

## Tinnitus Case study

### Case title: Internet-based tinnitus intervention

### Clinical history/description

Patient A attended his local tinnitus clinic due to distressing tinnitus. He had a mild hearing loss and was not using hearing aids. An initial tinnitus therapy session provided explanations about tinnitus and sleep hygiene. Practically arranging appointments was difficult as he was employed abroad and was not able to attend his local clinic frequently. The clinic suggested registering for a study looking at the effects of an Internet-based tinnitus intervention. The patient registered and completed the screening questionnaire. This indicated that he was aged around 40-50 years. He had experienced tinnitus constantly for 2 years in both ears. The tinnitus was described as a complex presentation of ringing, buzzing, low and high pitched sounds, pulsating, clicking, music, voices and humming. He attributed his tinnitus to long periods of exposure to noise without adequate hearing protection. He described being generally grumpy and irritable as a result of the tinnitus. Specific difficulties included trouble getting to sleep, concentrating, and hearing on his mobile phone and television. Loud noises were annoying and aggravated the tinnitus. Hyperacusis together with tinnitus resulted in him being unable to do the things he previously enjoyed. Although he was struggling to hear he did not want hearing aids. He explained that he hated anything in his ears.

Table 1: Background information about the patient

Demographic information	
Gender	Male, age 40-50
Attributed cause of tinnitus	Long periods of noise exposure without adequate ear protections: 20+ years, machinery and guns
Tinnitus duration	2 years Both ears constantly
Tinnitus presentation	A complex presentation with a combination of ringing, buzzing, low and high pitched sounds, pulsating, clicking, music, voices and humming
Difficulties as a result of tinnitus	Difficulties getting to sleep Difficulty concentrating Difficulty hearing on his mobile phone and television Loud noises were annoying and aggravated the tinnitus Grumpy and irritable as a result of the tinnitus Unable to do the things he previously enjoyed due to sound sensitivity and tinnitus
View of tinnitus	"I cannot cope. The tinnitus is annoying and I can do without it. It is hard to block out. I get stressed over it."
Hyperacusis	Yes, especially with crying babies, the washing machine/dishwasher end of cycle sound and listening to the kettle
Comments on hearing difficulties	I do struggle to hear, but it is because I need to listen over the tinnitus. It was worrying seeing the specialist as he suggested hearing aids, something I do not want. When have to wear ear plugs etc and I hate anything in my ears, so it was a relief when another specialist thought that I didn't need them.

Table 2: Pre-intervention online screening assessment

Both the Tinnitus Functional Index and the Tinnitus Handicap inventory were done and indicated significant or moderate levels of tinnitus with a score of 44/100 and 48/100 respectively. Mild levels of anxiety and depression were identified (8/21 on the Generalized Anxiety Disorder questionnaire; 5/28 on the Patient Health Questionnaire). The Insomnia Severity Index showed subthreshold insomnia at 10/28. There was mild hearing handicap (14/40 on the Hearing Handicap Inventory). Strong hyperacusis was present (28/40 on the hyperacusis questionnaire).

<b>Outcome Measures</b>	<b>Abbreviation</b>	<b>Range of scores</b>	<b>Internal consistency (Cronbach's alpha)</b>	<b>Levels of significance</b>	<b>Pre-intervention score</b>
Tinnitus Functional Index (Meikle et al., 2012);	TFI	0–100	0.97/ 0.8	>25: mild 25-50: significant 50+: severe	44
Tinnitus Handicap Inventory (Newman, Jacobson, & Spitzer, 1996)	THI	0–40	0.87	0-16 no handicap 18-36 mild handicap 38-56 moderate handicap 58-100 severe handicap	48
Hearing Handicap Inventory-Screening (Newman, Weinstein, Jacobson, & Hug, 1991)	HHI-S	0–40	0.93	0–8: 13% probability of HI, 10–24: 50% probability of mild-moderate HI 26–40: 84% probability	14
Generalized Anxiety Disorder (Lowe et al., 2008)	GAD-7	0–21	0.89	0-4: minimal anxiety 5-9: mild anxiety 10-14: moderate anxiety 5-21: severe anxiety	8
Patient Health Questionnaire (Spitzer, Kroenke, Williams, & Löwe, 2006)	PHQ-9	0–28	0.83	5-9: mild depression 10–14: moderate 15–19: moderately severe severe	5

				20–18: severe depression	
Insomnia Severity Index (Bastien, Vallières, & Morin, 2001)	ISI	0–28	0.74	0–7: Not clinically significant 8–14: Sub-threshold Insomnia 15–21: moderate Severity 22–28: severe	19
Satisfaction with Life Scales (Diener, Emmons, Larsen, & Griffin, 1985)	SWLS	0–35	0.87	0–9: Extremely dissatisfied 10–14: Dissatisfied 15–19: Below average satisfaction 20–24: Average satisfaction 25–29: High satisfaction 30–35: highly satisfied	28
Hyperacusis Questionnaire (Khalifa et al., 2002)	SWLS	0–42	0.66 /0.88	>28: strong hypersensitivity	28
Cognitive Failures Questionnaire (Broadbent, Cooper, FitzGerald, & Parkes, 1982)	CFQ	0–100	0.89	Higher scores indicate more difficulties	29

### Questions

- I. *With this level of tinnitus severity, should an Internet-based intervention be considered?*
- II. *By what means should we be evaluating all these comorbidities?*
- III. *If not these, which outcome domains should we be assessing?*
- IV. *Which outcome measure is most sensitive to changes in tinnitus severity?*
- V. *Which other specific outcome measures should we consider for those with tinnitus?*

### Discussion of questions

- I. *With this level of tinnitus severity, should an Internet-based intervention be considered?*

Internet-based interventions have pre-defined inclusion and exclusion criteria. Generally, a minimum cut-off score for inclusion ensures that participants have the potential to observe benefit from the study intervention. No maximum cut-off score was employed. Internet intervention studies tend to exclude people who have other serious additional health or mental health problems or are undertaking additional interventions. A complex range of factors contribute to a successful outcome, however the factors cannot always be predicted before commencing the intervention. The patient in this case had difficulty attending his local clinic and although he met all inclusionary criteria, he presented with mild levels of anxiety and depression. Someone with higher levels

may need to be carefully monitored to ensure these do improve and evaluated whether any additional help is required.

*II. Should we be evaluating these comorbidities?*

Good justification is required for each assessment measure administered. In an Internet-based intervention there is a greater possibility of not detecting problems as there is no face-to-face interaction with the patient. Thus a thorough investigation of their symptoms is required. There is, however, also a fine balance between overloading the patient. Carefully selecting assessment measures that are not too tedious should be sought when many need to be completed. Very high levels of anxiety and depression should be picked up and may need addressing before the patient is able to focus on addressing the tinnitus.

*III. If not these, which outcome domains should we be assessing?*

This is an important question. There are many possibilities. Some research has looked at what tinnitus patients find is the most relevant outcomes to them. One study indicated that psychological questionnaires relating to anxiety, social phobia, obsessive-compulsive behavior, depression, and worry were rated as relevant, whereas a questionnaire related to panic disorder was not rated as applicable by those with tinnitus (Aazh & Moore, 2017). Ideally a core set of domains that are assessed across clinics would be ideal. Further work is required to establish the most appropriate and psychometrically robust measures for a tinnitus population. In view of these limitations, work is currently underway to identify a core set of outcome measures for tinnitus (Fackrell et al., 2017; Hall, Londero, & Schlee, 2015; Hall et al., 2015).

*IV. Which outcome measure should be used to assess tinnitus severity?*

Both the TFI and THI were used here for comparative purposes. The measure selected will depend on various factors such as the purpose of testing (diagnostics/responsiveness to treatment). Also on whether the questionnaire is validated psychometrically for the population being tested. The TFI has been specifically designed and validated to assess responsiveness to treatment, where many other tinnitus measures have been designed for diagnostic purposes only.

*V. Which other specific outcome measures should we consider for those with tinnitus?*

Appendix A lists some suggestions. These are not the only options. The considerations mentioned above apply to selecting other questionnaires as well. These have generally been considered as secondary outcome measures. Thus short outcome measures may be preferred.

## Research study

The patient was randomized to receive 8 weeks of Internet-based Cognitive Behavioural Therapy principles (CBT) for tinnitus. This intervention consisted of the following key elements (Beukes et al., 2016):

- The intervention was provided on a purpose-built secure web-based platform. It had the required security features in place for data protection
- The content was based on CBT principles as these presently have the most robust evidence of effectiveness in minimizing the effects of tinnitus, particularly longer-term (Hesser, Weise, Westin, & Andersson, 2011). Audiological principles formed from

clinical experience and research found to be effective for tinnitus also informed the theoretical base of the intervention.

- The content was divided into different modules. Two-three modules were released on a weekly basis with a core of 16 modules recommended to all participants. An additional 5 modules were optional and only recommended for specific difficulties related to insomnia, concentration, hyperacusis and communication problems.
- It was a guided intervention with an audiologist who reviewed participants' work and progress. A secure messaging system enabled communication between the audiologist and patients
- There were interactive elements, such as videos and worksheets, to encourage engagement in the intervention. These could be completed during or outside intervention-related activities.

The first module discussed the requirements for the intervention. These included trying to set aside some time each day to work on the intervention. The patient indicated he would work at it each morning before work but after breakfast. The module emphasized the commitment required and setting some goal with some suggestions to select. The patient indicated that he was 100% committed and willing v) to try new things. The specific goals he set were: i) Learning how to cope with the tinnitus more effectively rather than battle with it ii) Having a better understanding of tinnitus iii) Making the tinnitus less annoying and intrusive iv) Being able to relax more easily v) Reduce tension and stress caused by work and tinnitus

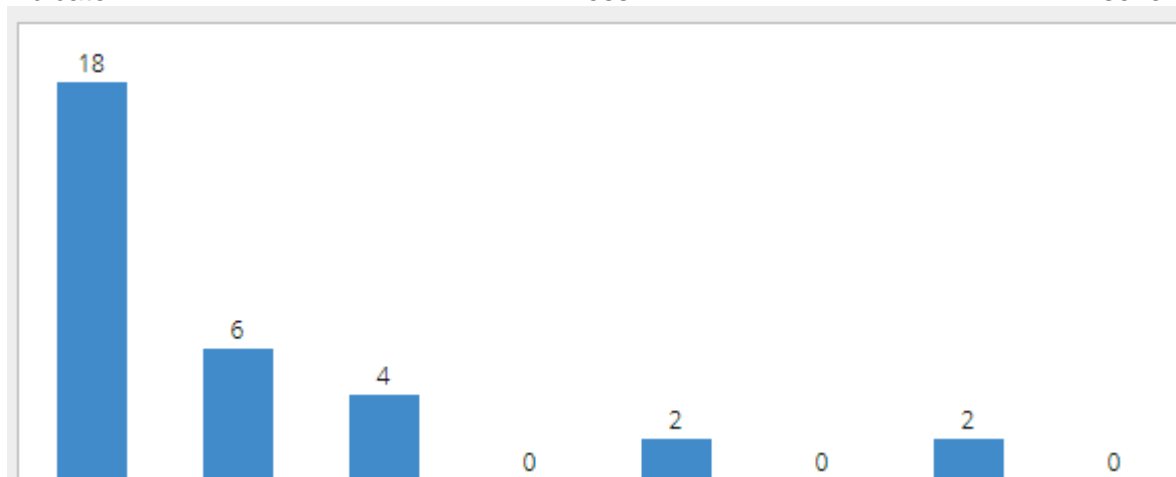
Table 3. Preparation to do the program: Patient responses

Question	Answer/ Rating
Commitment to doing the program rated on a scale of 1-10	10
Willingness to try new things	10
When will you commit to doing the program each day?	Before work after having breakfast
Intervention goals	Learning how to cope with the tinnitus more effectively rather than battle with it
	Having a better understanding of tinnitus
	Making the tinnitus less annoying and intrusive
	Being able to relax more easily
	Reduce tension and stress caused by work and tinnitus

### Progress during and after undertaking the intervention

The patient was monitored weekly by means of the THI screening version. Results are shown in Figure 1. It indicates a gradual decline over time and that this decline is maintained. The large initial decline early on between weeks 1 and 2 is substantial and may be related to being on an intervention and knowing he is getting support. It could also be related to the impact of the initial modules.

Figure 1. THI-screening scores, measured weekly while doing the intervention. Lower scores indicate less severity.



The modules completed are shown in Table 3. He read all the modules and completed the relevant modules. He was very engaged and regularly logged into the website. Table 3 also provides his usefulness ratings and comments about the modules. Note that the patient found some modules, such as trying to reinterpret his tinnitus, less useful than those covering relaxation.

Table 3. Modules undertaken, usefulness score and comments. All the modules were recommended due to his pre-intervention scores.

Category	Module	Patient rating how useful the chapter was: Scale 1-5	Patient comments taken from his worksheets
General	Understanding tinnitus	5	I learned the term habituation. It's about getting used to tinnitus. I still focus on it and get stressed over it. New techniques will steer me away from this. I like the example of a new picture on the wall and I can relate to this very well.
	Progressive relaxation programme (6 steps from deep relaxation to rapid relaxation)	5	Good use of positive imagery and a really good session. After tensing muscle groups It feels like I can feel them unwind and I feel much lighter in those areas so hopefully, I have the technique correct.
CBT	Reinterpreting tinnitus	2	Can visualize everything well, plant room, closing the door, going up on deck surrounding area, but finding this difficult view as an alternative sound. Will try again for a few days if not then I may have to find a different image.
	Positive imagery	5	Snorkelling, able to focus 95%, combined with relaxation, so I dived into the sea first swam around explored a bit, different shoals of fish , the sea bed then did my relaxation exercises and then

			continued to explore, found a ship wreck a clown fish. This seems to work. It feels like it's working well.
	Identifying negative thoughts and cognitive restructuring	4	Don't over think the "what if, why me, If only I had" thoughts anymore. It has happened and now we have a method to deal with the tinnitus. The main aim is not to be stressed by tinnitus and to recognise what causes the stress before it happens. Then to relax and everything is easier to accept and deal with. A calm approach helps every time and this can prevent the tinnitus from becoming annoying and its then manageable.
	Exposure to tinnitus	4	Reflecting back initially my tinnitus bothered me but towards the end of the session after I had relaxed I sat still for a minute as was unaware of my tinnitus, It felt so good.
	Focus	5	Finding it hard to concentrate on only one sound, will keep working at it.
Optional modules	Sound enrichment	4	I use different sounds throughout the day when working at my desk. I find one sound it too much.
	Sleep guidelines	5	I now get up the same time every day, and go to bed within 1 hour every day, I have reduced caffeinated beverages before bedtime.
	Hyperacusis	4	Unload and load the dishwasher alone in the quiet to get used to the noise Low back ground noise when working when alone in the house. This is definitely helping.
	Hearing tactics	5	Useful tips to help me hear better. Patisserie- avoid dump waiter area, I usually ask to sit upstairs as downstairs has too many awkward areas, each corner has its problems, 1 toilet area, 2 dumbwaiter area, 3 main door, 4 serving area and people queuing

Following the intervention the same questionnaires were completed. Improvements were seen in all aspects as seen in Table 4. Encouraging these improvements were maintained one year later despite not having any further intervention. He found the tools useful as they could be done anywhere. This was handy as he spends a lot of time travelling. He applied many of the strategies during his daily life. When realizing he was getting uptight about something he would remember the strategies to help calm him down again.

**Table 4. Post-intervention Outcomes and 1-year follow-up outcomes**

Outcome measures	Abbreviation	Initial score	Post-intervention	1-year follow-up
<b>Tinnitus Functional Index</b>	TFI	44	9	2
<b>Tinnitus handicap inventory</b>	THI	48	18	6
<b>Hearing Handicap inventory</b>	HHI-A	14	6	6
<b>Generalized anxiety disorder questionnaire</b>	GAD-7	8	5	5
<b>Health Questionnaire</b>	PHQ-9	5	1	0
<b>Insomnia severity</b>	ISI	10	0	0
<b>Satisfaction with life</b>	SWLS	32	32	33
<b>Hyperacusis</b>	HQ	28	14	11
<b>Cognitive Failures questionnaire</b>	CFQ	29	21	19
<b>Goals</b>	All achieved			

As clinical scores do not always relate to patient perceptions he was asked about his experiences. He indicated that no further treatment was required. Overall he found the programme very helpful as can be seen from Table 5.

Table 5. Comments about the intervention undertaken.

Questions asked	Comments
<b>What was the best aspect of your treatment?</b>	Having a structure and positive feedback and advice from the personal messages. It helped me understand and enabled me to adjust and accept the tinnitus and be more relaxed about it.
<b>How has it helped?</b>	Thank you for your support throughout, it has helped tremendously and I have such a better understanding, feeling and approach to my tinnitus, these last few weeks it has reduced enormously, with minor flare ups. I successfully attended to Pantos this year and my tinnitus did not prevent me from having a wonderful time. The stress and relaxing techniques have been wonderful and these will remain part of my daily and weekly routine where ever I may be in the world. The program has helped me relax and reflect differently on tinnitus. I now feel I can cope a lot better with tinnitus.
<b>Which modules were the most helpful?</b>	I have found the relaxation technique program very informative and some elements I felt I have really benefited from. Shifting Focus was a hard concept and this I did not get on well with. Whereas positive imagery and the relaxation



	steps provided me with excellent results. To the extent that I have had a few weeks where my tinnitus has virtually been non-existent. Trying to look at negative thoughts from a different angle has also helped. In general the more relaxed less stressful I am the less my tinnitus flares up.
<b>What will you continue using?</b>	I will keep the techniques going as I have seen the benefit of them. I have found over the last month that by trying to keep less stressed has had a huge impact on my tinnitus. I will continue to incorporate all the relaxation techniques, from the deep to the rapid, into my everyday life. By making situations less stressful then it's easier to cope and makes one feel in a better place. Sleep hygiene and routine is a real benefit although extremely difficult when working away, but this is where the rapid techniques help, just before and after a meal. With deeper techniques at bedtimes. I have learned to break my worries down. This makes it much more manageable and achievable, that way I still feel in control and this helps me manage my tinnitus.

### Questions for the reader

- I. *Why are the TFI and THI scores so different at post-intervention?*
- II. *Can treatment be stopped at this point?*
- III. *Why have the scores decreased more at 1-year post-intervention?*
- IV. *Why have most of the scores decreased, such as hearing disability despite not wearing amplification?*

### Discussion of the questions

- I. *Why are the TFI and THI scores so different?*
  - a. This is interesting. It may indicate that the TFI is more responsive to change. It appears as though for this patient the THI score may be more inflated as the patient was not reporting many remaining difficulties. Studies directly comparing these outcome measure is required.
- II. *Can treatment be stopped at this point?*
  - a. Having a set treatment period can be beneficial. The patient knew they were required to commit for 8 weeks and his progress would then be reviewed. Looking at the outcome measure scores alone, the levels indicated are generally below the levels suggesting clinical care is required. It is important also finding out from the patient whether they have achieved their goals and require any further help. He indicated that he had enough strategies to cope and did not require further help.
- III. *Why have the scores decreased more at 1-year post-intervention?*
  - a. The intervention period is there to provide the strategies and try them. Following this the patient is likely to continue using the strategies that are most

effective. This patient had clearly internalized the strategies and was applying them to different situations in daily life. It is likely that over time they were done without thinking, such as better managing a stressful event which in the past may have triggered his tinnitus to flare-up.

- IV. *Why have most of the scores decreased, such as hearing disability despite not wearing amplification?*
- a. The theoretical framework of the intervention is based on CBT. The aim of CBT is to lead to positive behavioral change. If these behavioral changes are made they can have an effect on secondary tinnitus effects. This is not always assessed as interventions primarily focus on identifying whether tinnitus severity has decreased. It is encouraging to see that an intervention can have a holistic effect.

## References

- Aazh, H., & Moore, B. C. (2017). Usefulness of self-report questionnaires for psychological assessment of patients with tinnitus and hyperacusis and patients' views of the questionnaires. *International Journal of Audiology*, , 1-10.
- Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Medicine*, 2(4), 297-307.
- Beukes, E. W., Vlaescu, G., Manchaiah, V., Baguley, D. M., Allen, P. M., Kaldo, V., & Andersson, G. (2016). Development and technical functionality of an internet-based intervention for tinnitus in the UK. *Internet Interventions*, 6, 6-15.
- Broadbent, D. E., Cooper, P. F., FitzGerald, P., & Parkes, K. R. (1982). The cognitive failures questionnaire (CFQ) and its correlates. *British Journal of Clinical Psychology*, 21(1), 1-16.
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, 49(1), 71-75. doi:10.1207/s15327752jpa4901\_13
- Fackrell, K., Fearnley, C., Hoare, D. J., & Sereda, M. (2015). Hyperacusis questionnaire as a tool for measuring hypersensitivity to sound in a tinnitus research population. *BioMed Research International*, 2015
- Hall, D. A., Haider, H., Kikidis, D., Mielczarek, M., Mazurek, B., Szczepek, A. J., & Cederroth, C. R. (2015). Toward a global consensus on outcome measures for clinical trials in tinnitus: Report from the first international meeting of the COMiT initiative, november 14, 2014, amsterdam, the netherlands. *Trends in Hearing*, 19, 2331216515580272.
- Hall, D., Londero, A., & Schlee, W. (2015). TINNET COST action BM1306: An international standard for outcome measurements in clinical trials of tinnitus. *Trials*, 16(1), P18.
- Hesser, H., Weise, C., Westin, V. Z., & Andersson, G. (2011). A systematic review and meta-analysis of randomized controlled trials of cognitive-behavioral therapy for tinnitus distress. *Clinical Psychology Review*, 31(4), 545-553.

- Khalifa, S., Dubal, S., Veuillet, E., Perez-Diaz, F., Jouvent, R., & Collet, L. (2002). Psychometric normalization of a hyperacusis questionnaire. *ORL; Journal for Oto-Rhino-Laryngology and its Related Specialties*, 64(6), 436-442. doi:67570 [pii]
- Lowe, B., Decker, O., Muller, S., Brahler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the generalized anxiety disorder screener (GAD-7) in the general population. *Medical Care*, 46(3), 266-274. doi:10.1097/MLR.0b013e318160d093 [doi]
- Meikle, M. B., Henry, J. A., Griest, S. E., Stewart, B. J., Abrams, H. B., McArdle, R., . . . Vernon, J. A. (2012). The tinnitus functional index: Development of a new clinical measure for chronic, intrusive tinnitus. *Ear and Hearing*, 33(2), 153-176. doi:10.1097/AUD.0b013e31822f67c0 [doi]
- Newman, C. W., Jacobson, G. P., & Spitzer, J. B. (1996). Development of the tinnitus handicap inventory. *Archives of Otolaryngology–Head & Neck Surgery*, 122(2), 143-148..
- Newman, C. W., Weinstein, B. E., Jacobson, G. P., & Hug, G. A. (1991). Test-retest reliability of the hearing handicap inventory for adults. *Ear and Hearing*, 12(5), 355-357.
- Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, 166(10), 1092-1097.

### Suggested reading

- Beukes, E. W., Andersson, G., Allen, P. M., Manchaiah, V., & Baguley, D. M. (2018). Effectiveness of guided internet-based cognitive behavioral therapy vs face-to-face clinical care for treatment of tinnitus: a randomized clinical trial. *JAMA Otolaryngology–Head & Neck Surgery*, 144(12), 1126-1133.
- Beukes, E. W., Allen, P. M., Baguley, D. M., Manchaiah, V., & Andersson, G. (2018). Long-term efficacy of audiologist-guided Internet-based cognitive behavior therapy for tinnitus. *American journal of audiology*, 27(3S), 431-447.
- Beukes, E. W., Manchaiah, V., Davies, A. S., Allen, P. M., Baguley, D. M., & Andersson, G. (2018). Participants' experiences of an Internet-based cognitive behavioural therapy intervention for tinnitus. *International journal of audiology*, 57(12), 947-954.