 (5.7)
Post	6	6.3 (4.6)	0	NA	6	16.0 (15.4)	8	11.1 (9.5)	1	15
PDSS-SR										
Pre	11	3.5 (4.5)	1	1.00	8	2.9 (2.8)	12	3.4 (3.9)	2	00
Post	7	1.7 (3.0)	0	NA	7	1.6 (2.6)	8	0.5 (1.4)	1	00
PSWQ-A										
Pre	11	24.5 (11.8)	1	24	8	22.6 (9.1)	13	30.0 (6.1)	2	23 (4.2)
Post	8	18.1 (7.1)	0	NA	7	19.6 (7.1)	8	24.1 (8.4)	1	10
IHS										
Pre	11	51.5 (21.4)	1	86	9	63.5 (17.1)	12	73.5 (22)	2	78 (5.7)
Post	6	36.3 (13.0)	0	NA	6	51.2 (10.7)	8	52.1 (21.8)	1	39

Note. Not available (NA) is used when no data were available for a particular group. T = tinnitus; M = misophonia; H = hyperacusis; THM = tinnitus and hyperacusis and misophonia; TH = tinnitus and hyperacusis; TIQ = Tinnitus Impact Questionnaire; HIQ = Hyperacusis Impact Questionnaire; MIQ = Misophonia Impact Questionnaire; SSSQ = Sound Sensitivity Symptoms Questionnaire; SADT = Screening for Anxiety and Depression in Tinnitus; THI = Tinnitus Handicap Inventory, HQ = Hyperacusis Questionnaire; ISI = Insomnia Severity Index; VASL = Visual Analog Scale of Tinnitus Loudness; VASA = Visual Analog Scale of Tinnitus Annoyance; VASE = Visual Analog Scale of Effect of Tinnitus on Life; GAD-7 = Generalized Anxiety Disorder Questionnaire; PHQ-9 = Patient Health Questionnaire; SHAI = Short Health Anxiety Inventory; Mini-SPIN = Mini-Social Phobia Inventory; OCI-R = Obsessive Compulsive Inventory–Revised; PDSS-SR = Panic Disorder Severity Scale-Self Report; PSWQ-A = Penn State Worry Questionnaire–Abbreviated; IHS = Inventory of Hyperacusis Symptoms.

Table 5. Percentage of abnormal scores for the main diagnosis groups.

Questionnaire	Tinnitus		Misophonia		Tinnitus and hyperacusis	
	Pre	Post	Pre	Post	Pre	Post
TIQ	100	37.5	NA	NA	100	45.5
HIQ	25	0	44	0	91	22
MIQ	0	0	78	22	27	12.5
SSSQ	27	11	22	12.5	85	22
SAD-T	82	20	78	50	100	50
THI	100	55.5	NA	NA	100	67
HQ	27	0	55.5	43	69	33
ISI	100	55.5	67	33	85	62.5
GAD-7	67	22	62.5	60	100	55.5
PHQ-9	75	22	50	28.5	100	44
SHAI	50	29	37.5	33	85	62.5
Mini-SPIN	27	0	50	20	23	12.5
OCI-R	18	0	37.5	33	23	12.5
PDSS-SR	9	14	0	0	8	0
PSWQ-A	54.5	25	62.5	29	85	50
IHS	27	17	78	33	83	37.5
SUI	54.5	22	50	14	83	33
HMH	67		78		77	
PMH	50		89		61.5	
SMH	75		78		77	
DRUG	33		44		38.5	

Note. Not available (NA) is used when no data were available for a particular group. TIQ = Tinnitus Impact Questionnaire; HIQ = Hyperacusis Impact Questionnaire; MIQ = Misophonia Impact Questionnaire; SSSQ = Sound Sensitivity Symptoms Questionnaire; SADT = Screening for Anxiety and Depression in Tinnitus; THI = Tinnitus Handicap Inventory; HQ = Hyperacusis Questionnaire; ISI = Insomnia Severity Index; GAD -7 = Generalized Anxiety Disorder Questionnaire; PHQ-9 = Patient Health Questionnaire; SHAI = Short Health Anxiety Inventory; Mini-SPIN = Mini-Social Phobia Inventory; OCI-R = Obsessive Compulsive Inventory–Revised; PDSS-SR = Panic Disorder Severity Scale-Self Report; PSWQ-A = Penn State Worry Questionnaire–Abbreviated; IHS = Inventory of Hyperacusis Symptoms; SUI = expressing suicidal or self-harm ideation based on Item 9 of the PHQ-9; HMH = History of Mental Health problems; PMH = Parental Mental Health problems; SMH = seen Mental Health professionals in the past; DRUG = taking psychiatric medication or psychological therapies in addition to the CBT for tinnitus, hyperacusis, and misophonia.

highest proportion of patients who were receiving counseling and/or psychiatric medication in addition to CBT. The posttreatment columns for these three groups show that after CBT, the proportion of patients with abnormal scores was reduced for all measures except PDSS-SR for group T. Based on the key measures of the impact of misophonia and hyperacusis, MIQ and HIQ, about 22% in groups M and TH were classified as experiencing a significant impact of their main complaints post CBT. These percentages were lower than the pretreatment values of 78% (group M) and 91% (group TH). Based on the measures of the impact of tinnitus, TIQ and THI, about 37.5% (25% severe impact and 12.5% slight impact) and 55.5% (33% slight and 22% severe impact) were classified as experiencing an impact of their tinnitus post CBT, respectively. These percentages were lower than the pretreatment values of 100% with severe tinnitus impact as measured via the TIQ, and 92% with severe tinnitus impact and 8% with moderate tinnitus impact as measured via the THI. Pretreatment sleep difficulties as measured via the ISI were moderate for 42% and severe for 58% of patients in group T and slight for 15%, moderate for 38.5%, and severe for 31% of patients in group TH. Based on posttreatment ISI scores, these changed to slight for 11%, moderate for 11%, and severe for 11% (group T) and slight for 12.5% and severe for 12.5% (group TH).

Table 6 shows the results of the LMM analyses. Table 7 displays the results of pairwise comparisons for the different diagnostic groups for measures where the LMM showed a significant effect of diagnosis. The LMM showed significant effects of time for all measures. In all cases, the effect of time reflected an improvement in scores post CBT. The ESs were large at 1.4 (95% CI [0.64, 2.14]), 1.16 (95% CI [0.28, 2.06]), 1.32 (95% CI [0.16, 2.48]), 2.58 (95% CI [1.11, 4.06]), 0.95 (95% CI [0.39, 1.51]), 0.73 (95% CI [0.26, 1.19]), 0.87 (95% CI [0.35, 1.4]), 0.93 (95% CI [0.32, 1.55]), and 1.4 (95% CI [0.75, 2.14]) for the 4C-T, 4C-H, 4C-M, TIQ, HIQ, MIQ, SSSQ, HQ, and SAD-T, respectively.

Patients in group TH showed significantly higher scores on the HIQ than those in groups T and M. This

Table 6. Linear mixed-model outcomes.

		Pre	Post	Time			Diagnosis		Drug		Gender		Random effects
Questionnaire	***n***	***M* (*SD*)**	***M* (*SD*)**	***F***	***p***	***ES* (*g*)**	***F***	***p***	***F***	***p***	***F***	***p***	***Variance Subject (Intercept)***
4C - T	23	15 (14)	53 (33)	29	**< .001**	1.4	< .001	.98	0.26	.62	0.12	.73	56.4
4C - H	7	13 (5.7)	27 (12)	16	**.005**	1.2			9.22	**.02**	2.47	.16	1.34
4C - M	9	17 (5.3)	26 (7.4)	12	**.007**	1.3			0.77	.4	0.37	.56	2.24
TIQ	19	16.6 (4.0)	4.8 (5.0)	71	**< .001**	2.6	0.13	.722	1.65	.21	0.14	.71	< .001
HIQ	28	12.3 (8.7)	4.6 (5.3)	20	**< .001**	0.9	7.93	**.001**	0.25	.62	0.001	.97	< .001
MIQ	28	9.1 (8.6)	5 (6.8)	11	**.003**	0.7	18.5	**< .001**	1.1	.31	1.25	.27	4.27
SSSQ	33	6.3 (5)	2.3 (2.4)	17.5	**< .001**	0.9	12.5	**< .001**	1.27	.26	0.47	.49	< .001
SADT	33	8.4 (3.6)	3 (3.0)	44.6	**< .001**	1.4	2.74	.08	0.59	.45	0.21	.65	0.41
THI	25	72.9 (17)	29 (24)	57	**< .001**	2	3.05	.09	0.44	.51	2.09	.15	< .001
HQ	33	21 (10)	15 (8.6)	6.5	**.013**	0.9	3.02	.057	1.4	.24	2.72	.1	< .001
ISI	34	16 (8.6)	7.8 (6.9)	31.5	**< .001**	1.1	10.3	**< .001**	2.65	.11	1.22	.28	11.63
VASL	25	7.4 (1.8)	5.1 (2.7)	18.9	**< .001**	1.0	3.22	.08	0.11	.74	0.92	.35	1.13
VASA	25	8.3 (1.6)	4.3 (2.7)	46.3	**< .001**	1.7	0.62	.43	0.14	.71	4.01	.055	0.34
VASE	25	8.2 (1.8)	3.7 (3.2)	44.2	**< .001**	1.5	0.003	.95	0.07	.8	3.16	.09	0.79
GAD-7	33	14 (6.1)	7.0 (5.0)	28.1	**< .001**	1.0	2.02	.15	3.04	.09	0.45	.5	7.47
PHQ-9	33	14.9 (7.1)	5.8 (5.3)	35.2	**< .001**	1.3	6	**.004**	3.4	.068	0.4	.53	< .001
SHAI	33	20.3 (8.9)	16.7 (9.3)	11	**.003**	0.4	2.32	.12	3.2	.08	2.14	.15	59.95
Mini-SPIN	32	3.66 (3.1)	2.16 (2.7)	5.5	**.028**	0.4	0.8	.45	0.05	.82	0.005	.94	4.53
OCI-R	32	14.6 (11.5)	11.1 (10.8)	5.4	**.03**	0.3	1.3	.28	0.0014	.97	1.15	.29	100.26
PDSS-SR[a]	31	3.3 (3.8)	1.2 (2.3)	χ^2: 16.1	**< .001**	0.6	χ^2: 0.09	.96	χ^2: 1.77	.18	χ^2: 2.6	.1	0.34
PSWQ-A	32	26.2 (9.4)	20.6 (7.7)	12.7	**.0014**	0.5	3.19	.054	5.63	**.024**	4.64	**.038**	34.56
IHS	32	63.1 (22)	47.1 (17.4)	15.4	**< .001**	0.9	4	**.029**	1.56	.22	2.52	.12	98.50

Note. The table shows: sample size (*n*), time (pre/post), diagnosis (tinnitus, misophonia, or tinnitus and hyperacusis); Drug (whether they were taking psychiatric medication or psychological therapies in addition to the therapy for tinnitus, hyperacusis, and misophonia), and gender (male/female). Significant *p* values are in bold font. *ES* = effect size; 4C-T = 4C Tinnitus Management Questionnaire; 4C-H = 4C Hyperacusis Management Questionnaire; 4C-M = 4C Misophonia Management Questionnaire; TIQ = Tinnitus Impact Questionnaire; HIQ = Hyperacusis Impact Questionnaire; MIQ = Misophonia Impact Questionnaire; SSSQ = Sound Sensitivity Symptoms Questionnaire; SADT = Screening for Anxiety and Depression in Tinnitus; THI = Tinnitus Handicap Inventory; HQ = Hyperacusis Questionnaire; ISI = Insomnia Severity Index; VASL = Visual Analog Scale of Tinnitus Loudness; VASA = Visual Analog Scale of Tinnitus Annoyance; VASE = Visual Analog Scale of Effect of Tinnitus on Life; GAD -7 = Generalized Anxiety Disorder Questionnaire; PHQ-9 = Patient Health Questionnaire; SHAI = Short Health Anxiety Inventory; Mini-SPIN = Mini-Social Phobia Inventory; OCI-R = Obsessive Compulsive Inventory–Revised; PDSS-SR = Panic Disorder Severity Scale–Self Report; PSWQ-A = Penn State Worry Questionnaire–Abbreviated; IHS = Inventory of Hyperacusis Symptoms.

[a]Gamma-generalized linear mixed model with a log-link function was used to meet the normality assumption. Chi-square statistic χ^2 is reported instead of *F* value. Model equation: score ~ time + diagnosis + drug + gender + (1 | subject).

Table 7. Post hoc tests of the effect of diagnosis, with Bonferroni corrections.

	Diagnosis								
	Tinnitus and hyperacusis vs. tinnitus			Misophonia vs. tinnitus			Tinnitus and hyperacusis vs. misophonia		
Questionnaire	Estimate (95% CI)	*t*	*p*	Estimate (95% CI)	*t*	*p*	Estimate (95% CI)	*t*	*p*
HIQ	7.9 [1.9, 14]	3.31	**.007**	1.45 [–4.8, 7.7]	0.58	1.00	6.5 [0.7, 12.3]	2.9	**.023**
MIQ	4.3 [–1.6, 10.1]	1.83	.23	12.6 [6.6, 18.5]	5.3	**< .001**	–8.3 [–13.8, –2.7]	3.8	**.002**
SSSQ	4.7 [1.9, 7.5]	4.25	**< .001**	0.34 [–2.6, 3.3]	0.29	1.00	4.4 [1.4, 7.3]	3.8	**.002**
ISI	–3.6 [–9.6, 2.4]	1.50	.43	–10.9 [–17.6, –4.4]	4.1	**< .001**	7.3 [0.7, 13.9]	2.8	**.024**
PHQ-9	2.9 [–1.7, 7.5]	1.59	.37	–3.6 [–8.7, 1.5]	1.80	.24	6.5 [1.4, 11.6]	3.2	**.009**
IHS	18.3 [0.4, 36.2]	2.56	**.04**	11.5 [–7.8, 30.8]	1.5	.43	6.8 [–11.9, 25.6]	0.9	1

Note. Significant *p* values are in bold font. CI = confidence interval; HIQ = Hyperacusis Impact Questionnaire; MIQ = Misophonia Impact Questionnaire; SSSQ = Sound Sensitivity Symptoms Questionnaire; ISI = Insomnia Severity Index; PHQ-9 = Patient Health Questionnaire; IHS = Inventory of Hyperacusis Symptoms.

suggests that HIQ scores effectively discriminate between patients with and without a diagnosis of hyperacusis. MIQ scores were higher for patients in group M than for those in groups T or TH, suggesting that MIQ scores effectively differentiate between patients with and without misophonia. For the SSSQ, pairwise comparisons showed higher SSSQ scores for group TH than for groups T and M. For the ISI, patients in group M had lower scores than those in groups T or TH. For the PHQ-9, patients in group TH had higher scores than those in group M. For the IHS, patients in group T had lower scores than group TH.

For the 4C-H, there was a significant effect of Drug. Patients who were receiving psychiatric medication or psychological therapies in addition to CBT for hyperacusis had significantly lower 4C-H scores (lower 4C scores indicate having less confidence in managing their hyperacusis) than those who were not receiving additional treatments. For the PSWQ-A, there were significant effects of Drug and gender. Patients receiving psychiatric medication or psychological therapies in conjunction with CBT had significantly lower PSWQ-A scores than those who were not receiving additional treatments. Female patients had higher PSWQ-A scores than male patients.

Discussion

To the authors' knowledge, this is the first study that compares scores for a wide range of questionnaires related to misophonia, hyperacusis, and tinnitus and mental illness before and after CBT delivered by audiologists via video calls. A wide range of questionnaires (mainly abbreviated versions) were used that have been shown to be useful in screening for psychological comorbidities among patients seeking help for misophonia, hyperacusis, and tinnitus (Aazh & Moore, 2017b). These were used to screen for anxiety and mood disorders, with the intention of referring a patient to appropriate mental health services if they had abnormal scores. These questionnaires have been shown to be relevant and acceptable to patients seeking help for tinnitus and/or hyperacusis (Aazh & Moore, 2017b). Several validated measures were used to assess the impact of tinnitus (TIQ, 4C-Tinnitus, THI, VAS), hyperacusis (HIQ, SSSQ, IHS, and HQ), and misophonia (MIQ). However, some of the measures used here were not validated (4C-misophonia and 4C-hyperacusis).

Pre- and post-CBT comparisons showed that all measures related to misophonia, hyperacusis, and tinnitus improved, all with large ESs. Sleep disturbances and symptoms of anxiety and mood disorders improved significantly, with medium ESs for the SHAI, Mini-SPIN, OCI-R, PDSS-SR, and PSWQ-A and large ESs for the ISI, SAD-T, GAD-7, and PHQ-9. Among the psychological measures, the highest ESs were for the PHQ-9, GAD-7, and SAD-T, which assess general symptoms of anxiety and depression. The lowest ESs were for measures related to specific anxiety disorders, namely, OCI-R, Mini-SPIN, SHAI, PSWQ-A, and PDSS-SR. These outcomes suggest that CBT delivered by audiologists via video calls for the management of misophonia, hyperacusis, and tinnitus is: (a) effective in reducing the impact of these conditions on the patient's life; (b) effective in reducing the impact of these conditions on psychological well-being or on possible general anxiety and depression symptoms; and (c) less effective in alleviating specific anxiety disorders, such as panic disorder, health anxiety social phobia, and OCD. This highlights the need for additional support from mental health professionals when such psychological disorders are identified.

In this study, the ESs for the measures of tinnitus, insomnia, anxiety, and depression were larger than for a previous study that used six sessions of face-to-face, audiologist-delivered CBT (Aazh, Bryant, & Moore, 2019). The ES values reported by Aazh, Bryant, and Moore (2019) were 1.7 for the THI, 0.51 for VAS of Tinnitus Loudness (VASL), 1.2 for VAS of Tinnitus Annoyance (VASA), 1.3 for VAS of Effect of Tinnitus on Life (VASE), 0.92 for the ISI, 1.1 for the GAD-7, and 1.3 for the PHQ-9. In the current study, the ES values were 1.98 (95% CI [0.82, 3.15]) for the THI, 1 (95% CI [0.39, 1.7]) for the VASL, 1.7 (95% CI [0.76, 2.61]) for the VASA, 1.5 (95% CI [0.67, 2.27]) for the VASE, 1.1 (95% CI [0.57, 1.67]) for the ISI, 1 (95% CI [0.45, 1.58]) for the GAD-7, and 1.3 (95% CI [0.57, 1.99]) for the PHQ-9. Although these two studies were similar regarding the key principles of the CBT intervention, there were some methodological differences between them that could explain the larger ESs observed in the current study. For example, the current study differed from the study of Aazh, Bryant, and Moore (2019) with regard to the number of sessions CBT sessions (14 vs. 6), method of delivery (video vs. face to face), the time interval between the last two sessions (6 months vs. 1 week), the completion rate (91% vs. 77.5%), and the study populations (self-funded patients being treated by a private clinic vs. patients seen free of charge in the U.K. National Health Service). In addition, compared to the study of Aazh, Bryant, and Moore (2019), the patient population in the current study had more severe pretreatment scores for the THI (M = 73, SD = 17 vs. M = 62, SD = 16), VASL (M = 7.4, SD = 1.8 vs. M = 6.3, SD = 2.1), VASA (M = 8.3, SD = 1.6 vs. M = 7.5, SD = 1.7), VASE (M = 8.2, SD = 1.8 vs. M = 7, SD = 2), GAD-7 (M = 14, SD = 6.1 vs. M = 12, SD = 6), and PHQ-9 (M = 14.9, SD = 7.1 vs. M = 13, SD = 6). On the one hand, worse pretreatment scores provide more opportunity for improvement,

leading to larger ESs, but on the other hand, worse scores can indicate a more complex patient population, making the treatment more challenging and reducing the ESs. Because of these differences across studies, no conclusions can be drawn about the relative effectiveness of CBT delivered face-to-face and via video calls.

Our results showed that 25% of patients with tinnitus and 22% of patients with misophonia were classified as having a significant impact of their main complaints after treatment. This suggests that for some patients, ongoing support may be needed, after they finish CBT. Future research should explore what kind of posttreatment support or interventions might further reduce the impact of these conditions.

Abnormal depression scores posttreatment occurred for 22% of patients in group T and 44% of patients in group TH. For anxiety, the highest proportions of patients with abnormal scores were 60% of group M for the GAD-7 and 62.5% of group TH for the SHAI. These outcomes are consistent with previous research showing that about 50% of patients with depression and/or anxiety do not recover fully after taking psychiatric medication and/or having psychotherapy, including CBT (Al-Harbi, 2012; González-Valero et al., 2019; Kennedy & Giacobbe, 2007). More research is needed to better understand the underlying mechanism of comorbid depression and anxiety that might exist among patients with misophonia, hyperacusis, and tinnitus and to provide clinicians with better guidance in their treatment.

Study Limitations

RCTs are needed to assess more accurately the efficacy of audiologist-delivered CBT provided via video calls. As this study did not have a control group, it is difficult to determine if the improvements in scores were produced specifically by the CBT or were overestimated due to the placebo effect of receiving treatment from a specialist (Pocock, 1983).

Another limitation is the retrospective design, which limited the study to the data collected in routine clinical practice. For example, misophonia was assessed with only one questionnaire, the MIQ. This is because other misophonia questionnaires were not used in routine clinical practice at the start of the study period.

There were only a few patients with a diagnosis of H and THM. Therefore, patients who fell in these diagnostic groups were excluded from most of the analyses. Overall, our sample size was small. Future studies with larger cohorts are required to assess change in scores following CBT for patients with a diagnosis of H or THM and also to address the interaction effects of taking psychiatric medication and/or other psychological therapies in addition to undertaking CBT.

Conclusions

This preliminary study shows that audiologist-delivered CBT provided via video calls gave promising results in helping patients to reduce the impact of misophonia, hyperacusis, and tinnitus on their life. Mostly, the ESs were larger for measures related to the impact of misophonia, hyperacusis, and tinnitus and for symptoms of general anxiety and depression symptoms than for measures related to specific anxiety disorders, namely, social phobia and OCD. Although most patients showed improvement in their self-report measures, between 22% and 25% of patients were still classified as having a severe impact of their main complaint (misophonia, hyperacusis, and tinnitus) after treatment. For group T, about 20% of patients were classified as having significant psychological problems and 11% had severe insomnia after treatment. For groups TH and M, 55.5% and 60% of patients, respectively, were classified as having general anxiety and 44% and 28.5%, respectively, had symptoms of depression after treatment. This suggests that for some patients, ongoing psychological support may be needed after they finish CBT. This study did not have a control group; therefore, its results need to be interpreted with caution.

Data Availability Statement

The data can be obtained by writing to the corresponding author.

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