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UNIVERSITY OF SOUTHAMPTON
FACULTY OF ENGINEERING AND THE ENVIRONMENT
INSTITUTE OF SOUND AND VIBRATION
Doctorate of Philosophy

TINNITUS IN COCHLEAR IMPLANTEES: COGNITIVE BEHAVIOURAL
THERAPY FOR COCHLEAR IMPLANT USERS

By Eliza M. Tucker

Background to the study: Cochlear implants (CI) can help to suppress tinnitus and often make existing tinnitus more bearable. However, a number of patients still suffer from tinnitus afterwards. In some cases the implantation makes existing tinnitus worse, or tinnitus may occur as a result of cochlear implantation. Because of the inconclusive aetiology of tinnitus it is difficult to treat its effects. So far, one of the most popular treatments for tinnitus is the widely used Cognitive Behavioural Therapy (CBT), which aims to influence dysfunctional emotions, behaviours and cognitions through a goal-orientated, systematic procedure. CBT aims to minimize the side-effects of tinnitus and help to manage it in a more efficient way. CBT has been investigated in several studies and shows promising results in reducing the debilitating effect of tinnitus. CBT has not yet been used specifically for, or investigated in, relation to treating CI users suffering from tinnitus.

Aims and outline of the study: Our research aimed to investigate CBT's effectiveness for cochlear implant users. Using a randomized control trial, we investigated whether two-hour Tinnitus Workshops for the control group were as equally as effective as CBT for the research group. We also explored if either type of treatment for cochlear implant users needed any modifications to make them more suitable for this group of tinnitus sufferers. Using Open Questions, we investigated tinnitus in cochlear implant users. We analysed the Open Questions from both groups, creating a profile of a typical cochlear implant user who suffers from tinnitus, and we also explored whether both interventions (Tinnitus Workshop or CBT) were suitable for this kind of patient. Data was gathered, pre- and post-interventions, by questionnaires; these were Tinnitus Questionnaires (TQ), Visual Analogue Scale (VAS), Quality of Life Short Form 36 Health Survey (SF-36) and Hospital Anxiety and Depression Scale (HADS).

Results: In the control group, we found no significant differences between the TQ scores pre- and post-intervention. VAS scores post-intervention were lower than pre-intervention, indicating some improvement in individual tinnitus perception; however, the difference was not significant. In the research group, we found small, but not significant, differences in both TQ pre- and post-intervention ($z = 1.83$, $p > .05$) and in VAS ($z = 0.14$, $p > .05$). No significant differences were found between the control and the research group pre- and post-intervention.

Conclusions: The questionnaires used in this study, such as TQ or VAS, showed a decrease in general tinnitus distress, but a larger-sized sample group may be needed for greater statistical certainty. The results from the Open Questions showed that cochlear implant users were affected by tinnitus in a similar way to non-cochlear implant users. Overall, both interventions need further, small modifications and adjustments to their protocols in order to be more effective for this type of tinnitus sufferer.

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Declaration of authorship

Declaration of authorship

I, Eliza Maria Tucker, declare that this thesis, entitled
“Tinnitus in cochlear implantees: Cognitive Behavioural Therapy for cochlear implant
users” and the work presented in it are my own and have been generated by me as the
result of my own original research. I confirm that:

1. this work was done wholly or mainly while in candidature for a research degree at this
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qualification at this University or any other institution, this has been clearly stated;
3. where I have consulted the published work of others, this is always clearly attributed;
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exception of such quotations, this thesis is entirely my own work;
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6. where the thesis is based on work done by myself jointly with others, I have made
clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signed:.....

Date:.....

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“ Ain't no mountain high enough, ain't no valley low enough, ain't no river wide enough...”

I dedicate this thesis to my son Alec.

Abbreviations

Abbreviations

ANS – Autonomic nervous system
BDI – Beck Depression Inventory
BT – Behavioural therapy
CBT – Cognitive Behavioural Therapy
CI – Cochlear implant
CNS – Central nervous system
CT – Cognitive therapy
DAs – Dysfunctional assumptions
GPG – Good Practice Guide
HADS – Hospital Anxiety and Depression Scale
IHC – Inner hair cells
NATs – Negative automatic thoughts
NICE – National Institute of Clinical Excellence
NIHR – National Institute of Hearing Research
NREM – non-rapid eye movement
PMR – Progressive muscle relaxation
OHC – Outer hair cells
REM – Rapid eye movement
SAOE – Spontaneous otoacoustic emissions
SF-36 – Quality of Life, Short Form 36 Health Survey
THI – Tinnitus Handicap Inventory
THT – Tinnitus Habituation Therapy
TQ – Tinnitus Questionnaire
TRT – Tinnitus Retraining Therapy
VAS – Visual Analogue Scale

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Chapter One – Introduction

1.1 The aims of this thesis

The main purpose of this study was to compare the effectiveness of Cognitive Behavioural Therapy and a Tinnitus Workshop as treatments in reducing tinnitus distress in cochlear implant users. Both interventions were based on the psychological model of tinnitus and applied conditions were evaluated using statistical methods.

The second aim was to analyse and create a general overview of how tinnitus affected this group of participants. Conclusions from Open Questions might appear to be more speculative than factual, and are, moreover, influenced by personal and emotional reactions towards tinnitus.

Thirdly, we also wanted to investigate how and if cochlear implants help to reduce or alleviate symptoms of tinnitus and how they change the perception of tinnitus.

Fourthly, this study included Cognitive Behavioural Therapy as a main method in reducing tinnitus distress in cochlear implant users. This kind of treatment was used for the first time for this group of tinnitus sufferers and we wanted to investigate if any modifications are needed.

1.2 Introduction and overview

Tinnitus is the sensation of sound that sometimes causes suffering. The traditional definition of tinnitus, for many years, has been, “*any sound generated from within the head*” (Jastreboff, 1993). However, this definition does not consider any mechanisms or possible causes of tinnitus.

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A recent definition of tinnitus as a “phantom perception” was introduced by Jastreboff (Jastreboff, 1996), where tinnitus was defined as *“the perception of sound that results exclusively from activity within the nervous system without any corresponding mechanical, vibratory activity within the cochlea, and not related to any external stimulation of any kind”*. This definition comes from the Neurophysiological Model of Tinnitus, and that is why it is limited to a neurophysiological approach and does not consider the wider context of how tinnitus is caused.

The definition this review adopts belongs to McFadden (McFadden, 1982) who describes tinnitus as a *“perception of sound that is involuntary and originates from the head”*. This definition is simple; it pinpoints the source of tinnitus to the head and, therefore, brings together hearing and sensitivity to external sounds. It is usually described by sufferers as ringing, buzzing or whistling noises with different pitches and frequencies.

Tinnitus, which usually lasts for a few minutes, is a universal sensation. Sometimes, tinnitus can last longer (up to one hour), especially after a loud noise (Dobie, 2004). Chronic tinnitus, which is the subject of this study, is heard with different intensities all the time – it can be both intermittent and continuous. Because it is heard only by its sufferer (except for objective tinnitus, which is heard by other people), it is difficult to measure any characteristic features of tinnitus. Also, the intensity of tinnitus does not strictly correlate with the personal perception of it and its severity. In other words, not everyone who has tinnitus suffers from it.

Tinnitus frequently occurs with hearing loss, and that is why one theory hypothesizes that tinnitus is the result of damaged hair cells in the cochlea (Jastreboff, 1999). However, even though tinnitus may be a medical condition, psychological factors are also involved in its development and existence. Tinnitus, as a constant, uncontrolled sound may have a negative influence on the feelings and wellbeing of sufferers. In current tinnitus treatment, it is considered important to first improve the hearing ability of the patient, if appropriate, before treating tinnitus on its own. In many cases, hearing aids, as well as cochlear implants, can help to alleviate tinnitus. People who use any hearing devices are

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more capable of concentrating on sounds other than the tinnitus and they undergo a process of habituation, which is key to tinnitus management.

Cochlear implants (CIs) are devices that can restore hearing in the profoundly deaf. CIs have been implanted successfully for 30 years and currently there are around 170,000 people using CIs worldwide. There is much evidence that CIs can suppress tinnitus (Ito & Sakakihara, 1994; Baguley & Atlas, 2007). Cochlear implantation is beneficial in treating tinnitus in most cases, but for 3-5% of cochlear implant users tinnitus remains unchanged (Ito & Sakakihara, 1994; Quaranta, 2004). Because of the inconclusive aetiology of tinnitus, the relationship between cochlear implants and tinnitus suppression still needs clarification.

The type of treatment that is offered to tinnitus patients plays an important role in tinnitus management. Among the different possible remedies and methods to alleviate tinnitus, Tinnitus Retraining Therapy (TRT) and Cognitive Behavioural Therapy (CBT) are the most popular. For this study, CBT was used as the intervention for the research group and a Tinnitus Workshop as the intervention for the control group. Both interventions aimed to improve general tinnitus distress in cochlear implant users.

Cognitive Behavioural Therapy is a widely used method in treating anxiety disorders and depression; it has also appeared to be effective in treating tinnitus. CBT is a psychotherapeutic approach that aims to influence dysfunctional emotions, behaviours and cognitions through a goal-oriented, systematic procedure. The assessment procedure we used in CBT for the research group involved structured interviews, daily diaries and self-reporting questionnaires. CBT also includes applied relaxation, imagery and distraction techniques, management of sleep and cognitive restructuring of the thoughts and beliefs associated with tinnitus. The effect of psychological treatment according to CBT principles has been investigated in several studies and has showed promising results in reducing the level of annoyance of tinnitus (Andersson & Lyttkens, 1999).

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Tinnitus Workshops based on a psychological model of tinnitus were provided for cochlear implantees in the control group. This intervention lasted only two hours and consisted of part tinnitus education, part methods of relaxation, part distraction exercise and part education about sleep hygiene. The Tinnitus Workshops aimed to inform sufferers about the most important aspects of tinnitus and explain the best coping methods. The character of this intervention was rather informative; however, participants asked many questions and shared their difficulties with other participants.

1.3 Outline of following chapters

Chapter Two: Background and literature review

This chapter introduces the concepts involved in, and a literature review concerning, the epidemiology of tinnitus. It also includes a review of literature concerning cochlear implants and Cognitive Behavioural Therapy for tinnitus sufferers.

Chapter Three: Methodology

This chapter describes the design of the project; the introduction of the participant groups; the questionnaires used; and the exact procedures undertaken in both interventions.

Chapter Four: Results

This chapter presents the results obtained from both groups. The results of the Open Questions and evaluation of feedback forms are also included in this chapter.

Chapter Five: Discussion

This chapter discusses the results obtained from the Open Questions, feedback forms and therapy notes. It also considers the constraints, as well as the advantages, of this study.

Chapter Six: Conclusions and future research

This chapter contains a general discussion of the project, conclusions arising from it and areas for possible research in future.

Chapter Two – Background and literature review

2.1 History of tinnitus

The first written documents describing tinnitus come from Egyptian papyruses (Stephens, 2000), from the beginning of the 18th Dynasty (sixteenth century B.C.). A reference to the “bewitched ear” is assumed to be tinnitus, and the Egyptians used an infusion of balanties and frankincense oil for the external treatment of the ear.

In the later Crocodilopolis papyruses (late-second century A.D.), there are two descriptions of treatment for “humming in the ears”. Both of them include the insertion of a reed stalk into the external meatus, with different combinations of herbal oils.

The ancient Assyrians recorded their remedies on clay tablets and used drugs such as opium, belladonna and cannabis (Stephens, 1984). According to a text translated by Campbell (1931), people described different types of tinnitus: they included “singing of the ears”, “whispering” and “speaking of the ears”, and also they divided their treatments according to the site of tinnitus. The main ingredients used by the Assyrians to treat tinnitus were herbs, such as tea tree oil and, also animal materials, such as bones and horns. They also used amber, turpentine, myrrh and cedar sap (Stephens, 1984).

The ancient Babylonians, dating back to at least the seventh century B.C., used a mixture of herbal oil, juice of bitter almonds and myrrh, poured into the ear, to treat tinnitus. The Babylonians also made the first recorded suggestion that reducing alcohol consumption might relieve tinnitus (Stephens, 1984).

Greco-Roman medicine is full of theories about hearing problems and treatments, but most of them are not concerned with how they tried to cure tinnitus. However, it is during this era that many historical figures, significant to modern medicine, demonstrated an interest in the field of tinnitus or took significant steps towards its discovery. For example, the two Greek physicians, Empedocles and Hippocrates, introduced the concept

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of the four humours and Hippocrates was the first person to emphasize the importance of observing the patient (Stephens, 2000).

According to Empedocles' theory, the body includes cold, dry, moist and hot humours, which correspond to earth, air, water and fire. Being healthy depends on the balance between these four components. It was during the Greco-Roman period that the effect of masking was noticed, although there are some doubts as to who stated: "Why is it that buzzing in the ears ceases if one makes a sound? Is it because a greater sound drives out the lesser?" It was thought that Aristotle was the author, but recently it was proved that it came from one of Aristotle's imitators rather than Aristotle himself (Stephens, 2000).

A Roman writer, Aurelius Cornelius Celsus (25 B.C–50 A.D.) gave an accurate description of tinnitus: "... ears produce a ringing noise within themselves and this also prevents them from perceiving sounds from without". He divided tinnitus into three types: due to a head cold; an effect of disease or prolonged headaches; due to the onset of other serious illnesses. We can compare the first type to *otitis media, or inflammation of the middle ear*, (Stephens, 1984), which was treated by holding one's breath until some "humours" flowed through the ear. For the two other types of tinnitus, the advice was to go on a diet, exercise more and to administer ear drops.

An interesting and bizarre method of treating tinnitus was described by Pliny the Elder (23-79 A.D.), who referred to tinnitus more as a disease or pain in the ears. He suggested combining earthworms boiled in goose grease, with woodlice, ox gall, fox fat, boar semen, ass dung, woman's breast milk and foam from a horse's mouth, then inserting the mixture into the auditory meatus. Surprisingly, this magic mixture was in common use until 1618.

There are similarities between the Chinese concept of yin and yang and the Greco-Roman stress on balancing humours in order to stay healthy. The Greek theories came to Europe via the Byzantines and the Islamic physicians. A particularly important writer was Paul of Aegina (624-690), who combined Greek theories with a few significant medical changes.

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He, like his predecessors, distinguished three different categories of tinnitus: due to fevers; chronic noises produced by thick and viscid humours; and chronic hissing sounds. He also advised introducing an herbal mixture, including vinegar, into the auditory meatus.

The Islamic physician Avicenna or Ibn-Sina (980-1034), wrote a medical textbook that gathered up previous work and research about hearing problems and became a recognized text for several centuries. In the medieval period, Gilbertus Anglicus (1180-1250) wrote the first *Compendium Medicinæ* (1240), the first English medical text, and he included a chapter about “Ringing in the ears” (Getz, 1981). Although there was a great progress in discovering the anatomy of ear during this period, the treatment for tinnitus did not evolve, and lack of ideas and pharmacological knowledge made people return to their previous methods and remedies.

In the late eighteenth century, after electricity was discovered, Georg Daniel Wibel, in 1768, (Stephens, 1984) described the use of electricity in suppressing tinnitus, although he did not detail his technique. The confusion about tinnitus continued, and even the famous English physician Erasmus Darwin, did not mention tinnitus in his anatomical work, *Zoonomia, or the Laws of Organic Life* (1794).

In the early nineteenth century, two interesting men investigated tinnitus: Jean Marie Gaspard Itard, who could be regarded as the father of audiological medicine, and John Harrison Curtis, who founded the first ear hospital in London – the Royal Ear Hospital. Itard divided tinnitus into two main categories: one category included cases related to real sound, called “true tinnitus”. He recommended that this should be treated *inter alia* by applying leeches to the neck or around the ear (it is interesting that this kind of method as a cure for tinnitus is still in use by non-orthodox practitioners in Iran (Stephens, 1984)). Itard’s other category included tinnitus cases that exist without any acoustical basis; they were called “false tinnitus”. In both categories, Itard emphasized that tinnitus was accompanied by hearing loss. His main success was in his understanding of the treatment of tinnitus: he focused on the side-effects and, for the first time, sleep disturbances, rather

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than looking for the causes. Itard considered tinnitus as “an extremely irksome discomfort which leads to a profound sadness in affected individuals. Of all symptoms, it is the one to which we habituate the least over time.”

According to Itard, the role of physicians was to focus on helping tinnitus sufferers to cope with it and make their lives more tolerable. His treatment was based on the external, natural masking sounds that helped to ease the effects of tinnitus. One case of historical significance was that of a woman who decided to live close to a watermill, where the sound of the running water being churned brought relief of her tinnitus.

Itard’s thoughts about the consequences of tinnitus and preventing the increase of it, was a major step towards a new treatment, as was the realization that previous treatments and methods were ineffective. Curtis was not as innovative as Itard, but he emphasized the psychological aspects of tinnitus. His treatment recommended relaxation, spa visits, rest and other activities that could help patients to cope with tinnitus. He also recognized that tinnitus should be treated during the early stages to prevent further aggravation and to avoid the long-term psychological consequences; he noted that sustained tinnitus could lead to auditory hallucinations (Stephens, 1984)

During the late-nineteenth century, there were major technological advances in medicine, such as asepsis and anaesthesia, but cures for tinnitus remained largely the same. Itard’s method of natural-sound masking continued and, eventually, in 1928, Spading created a harmonic generator, one of the earliest sound devices for the treatment of tinnitus (Stephens, 1984).

The history of finding a treatment for tinnitus has been slow and unclear. We remain confused about tinnitus and there are still plenty of theories about the cause of it. In the future, we have to combine psychological techniques with audiological methods, and together create the best possible treatment for tinnitus. Unfortunately, Itard’s statement (1821) that “treatment of tinnitus is generally unsuccessful and in most cases the

physician's orientation must be towards the relief of disturbing symptoms" still applies today (Stephens, 1984).

2.2 Epidemiology of tinnitus

The epidemiology of hearing disorders including tinnitus and balance problems is important for at least three reasons:

- it reveals the prevalence of such problems
- it explains what factors may cause or influence hearing disability in general
- it shows how effective available hearing services are in meeting each client's needs (Davis, 1995; Tyler, 2000).

According to Davis (Davis, 1995), information concerning the epidemiology of hearing disturbances should be recognized and considered by the health services to enable appropriate care and further treatment. To obtain this information, various questionnaires and surveys should be distributed, asking for information about each patient's specific hearing problems, together with a description of what factors seem to influence the disturbance and type of hearing impairment. Davis also suggested that it is essential to find out what kind of services are the most effective, including the coverage, costs and benefits of those services (Davis, 1995). The results obtained should highlight any gaps which exist in the service and the research needed in order to improve the auditory-health care programme. With regard to tinnitus only, it is essential that all these aspects are investigated fully, for example risk factors and aetiology of hearing disabilities and their consequences. Then the facilitators would understand the need and justification for a tinnitus service and would be prepared to invest in a care system that takes into account the needs of patients, as well as the effects and potential benefits of available treatments (Davis, 1995).

Tinnitus is a common condition in the population and is associated with differences in aetiology, severity and symptom response, which is why the exact prevalence of tinnitus in the general population remains unclear (Sanchez, 2004). Nevertheless, recent epidemiological studies have contributed towards our understanding of the prevalence of

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tinnitus. The most prominent study of this kind was the National Study of Hearing, conducted by the National Institute of Hearing Research (NIHR). The research was conducted in the 1980s and was a 15-year, multipurpose, multi-stage study, investigating hearing disorders in the UK population, including types of pathology, risk factors, impairment and disability. The research consisted of two tiers of investigation: Tier A consisted of 48,313 adults with ages ranging from 18-80 in four cities in the UK (initial sampling). The method of investigation included short and simple postal questionnaires. The response rate was 81%. Tier B consisted of the clinical examination of 3,234 adults chosen from Tier A. Clinical examinations included taking of occupational history, ear examinations and blood tests. The results of the study showed that:

- The reported prevalence of tinnitus in the sample was 10.1% (Tier A).
- Unilateral hearing tinnitus was reported by 5.1% of the subjects.
- 5% of the subjects in the study reported bilateral tinnitus.
- 5% of the subjects had moderately or severely annoying tinnitus.

Due to the complex phenomenon that is tinnitus, issues around its definition persist, creating variation of questions posed in questionnaires and surveys used in different hospitals, that in turn, affect epidemiological data and treatment studies alike (Sanchez, 2004). Two main aspects of tinnitus are taken into consideration: its duration and its perceived severity. Many people complain about tinnitus that has occurred just after exposure to a loud noise, or after using drugs. It is a common reaction and after a while the tinnitus vanishes. This is why the distinction between “significant” and “non-significant” tinnitus has been introduced (Sanchez, 2004).

The National Study of Hearing developed the widely known definition of prolonged, spontaneous tinnitus – it has to last longer than five minutes and cannot be the result of noise exposure. When estimating the prevalence of tinnitus, the most important determinant is the degree of cochlear disorder (which can lead to tinnitus later), not the cause itself. This is why Davis argues that “whatever caused the hearing loss probably caused the tinnitus too” (Davis, 1995). Although tinnitus is often related to hearing loss, the numbers of people who suffer from tinnitus without any obvious hearing problem

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cannot be underestimated. Barnea (1990), for example, found out that 8% of his patients with normal hearing experienced tinnitus. So far, several studies have been carried out to try to explain the aetiology of tinnitus within the population of normal-hearing people and to try to establish the best method of helping them.

Estimated levels of tinnitus in industrialized countries, according to data received from different studies conducted in the UK (Coles, 1995; Davis, 1995), are:

- about 35% of the population experienced tinnitus of some type or duration; many of these cases, even the non-spontaneous, were not troublesome
- about 10% of the population experienced tinnitus lasting longer than 5 minutes
- at least 5% of the population who experienced tinnitus complained about sleeping problems due to tinnitus and/or moderate or severe annoyance, which may suggest that around 2 million people in the UK are affected
- 0.5% of the population experienced tinnitus that had a severe effect on their ability to lead normal lives. This corresponds to about 200,000 persons in the UK (Davis, 1995).

Sanchez (Sanchez, 2004) carried out a review of epidemiological studies of tinnitus published 1993-2003. The table below (*Table 1*) presents ten of the studies that reported a prevalence of 10.1-14.5%. There were no consistent findings with regard to the role of gender and age in the prevalence of tinnitus. However, it was found that there was a strong relationship between the reporting of tinnitus and concurrent hearing impairment.

Authors	Year	Sample	Tinnitus question	Prevalence	Age effect on tinnitus	Gender effect on tinnitus
Coles, Davis and El Refaie	1980-1995	Great Britain: National Study of Hearing, 32,718 people, aged 17-80	Prolonged spontaneous tinnitus (single question)	10.1%	No	Yes (female>male)
Parving et al.	1993	Denmark: Copenhagen Male Study, 3,387 males, aged 53-75 years	Prolonged tinnitus (single question)	17%	Yes	N/A
Quaranta et al.	1996	Italy: 2,170 people, aged >18	Prolonged spontaneous tinnitus (question not provided)	14%	Yes	N/A
Pilgramm et al.	1999	Germany: 3,000 people, aged >10	Prolonged tinnitus (question not provided)	13.0%	Yes	Not significant
Fabijanska et al.	1999	Poland: 10,349 people, aged >17	Prolonged tinnitus (question not provided)	20%	Yes	Yes (male>female)
Sanchez et al.	1999	Australian Longitudinal Study of Ageing	Tinnitus (two question provided)	17.8%	No	No
Nandahl et al.	2002	United States: The Epidemiology of Hearing Loss Study, 3,753 people, aged 48-92	Tinnitus (three questions provided)	8.2%	No	Yes (female>male)
Palmer et al.	2002	Great Britain: 22,194 people, aged 16-64	Prolonged tinnitus (one question provided)	27% males and 25% females (occasional); 6% males and 3% females (most of the time)	Yes	Yes (male>female)
Johanson and Arlinger	2003	Sweden: 590 people, aged 20-80	Prolonged spontaneous tinnitus (two questions provided)	13.2%	Yes	Yes (male>female)
Sindhusake et al.	2003	Australia: Blue Mountains Hearing Study, 2,015 people, aged >55	Prolonged tinnitus (one question provided)	30.2%	No	No

Table 1 Studies reporting the prevalence of tinnitus and related key variables (1993-2003). Reproduced from Sanchez et al. (2004) with permission

2.2.1 Clinical aspects

There have been numerous research studies to measure the prevalence of tinnitus in patients, in each ear and in the head: it seems to occur mostly on the left side and more men suffer from left-sided tinnitus. Most studies confirm that it usually starts with left-sided tinnitus, followed by right-sided tinnitus. But results from some studies are somewhat distorted and may not be reliable.

According to Davis (Davis, 1995), clinical reports have indicated the left ear as more commonly affected than the right, but only a marginally greater prevalence of tinnitus occurring in males on the left side only. Some studies confirmed that, in most cases, tinnitus is bilateral, followed in number of occurrences by unilateral left-sided and unilateral right-sided tinnitus (Andersson, 2005). One explanation could be that hearing loss appears frequently on the left side, which has not been totally proven (Davis, 2000). Another possibility might be that there is neural imbalance at the cortical level. Research conducted during the National Study of Hearing proposed that tinnitus laterality can depend on age. Left-sided tinnitus was found to be more common in those less than 40 years of age. A higher prevalence of left-sided tinnitus occurred in men in the under-40 age group, but for women in the same age group, right-sided tinnitus was more frequent. Tyler (Tyler, 2005) concluded that it is common for tinnitus to be stronger and more dominant in one ear, but this does not mean that tinnitus originates from that ear. On the contrary, Erlandsson (Erlandsson, 1995) proposed that there are multiple localizations of tinnitus and this may be perceived as more troublesome. The concept of left- and right-ear differences needs more clarification, although it is accepted that which side of the head tinnitus occurs does not influence the severity of it.

Tinnitus as a symptom deserves clinical attention for four reasons (Davis, 1995):

- It can be the first sign of an important pathology.
- It is usually accompanied by hearing loss, which in turn can influence the general wellbeing of the patient.

- It can be a warning sign of developing impairment and risk of future disability.
- Tinnitus can be compared to pain, in that it causes much suffering and psychological disability.

The distress caused by tinnitus

It is difficult to estimate the severity of tinnitus because it depends on its duration, acoustic characterization, and the individual's personal and emotional attitude towards it. For the purposes of general or therapeutic assessment, the severity of tinnitus is defined by an overall description and its effects on the patient.

As mentioned above, tinnitus cannot be measured objectively, which is why all information about its characteristics come from tinnitus sufferers. Loudness is one of the indicators of tinnitus severity, as it is impossible to measure tinnitus's acoustic characteristics and no objective measurement can be taken. Besides, according to Vernon (Vernon, 2000), the loudness of tinnitus and the possibility of the sound being masked does not necessarily describe the exact sound of the tinnitus. Quoting Flower (1943), Davis means that "in the majority of cases the tinnitus sounds are not very loud and have an annoying effect quite out of proportion to their loudness" (Davis, 1995). It is also suggested that loudness is not the dominant factor in creating the general annoyance and depression suffered by the patient, as it is often assumed.

The quality of tinnitus is difficult to describe as it may include a range of sounds. Pitch matches with external sounds are possible but limited, because the pitch-match frequency can mimic only one aspect of the quality of the sound. Also, there is an uncertain relationship between the pitch of tinnitus and its perceived unpleasantness. Nevertheless, high-pitched tinnitus is considered to be the most annoying and unbearable (Davis, 1995). The goal of pitch matching is to generate a sound that matches the tinnitus pitch. This, in turn, may be used to estimate the loudness of tinnitus. Although most tinnitus sufferers do not report tonal tinnitus, most are able to compare a pure tone, which has a specific pitch, to their tinnitus pitch. Indeed, some studies such as that of Vernon and Meikle (Vernon, 2000) reported that 92% of 1,033 patients could complete a pitch match.

Another important element to consider is tinnitus duration. It is said that continuous tinnitus tends to be more bothersome than tinnitus that tends to disappear for a while and return later (Davis, 1995). This statement may be controversial, as some patients with continuous tinnitus suffer terribly when it fluctuates in loudness and/or quality, which in turn makes some patients more anxious or causes increased fear of its sudden change. Nevertheless, intermittent tinnitus may also disturb the patient and create psychological reactions when it starts up unexpectedly. Undoubtedly, in both cases, tinnitus causes anxiety, which in turn aggravates the tinnitus and the general wellbeing of the sufferer.

There is a similar situation with tinnitus lateralization, where some patients complain that when tinnitus is located only on one side (and always in the same place), it creates an unpleasant feeling or simply psychological discomfort (Davis, 1995). However, when tinnitus spreads to the other ear, having been first present in only one ear, patients find it very disturbing and frightening. Yet, sided-ness may be a factor that influences the severity of tinnitus, although it is not fully proven.

2.2.2 Sufferers' descriptions of tinnitus

When individuals perceive tinnitus for the first time, anxiety and fear may have a devastating influence on the sufferer. That is why proper reassurance and explanation are so important. However, without knowledge and full understanding of the origin of tinnitus and a proper measurement test, it is hard to assess tinnitus and offer an adequate treatment.

The description of tinnitus depends on the individual sufferer, and their emotional distress and psychological ability to cope with tinnitus. Tyler (2000) also suggested that any personal description of tinnitus may be influenced by the patient's vocabulary and general level of education. The most common labels that were given to tinnitus include: "buzzing", "rushing", "roaring" and "whistling". Stouffer et al. (Stouffer et al., 1991)

found that 38% of subjects in their study described tinnitus as a “ringing” sound, whereas others (11.2%) used the term “buzzing”. Likewise, 8.2% said their tinnitus sounded similar to that made by a “cricket”.

2.3 Models of tinnitus: neurophysiological and psychological

The possible causes of tinnitus have been widely discussed in the literature and there is no single model to account for it. Moreover, the complex mechanisms in the generation of tinnitus cannot be discounted. The two models described below are not mutually incompatible; the neurophysiological model focuses more on how tinnitus is generated, while the psychological approach describes more how and why an individual reacts to tinnitus and focuses on the individual’s perception of tinnitus. There is a continuing dispute between the advocates of both models, as to which model is more effective and brings the most innovative ideas in tinnitus treatment. However, it is impossible to follow only one approach where the other has a lot to offer. So, in practice, both methods are commonly and equally employed, and probably a combination of these approaches provides the best suitable treatment for tinnitus patients.

In this study, only psychological methods, such as Cognitive Behavioural Therapy (CBT), was used to as a treatment to alleviate tinnitus. Based on the literature, we decided to use CBT because we considered this treatment to be the most suitable and effective in helping tinnitus patients who are also cochlear implant users. In our opinion, the psychological model of tinnitus and psychological strategies that have been developed, such as psychological interventions, as well as training in coping strategies have produced inspiring results, giving hope to both patients and clinicians (Kroener-Herwig, 2000).

2.3.1 The Neurophysiological Model of Tinnitus

The Neurophysiological Model of Tinnitus was created by Jastreboff in 1990 and suggests that the main definition of tinnitus is an increase in spontaneous activity in the absence of acoustic stimulation (Tyler, 2005).

This model identifies many systems within the brain as important paths for tinnitus occurrence, with the auditory system playing a secondary role (Jastreboff, 2004). The most crucial roles emphasize the involvement of the limbic system and autonomic nervous system, subconscious processing of information and subconscious learning, as well as sustained conditioned reflexes. According to this model, tinnitus becomes bothersome if the limbic system and the sympathetic part of the autonomic nervous system are activated. In this model, all levels of auditory pathways are involved in perceiving tinnitus. If an individual is not perturbed by his or her tinnitus, the auditory pathways are the only pathways engaged and tinnitus will be “heard” only within the auditory system. This is the reason why some individuals are not disturbed by their tinnitus (Jastreboff, 1999).

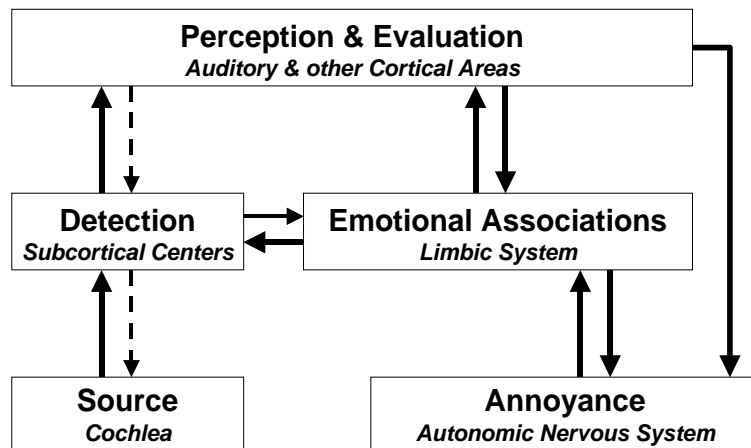


Fig. 2.0 The Neurophysiological Model of Tinnitus according to Jastreboff (2004)

Figure 2.0 presents the Neurophysiological Model of Tinnitus, where the auditory system provides the source of a tinnitus signal by producing tinnitus-related neuronal activity. According to Jastreboff's model, there is a high level of random, spontaneous activity in the auditory nervous pathways. This activity is normally interpreted as a "silence" and is filtered out at the subcortical levels, without being perceived in the cerebral cortex, so we cannot hear this activity as a sound. Each change in spontaneous activity caused by pathology at any site along the auditory pathways (inner ear, hearing nerve) can be distinguished from background noise by subcortical centres and identified as a different sound.

The neural system has particularly sensitive mechanisms for detecting new signals that have never been experienced before (Jastreboff, 1990). Subcortical centres are responsible for filtering, enhancing, and prioritizing the signals before they are sent to the cortex. They sort out signals according to their significance, giving priority to important signals. Generally, a new signal could be neutral, positive or negative. All new signals trigger a slight activation of the limbic and autonomic nervous systems. The most important signals are associated with emotions relating to survival or a threat to health or life.

Tinnitus meets these conditions and has emotional "spikes"; situations in which these spikes might occur include:

- Threats to the quality of life.
- New, abnormal, unknown activity that can create an "abnormal" perception and easily acquire a negative association as something unpleasant, annoying, dangerous and unknown.
- Often tinnitus emerges very rapidly, particularly when triggered by acoustic trauma, mechanical injury, viral infection or acute stress. It is thought that these events may be responsible for some damage in the cochlea (particularly the outer hair cells), and therefore tinnitus-related neural activity may be generated.

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- A person who starts to hear this new signal finds it difficult or even impossible to ignore. Controlling, escaping or curing tinnitus is also impossible and sufferers have thoughts such as, “I will not be able to work, to concentrate, to relax”, “I am going crazy”, “I will not be able to tolerate it”.
- Indicators of medical problems; people may be afraid that their hearing might be compromised.
- Many people complain of the loss of silence, something they previously greatly enjoyed.
- Another typical anxiety is that tinnitus will get worse and never end.

Negative counselling given in the past and, unfortunately, early encounters with health-care professionals often enhances negative concerns and thoughts. Once the person is told there is no hope because tinnitus is incurable, the brain starts to automatically monitor the presence of that sound. Tinnitus-related activity is detected all the time, meaning that it always reaches the cortex, and may be perceived incessantly.

At the level of the cortex, the signal is perceived and compared to other patterns stored in memory and its relevance is assessed. Since the brain perceives tinnitus as a very important and negative signal, its perception is exaggerated.

Another important aspect of tinnitus is the relationship between the perceived tinnitus and background noise: tinnitus will be perceived as being louder in a silent room, whereas in noisy environment, it will be naturally masked. This usually occurs when a person falls asleep in a quiet environment and then the intensity of tinnitus seems to be louder and more intrusive. As mentioned previously, perception of the tinnitus signal also depends on the status of the limbic and autonomic nervous systems. Activation of these systems aggravates the nervous system and makes the perception of tinnitus louder, although the intensity and audiometric loudness remain the same.

Stress, anxiety and the emotional status of individuals can influence the perceived loudness of the sound (Jastreboff, 2004). As long as tinnitus is simply a sensation, it will not result in negative behavioural reactions, whereas tinnitus which becomes troublesome

will lead to high activation of the autonomic nervous system and limbic system jointly. This is why people may show symptoms of anxiety, annoyance and problems with sleep, which may, eventually, lead to depression. In addition, the tinnitus may become so acute that sufferers avoid places with a lot of noise and may even withdraw from social life. Emotional responses lead to negative behavioural reactions in some patients. Negative reactions occur when they are strengthened and become a conditioned reflex. The conditioned reflex will be reinforced by cognitively induced activation of the limbic and autonomic nervous systems, as well as by stimuli that occur at the same time and provide additional stress (Jastreboff, 2004).

2.3.2 The Psychological Model of Tinnitus

The Psychological Model of Tinnitus invented by Hallam and his colleagues in 1984 proposed a different cause of tinnitus than cochlear mechanisms. The authors considered tinnitus to be “some neurophysiological disturbance in the auditory system at any point between periphery and cortex”; they added that tinnitus can occur without aural pathology (McKenna, 2004). The psychological model proposed by Hallam et al. was the first model to try to rationalize the mechanism of tinnitus. The researchers made the following observations before the model was finally developed:

- Presence of a neurophysiological disturbance in the auditory system (anywhere between the periphery and cortex) in most people with tinnitus.
- Reports of tinnitus in people with no hearing impairment when placed in a sound-proof room.

Hallam (Hallam, 1984) suggested that tinnitus should lose its novelty and habituation should naturally occur, but this might be disturbed in certain situations, such as the sudden onset of tinnitus, intense, aversive or unpredictable tinnitus, and tinnitus associated with emotional significance, combined with states of high central- and autonomic-nervous system arousal. This, in turn, would produce a pathophysiological

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positive-feedback loop, resulting in persistence of the symptoms. The psychological model assumes that both psychosomatic and somatic reactions, together with the activation of the central nervous system, play an important role in experiencing tinnitus. It was suggested that because of extreme levels of input, especially during high arousal, the attention system could be impaired and unable to filter and process the information. Because of this, individuals are not always aware of their tinnitus and some distractions, such as music and other sound maskers, can affect their perception of tinnitus. Hallam noted that most people are not bothered by tinnitus, so the natural approach would be to habituate tinnitus as a normal signal which, after a while, should lose its novelty and become normal sound. But on the other hand, Tyler and Baker pointed out that “people tend to learn to live with their tinnitus” (Tyler, 1983). Stephens et al. (1991) reported the inability to cope with tinnitus may even lead to psychological breakdown, such as committing suicide.

Giving significance to tinnitus, and thereby creating an emotional reaction to it, may disturb or delay the natural process of habituation. This process may be affected by the character of the tinnitus itself, such as its tendency to start up suddenly, or the emotional condition of the patient or the significance the patient attaches to tinnitus at the moment it is heard. Moreover, habituation may be slowed by any damage in neural pathways which are involved in natural habituation. According to Hallam, habituation will be achieved if arousal of the autonomic nervous system is decreased and the negative emotional connotations of tinnitus and other stresses are reduced. Tension and the arousal of autonomic nervous system may be changed by relaxation therapy, which is a part of Cognitive Behavioural Therapy (see Chapter 2.4.2).

In both neurophysiological and psychological models, the personal and emotional significance of tinnitus to the patient plays an important role and influences its treatment. The impact of tinnitus may be transformed by changing the individual’s perception of the problem, through the process of Cognitive Therapy (McKenna, 2004). McKenna proposed a cognitive model of tinnitus (*Fig. 2.1*), in which he described the relationship between the individual’s beliefs and emotions and their detection of tinnitus.

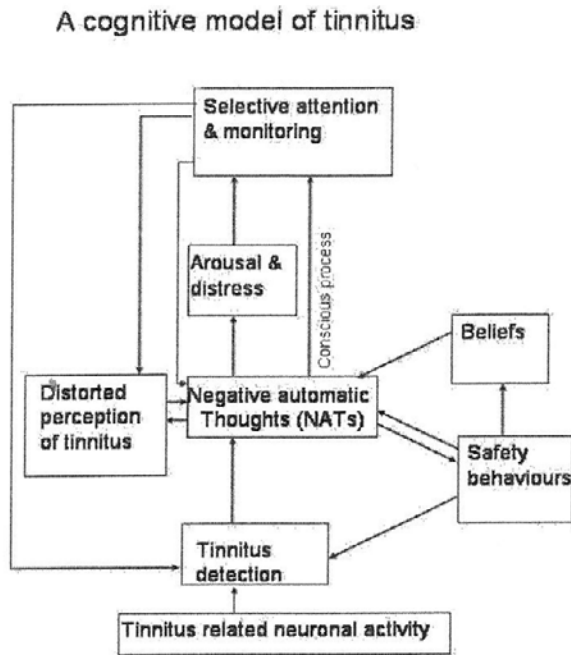


Fig. 2.1 The cognitive model of tinnitus McKenna (unpublished, 2009)

Cognitive Therapy (CT) is based on the assumption that it is possible to change behaviour and perception through a process of learning and understanding. It places greatest emphasis on the interpretation of events rather than the events themselves. Individuals have different interpretations of tinnitus: some of them treat tinnitus as a normal state, the effects of ageing or a normal auditory sensation, whereas some individuals' attitudes towards tinnitus make them stressed, angry and prone to negative thoughts like: "I will never be able to live with it", "I have a tumour", "there is something wrong with my head". Thoughts like these cause great distress; they distort the patient's

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attitude to tinnitus, which in turn increases tinnitus. Cognitive Therapy tries to stop this vicious circle and change negative beliefs.

In the psychological model, tinnitus is often compared with chronic pain; in both cases there may be a chronic fluctuation in intensity and the condition may not change rapidly over time (Wilson, 2000). Different types of treatments are used for tinnitus and chronic pain, none of which have lasting effect or bring the expected results. Consequently, “chronic pain and tinnitus are similar: emotional effects, reduced involvement in work-related activities, interpersonal problems, and decreased opportunities to engage in previously enjoyable activities” (Wilson, 2000). Treatment for both ailments (through the use of behavioural and cognitive abilities to deal with troublesome events) focuses on helping patients to cope better with, or habituate to, tinnitus or pain and achieve a state where these conditions do not create distress or anxiety. It does not mean that after the therapy tinnitus will disappear, but it enables the patient to function effectively despite the constant presence of tinnitus or pain.

Two main treatments have been used in the psychological model of tinnitus since 1980: counselling and sound therapy (Tyler, 2005). There are many papers that distinguish between the role of professional counselling and psychological therapy given to individual sufferers. In reality, the first counselling session is often with an audiologist, who would not have a deep knowledge of any method of therapy (including psychological assistance). Different psychological approaches focus on assumptions associated with the type of therapy: existential therapy is concerned with the overall experience and a way of dealing with everyday problems; cognitive and behavioural therapy together try to influence behaviour and emotional reactions through cognition; and humanistic therapy focuses on supporting personal development (Tyler, 2005). There is no one, overarching therapy which brings total relief from tinnitus; however, all approaches can offer an efficient way to ease its symptoms, as well as the resulting depression and anxiety. The most important factor in psychological therapy is that the conductor should be supportive and give positive feedback to the individual patient. Clinicians should be able to demonstrate knowledge and experience of tinnitus, as well as

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an understanding of the problem. An important aspect of treatment is the quality of the information that is provided to individuals. According to Tinnitus Retraining Therapy (TRT), based on the Neurophysiological Model of Tinnitus (see Chapter 2.4.1), information given to patients is one of the most significant parts of the treatment, because information gives patients more control over their tinnitus and helps them to feel less “victimized” (Tyler, 2004). Such information should include a basic background of hearing systems and hearing loss, facts about the difficulties caused by tinnitus, and the range of treatments. A significant component of therapy is demonstrating that the therapist understands the patient’s needs and encouraging the patient to attend therapy.

Sound therapy is the other essential component of psychological treatments for tinnitus, and is an integral part of counselling. Frequently, individuals find that environmental sound, background music or other noises can make tinnitus slightly less noticeable. Using this “escape” from tinnitus can give relief from constant sound in the ears, as well as beginning to create a positive approach towards tinnitus. Budd and Plug called this process “passive coping” (Tyler, 2004). Using sound as a source of treatment distracts the patient’s attention from tinnitus to other stimuli and helps to reduce the associated anxiety and annoyance, so that natural habituation can occur.

To sum up, the psychological model has found its place in tinnitus management and, with the help of Cognitive Behaviour Therapy, helps tinnitus sufferers. The psychological model focuses on the personal significance of tinnitus and works towards neutralizing it. Like the neurophysiological model, it is based on habituation, but the personal associations of tinnitus are more widely discussed during cognitive sessions. Neurophysiological and psychological models overlap, so tinnitus specialists and audiologists take as much as possible from both in order to develop the best method of helping tinnitus patients.

2.3.3 Critical review of the Psychological Model of Tinnitus

This study supports the psychological model of tinnitus and its methods of treatment, but there are some issues which challenge this approach as an effective method in tinnitus management.

Three systematic reviews are presented: “Cognitive behavioural therapy for tinnitus” (Martinez-Devesa, 2010), “A systematic review and meta-analysis of randomized controlled trials of cognitive behavioural therapy for tinnitus distress” by Hesser (Hesser et al., 2011) and “Systematic review and meta-analyses of randomized controlled trials examining tinnitus management”, by Hoare (Hoare, 2011). “Specialized treatment based on cognitive behaviour therapy versus usual care for tinnitus: a randomized controlled trial”, by Cima (Cima, 2012) is also included.

The studies shown in *Table 2* (below) aimed to assess the efficacy of psychological treatments that are based on the psychological model of tinnitus management.

Author/Date	Sample	Randomized	Control used	Type	Outcome measures	Bias	Limitations
Henry et al. (1996)	60	yes	yes	CCS and education	TRQ, THQ, TCQ, TCSQ, TKQ, BDI, LCB	Blinding, recruiting, withdrawal	Too many questionnaires?
Kroner et al. (1995)	43	yes	yes	CBT	Tinnitus diary, TQ	Blinding, recruitment, volunteer, allocation, response	
Weise et al., (2008)	130	yes	yes	Biofeedback based on CBT	TQ, diary ratings of loudness and of controllability	Recruitment, volunteers, allocation, response, blinding	
Andersson et al. (2005)	23	yes	yes	CBT	TRQ, HADS, ASI, daily diary via VAS	Recruitment, blinding, exclusion, volunteer, allocation, response	No conclusion regarding which specific features of CBT contributed to the effectiveness of the treatment. Evidence describes only elderly patients (65>)
Kaldo et al., (2007)	72	yes	yes	CBT-based self-help book guided by brief telephone support	TRQ, THI, HADS, Daily diary via VAS	Recruitment, blinding, withdrawal, volunteer, allocation, response	
Rief et al. (2005)	43	yes	yes	Psycho-physiological treatment	Self-ratings scales, TQ, diary data	Recruitment, blinding, withdrawal, volunteer, allocation, response	No conclusion regarding which specific features of CBT contributed to the effectiveness of the treatment.
Zachariat et al., (2004)	77	yes	yes	TCT	TQ, Tinnitus Coping Questionnaire, Questionnaire of Catastrophizing Cognition, Questionnaire of Dysfunctional Cognition, Jastreboff Questionnaire, Post-treatment: The questionnaire of subjective success, German questionnaire	Blinding, withdrawal, recruitment, volunteer	Patients were grouped according to gender, age and disability
Kroner-Herwing et al., (2003)	95	yes	yes	TCT	Tinnitus diary, TQ, Tinnitus disability questionnaire, COPE, Symptom checklist, questionnaire on subjective change	Recruitment, blinding, withdrawal, volunteer, allocation, response	

Table 2 A systematic review of Cognitive Behaviour Therapy, Martinez-Devesa (2010)

To analyse the review, an update of the “Cochrane Review”, originally published in 2007, was used. The primary outcome selected in this review was subjective loudness of tinnitus. Results showed that there was no significant difference in subjective loudness of tinnitus after treatment between CBT and treatments based on CBT or no treatment at all. As for secondary outcomes, authors found that quality of life improved after CBT intervention, compared to no treatment or treatment based on CBT. Similar results were found in depression scores, which improved when comparing CBT patients to those who had had no treatment. There was no evidence of improvement in depression scores when CBT was compared to other treatments such as yoga, education and “minimal contact-education”. Overall, the authors suggested that CBT has a positive effect on the management of tinnitus (Martinez-Devesa, 2010).

The following systematic review was presented by Hesser et al., and encompassed fifteen studies. It is the most recent review that investigated the efficacy of CBT (*Table 3*).

Author/Date	Sample	Control used	Type	Outcome measures	Bias	Other limitations
Andersson et al. (2002)	117	yes	CBT via internet	TRQ, VAS, HADS, ASI	Recruitment, withdrawal	
Andersson et al. (2002)	23	yes	CBT for elderly (<65)	TRQ, VAS, THI	Recruitment, withdrawal, allocation	No conclusion regarding which specific features of CBT contributed to the effectiveness of the treatment.
Andersson et al. (2010) – unpublished manuscript	99	yes	CBT via internet versus standard CBT	THI, HADS		
Brenz (2008) – German publication	112	yes	CBT	TQ, general depression scale (DASS)		
Henry et al. (1996)	60	yes	CCS + education	TRQ, THQ, TCQ, TCSQ, BDI, LCB	Blinding, recruiting, withdrawal	Too many questionnaires
Kaldo et al., (2007)	72	yes	CBT based self-help book guided by brief telephone support	TRQ, THI, HADS, VAS	Recruiting, blinding, withdrawal, volunteer, allocation, response	
Kroner-Herwing et al. (1995)	43	yes	CBT	TQ, discomfort scale, general depression scale (DASS)	Recruiting, blinding, withdrawal, volunteer, allocation, response	
Kroner-Herwing et al. (1995)	95	yes (waiting list and active control)	TCT	TQ, TDI, ADS, symptom checklist, questionnaire of subjective change	Recruiting, blinding, withdrawal, volunteer, allocation, response	
Lindberg et al. (1989)	27	yes	CBT	VAS		

Rief et al. (2005)	43	yes	Psychosomatic treatment	TQ, self-rating scale, VAS	Recruiting, blinding, withdrawal, volunteer, allocation, response	No conclusion regarding the specific features of CBT that contributed to the effectiveness of the treatment.
Scott et al. (1985)	24	yes	Psychological treatment	Daily recordings before and after treatment, psychoacoustic measurements, final interview	Recruiting, blinding, volunteer, allocation, response	
Seydel et al. (2010)	90	yes	TRT +CBT	TQ, ADS		
Weise et al. (2008)	130	yes	Biofeedback-based CBT	TQ, diary ratings of loudness and controllability	Recruitment, volunteers, allocation, response, blinding	
Zachriat & Kroner-Herwing (2004)	77	yes	TCT	TQ, Tinnitus Coping Questionnaire, Questionnaire of Catastrophising Cognition, Questionnaire of Dysfunctional Cognition, Jastreboff Questionnaire, Post-treatment: The questionnaire of subjective success, German questionnaire	Blinding, withdrawal, recruitment, volunteer	Patients were allocated according to gender, age and disability
Zetterqvist Westin et al. (2010)	64	yes (waiting list and active control)	acceptance and commitment therapy (ACT)	THI, ISI, QQLI, HADS, CG-I, TAQ	Volunteer, recruitment, withdrawal, blinding	Participants were excluded if they had a hearing impairment

Table 3 A systematic review of Cognitive Behavioural Therapy for tinnitus distress, Hesser (2011)

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According to the author, this systematic review is the largest of the randomized controlled trials of CBT for tinnitus. It included the potential methodological variability and moderators which may influence the effectiveness of CBT; moreover, the data evaluated and quantified the overall long-term effect of CBT in tinnitus management.

In conclusion, it was reported that CBT is an effective treatment in reducing tinnitus annoyance. Also it was suggested that CBT is most likely to be effective in treating tinnitus-related distress, but the underlying mechanism remains unclear (2011).

Equally, Hoare et al. (2011), presented a systematic review examining tinnitus management based on the Cognitive Behavioural approach. This systematic review evaluates CBT from a different approach. The authors included a Good Practice Guide (GPG) as a guidance to tinnitus management in the UK. GPG recommends that tinnitus management should be established according to an exact procedure, to avoid any omissions. It was suggested that tinnitus severity should be assessed using a Tinnitus Handicap Inventory (THI) or Tinnitus Questionnaire (TQ), and co-existing factors, such as depression and anxiety, should be measured using the Beck Depression Inventory (BDI) or the Hospital Anxiety and Depression Scale (HADS). The GPG states that tinnitus sufferers will be given, as appropriate, information/education, hearing aids, counselling, psychological support, relaxation therapy, CBT with professional supervision, sleep management, sound enrichment therapy and TRT. It was also suggested that using anti-depressants, anxiolytics and night sedation is advocated when necessary (Hoare, 2011).

Hoare's review aimed to find evidence for the efficacy of this suggested management of tinnitus. Due to the nature of our project, only the part which focuses on psychological intervention was selected and analysed (*Table 4, below*). Eleven randomized controlled trials were analysed; the majority confirmed that CBT resulted in moderate improvements.

Studies included in Hoare's review:

Reference	Study Quality
(Abbott et al., 2009)*	Moderate
Andersson et al. (2002)	Moderate
Andersson et al. (2005)	Moderate
Henry & Wilson (1996)	Moderate
Henry & Wilson (1998)	Low
Kaldo et al. (2008)	Moderate
Kroner-Herwing et al. (2005)	Moderate
Kroner-Herwing et al. (2003)	Moderate
Rief et al. (2005)	Moderate
(Robinson et al., 2008)*	High
Zachariat and Kroner-Herwing (2004)	Moderate

*Most of the included studies were used in other reviews, apart from Abbott et al. (2009) and Robinson et al. (2008)

Table 4 Studies included in a systematic review, Hoare et al. (2011)

In summary, nine of the included studies reported significant improvements in tinnitus intrusiveness (Hoare, 2011). However, out of the studies that measured depression levels only two found improvements and of the three studies that measured anxiety, just one showed improvement.

The review demonstrated that CBT delivered by a specialist or trained psychologist is much more effective than CBT delivered via the internet. Nevertheless, the only study that compared these methods did not find any significant differences in outcome measurements in TQ, THI or HADS. The authors suggested that, although CBT delivered via the internet is cost-effective and easy to establish, it also has the highest attrition of all interventions presented in this review. However, none of the studies included in the review was conducted by an audiologist or hearing therapist. According to the GPG, it is essential that CBT is conducted by an audiologist or trained clinical psychologist and it

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has been suggested that CBT overall should last between 7–22 hours, over a period of 6 to 15 weeks (Hoare, 2011).

In their conclusions, the authors confirmed a moderate level of efficacy for CBT, which means that it helps to manage the intrusiveness of tinnitus. It also was suggested that the efficacy of therapist-delivered CBT appears to be well established (Hoare, 2011).

The review by Cima et al. (2012), “Specialized treatment based on cognitive behaviour therapy versus usual care for tinnitus: a randomized control trial”, focused on assessing the effectiveness of a specialized care approach based on CBT, compared with the usual care given to the patients with different levels of tinnitus severity. This review emphasized that absence of medical cures and standardized treatment may lead to prolonged tinnitus and further, costly treatment.

The Cima trial took place in the Netherlands and only untreated Dutch speakers (aged under 18) were enrolled. Participants were randomized and allocated in groups of four to receive either the specialized treatment or usual care (2012). The specialized treatment included Cognitive Behavioural Therapy with sound-focused Tinnitus Retraining Therapy. For the results, the quality of life was assessed by the Health Utilities Index Score; tinnitus intrusiveness was assessed by the Tinnitus Questionnaire; and tinnitus impairment was assessed with the Tinnitus Handicap Inventory. Participants were assessed before the intervention and at 3 months, 8 months and 12 months. The full description of both treatments used in this Dutch trial is included in the article by Cima (Cima, 2012). The differences between CBT and usual care procedures are clearly presented. After usual care in the first stage of the intervention, the specialized treatment was started in the second stage of the intervention in the research group; it included two kinds of therapy (individual and group) with a combination, *inter alia*, of CBT, psycho-education and cognitive restructuring (Cima, 2012). The individual and group therapies were slightly different in their procedure, as well as their duration.

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In this study, randomization and treatment allocation took place in September 2007 and December 2009, followed by a control meeting in January 2011. The length of this project was crucial and resulted in a high drop-out rate from the project.

In the final results, there were no significance differences between the usual and specialized care in terms of protocol adherence and contamination (Cima, 2012). However, the results of primary outcomes, such as health-related quality of life, tinnitus severity and tinnitus impairment, indicated that there was significant improvement as a result of specialized care. Nevertheless, the outcome results may depend on the follow-up consultations and their final evaluation may vary.

The conclusions of the Cima trial indicate that although treatment based on CBT and other psychological interventions have no significant influence on tinnitus itself, they are effective in reducing tinnitus-related distress, which is commonly experienced by tinnitus sufferers. Moreover, psychological interventions in general help patients to cope with tinnitus and decrease the symptoms of “psychological tinnitus”. Nevertheless, much of the data presented by Cima is somewhat flawed and this should be noted when drawing a final conclusion or making recommendations for further practice.

The first thing that should be considered is the bias caused by means of recruitment for trials. Some of the participants were recruited via adverts, which were published in magazines, and may so target a specific population. Some of participants were volunteers and cannot represent a group of participants with a clinical need. It is often impossible to tell which aspect of CBT actually helps. Therefore, CBT is most beneficial when administered as a part of an entire programme of intervention.

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Another major limitation of the majority of the studies is the lack of blinding and lack of a placebo followed by the Hawthorne effect¹. But, on the other hand, it would be extremely difficult to create the conditions that fulfil all these requirements in such a difficult intervention as psychological treatment.

To summarize, there is no doubt that CBT is an effective method in alleviating tinnitus. These treatment methods demands a two-way collaboration between each patient and the CBT therapist; both of them are responsible for the outcome of the treatment. Understanding the goals of the therapy is imperative for a positive result in treatment. A patient needs to understand that CBT will not cure tinnitus, but may alter their cognition, attitudes and behaviour towards tinnitus in a way that will mean that they no longer perceive tinnitus as a negative, destructive experience.

2.4 Treatments for tinnitus

Tinnitus treatments have ranged from homeopathic herbal medicines to electrical stimulation and pharmacological intervention. Later, psychological interventions, such as counselling and relaxation, were included in holistic treatments. The reported results of the efficiency of particular treatments range from minimal to substantial. This may be the result of poor study performance, such as lack of a control group or lack of long-term outcomes. Also, some tinnitus treatments do not have a plausible mechanism of action or procedure to follow, which results in poor efficiency (Bauer & Brozoski, 2011).

Masking provides an example of how to ease tinnitus; however, both neurophysiological and psychological approaches recommended caution. Jastreboff suggested that if the

¹ Hawthorne effect is a term used, in the early 1950s, to describe a situation where changes in participants' behaviour during the study may be influenced by the special situation and social treatment they receive while participating in the study.

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tinnitus is completely suppressed or “masked”, it is not perceived by the individual, so it cannot be habituated, thus “*masking is counterproductive to habituation*” (Jastreboff, 2000). Nevertheless, McFadden (1982) concluded that maskers could give hope and some kind of relief to individuals, through the residual inhibition which occurs after tinnitus masking. Also, Vernon and Meikle (Vernon, 2000) explored the positive role of maskers, but they highlighted the individual’s role as a main participant in accepting this form of relief. As with all existing therapies, tinnitus-masking is not a cure: it only provides relief. The first piece of thorough research into tinnitus masking was made by Feldmann in 1971 (Vernon, 2000), where 34% of participants selected a sound that matched the pitch of their tinnitus. Another 32% of participants did not appear to be able to identify the type of sound the tinnitus made and any sound could be used to suppress their tinnitus. In 20% of participants, tinnitus was suppressed by high sound levels, and in 11% of individuals tinnitus could not be suppressed or eased by any kind of sound.

An extremely important phenomenon was discovered by Feldmann called “residual inhibition”, which describes the perception of tinnitus that was partly or completely suppressed for a period of time after the masking stimulus was turned off. The occurrence of residual inhibition is significant and it was suggested that it has the ability to accumulate and even protract over time (Vernon, 2000). However, it is important to emphasize that masking does not mean that the bothersome sound can be totally suppressed or covered by another sound. Tyler (Tyler et al., 2006) and colleagues suggested that, sometimes, tinnitus that exists only in one ear can be suppressed by applying a masking sound to the opposite ear.

Three major types of masking are available to help to suppress tinnitus: maskers, hearing aids and tinnitus instruments (which combine a hearing aid and maskers in one device). It is difficult to estimate which type of masking device is the most helpful, but the guideline states that if a patient has hearing loss, then hearing aids should be offered in the first instance. However, Hazell (Hazell, 1985) conversely claimed that maskers and tinnitus instruments are better devices than hearing aids alone in some cases.

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Regarding hearing aids, Scott (Scott et al., 1985) stated that hearing aids did not influence tinnitus. He suggested that it is important to improve the quality of life first, by improving hearing capacity. Hearing aids should be used for total and partial masking, as well as for psychological management. According to Coles, quoted by Searchfield, (Searchfield, 2005) there are some advantages resulting from fitting hearing aids that help to reduce tinnitus. The psychological benefits of improved hearing ability include better speech understanding, the ability to attend social activities, as well as better involvement in everyday life. If an individual pays less attention to his or her hearing, then, as a consequence, his or her attention to tinnitus is diminished. Another important factor is the environmental background that is created by hearing aids, which makes tinnitus more bearable. In the neurophysiological model of tinnitus, hearing aids amplify the ambient sound, which increases stimulation of the auditory system. This, in turn, helps to minimize differences between tinnitus and background neural activity, which occurs in less intrusive tinnitus (Sheldrake, 1995; Sheldrake, 2004).

The earliest article concerned with the benefits of hearing aids in tinnitus treatment was published in 1947 by Saltzman and Ersner, who discovered that hearing aids reduced or eliminated the perception of tinnitus (Sheldrake, 2004). Significant research was carried out involving 598 participants, where it was found that 16% of them could mask their tinnitus completely. In Wedel et al.'s report (Wedel, 1997), the comparison between hearing aids and tinnitus maskers showed that hearing aids were helpful and benefited in tinnitus suppression for patients (Sheldrake, 2004). In Sheldrake and Hazell's longitudinal study (10 years), equal benefits were obtained with hearing aids and maskers (Hazell, 1985).

In a systematic review by Hoare into the efficacy of hearing aids, which he described as sound enrichment devices and considered to be part of TRT. Three randomized control trials assessed the efficacy of different forms of sound therapy, including noise generators, maskers and hearing aids. All three therapies resulted in a general improvement; however, it was strongly advised that sound therapy should be combined with counselling. Hoare's review included an early study by Stephen and Corcoran

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(1985), where they investigated the effectiveness of maskers, hearing aids and combination devices and compared the results to outcomes from limited counselling without a sound device (Hoare, 2011). Unfortunately, the results did not show any improvements and, actually, in one of the groups, anxiety levels increased significantly after using maskers without any psychological support.

There have been few studies into the effectiveness of tinnitus instruments, due to the inferior quality of most devices. Thus far, some studies show that tinnitus instruments are more successful in tinnitus masking than a masker or hearing aid alone (Sheldrake, 2004).

The parameters of this study did not include any supplementary treatments which might help to alleviate tinnitus, such as antidepressants, anxiolytics, and night sedation or relaxation therapy (without the support of CBT). However, regarding antidepressants, Hoare (Hoare, 2011) in his review found no significant changes in tinnitus intrusiveness, anxiety or depression after medication. Overall, no significant changes have been found in THI or TQ after the intake of medication.

2.4.1 Tinnitus Retraining Therapy

From 1990, the most popular method in treating tinnitus became Tinnitus Retraining Therapy (TRT), which derived from the fundamental concept of the neurophysiological model – based on a failure of filtering mechanisms at the subcortical level, and symptoms becoming distressing because of the involvement of the limbic and autonomic systems (Andersson, 2005). TRT relies on two important features of the brain as a main control mechanism of tinnitus: brain plasticity and its natural ability to habituate different stimuli. During a lifetime of learning, people experience and understand a range of stimuli – this capacity to adapt means that the auditory system, with the autonomic and limbic system, can be retrained (Jastreboff, 2000). Special re-training procedures may lead to a “wrong” signal such as tinnitus being blocked and not passed on via the

autonomic system, so that the autonomic and limbic systems will not be activated. If the tinnitus signal is blocked from these two main systems, the tinnitus will not create any emotional reaction or annoyance, despite being perceived.

The crucial element of the neurophysiological model is habituation (*Fig. 2.2*). To habituate tinnitus means to adapt to tinnitus in such a way that it becomes meaningless, although loudness and pitch remain the same before and after treatment. In the neurophysiological model, two types of habituation can appear during treatment: habituation of reaction and habituation of perception.

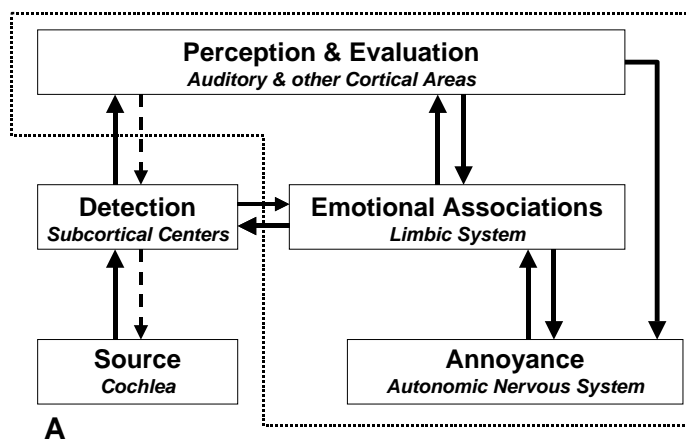


Fig. 2.2 Process of habituation to tinnitus, according to Jastreboff (2000)

It is assumed that the cortical part of the brain structure is involved in clinically relevant tinnitus. It involves beliefs and can be directly affected by counselling, teaching and changing patients' knowledge about their tinnitus.

Habituation of reaction to tinnitus (*Fig. 2.3*)

- This requires some manipulation within loop A and takes place by means of a gradual decrease in the stimulation level from the cortical areas to the limbic and autonomic systems.

- It may be achieved during directive counselling and a series of individual counselling sessions, the number of which depends on the individual needs of the patient.

The main purpose of counselling is to: demystify tinnitus; present tinnitus as a result of a compensatory activity occurring within the auditory system; reassure the patient and decrease his/her negative association regarding tinnitus. The counselling has to achieve the effect of lowered activation of the limbic and autonomic nervous systems, and so decrease negative reinforcement of the constantly present stimulus.

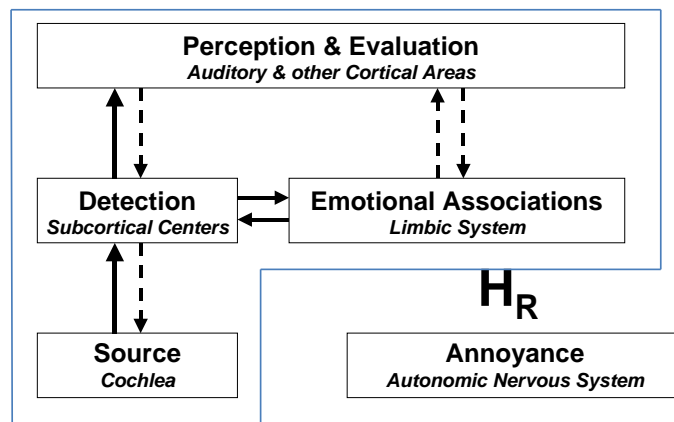


Fig. 2.3 Habituation of reaction to tinnitus (H_R), Jastreboff (2000)

When habituation of reactions is achieved, the autonomic nervous system is no longer activated, and the patient will not be bothered in any way by his/her tinnitus. They will still perceive their tinnitus, but their reflex reaction to this signal disappears, and the patient will not experience annoyance, anxiety or any other negative reaction to tinnitus. A good example of this was presented by Jastreboff (2000), when he compared tinnitus to the noise of a refrigerator, which may be totally ignored. Such a noise does not cause any emotional distress and, when attention is diverted towards other tasks, it is difficult to hear it; this indicates that a natural habituation reaction has occurred. Natural habituation

allows sufferers of tinnitus to lead a normal life, but TRT provides even greater relief. According to Jastreboff (2000), brain plasticity makes it possible to block a signal (in this case tinnitus) at the subconscious level, making the individual unaware of the presence of tinnitus – a process achieved through habituation of perception of tinnitus.

Habituation of perception of tinnitus (*Fig. 2.4*)

- This takes place as a result of a decreased level of stimulation from the auditory subcortical centres. If habituation of perception is achieved, the tinnitus signal is detected in the subcortical centres, but does not reach the conscious mind, so we do not “hear” it.
- It may be achieved using sound therapy, with various acoustic backgrounds, wide-band noise generators or hearing aids.

Sound therapy increases background neuronal activity and thereby decreases the contrast between it and tinnitus-related activity. It uses specific sound therapy with constant, low-level, neutral auditory signals that are intended to interfere with detection of the tinnitus signal, and so decrease sound within the auditory pathways.

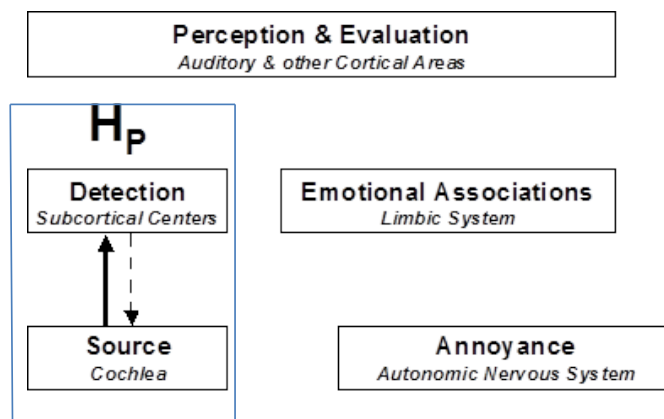


Fig. 2.4 Habituation of tinnitus perception (H_p), Jastreboff (2000)

Habituation of perception usually follows habituation of reaction; it takes place automatically, but slowly, and awareness of the tinnitus is greatly reduced.

In this situation, individuals are not aware of their tinnitus unless they focus their attention on it and, because habituation of their reaction also occurs, they will not be distressed by it. In all therapies for treating tinnitus, proper counselling is an essential element, but sound therapy may be replaced by other procedures. However, using low-level sound as a background is helpful for patients; quiet music usually makes tinnitus quieter and almost unnoticeable to an individual.

2.4.2 Cognitive Behavioural Therapy

Cognitive Behavioural Therapy is a psychotherapeutic approach that addresses dysfunctional emotions, behaviours and personal cognitions; it does this through a goal-orientated, well-structured procedure that focuses on solving existing problems and modifying dysfunctional thinking and behaviour (Beck, 1976). A historical overview of CBT starts with the development of behaviour therapy in the early twentieth century; it then was developed by amalgamation with cognitive therapy in the 1960s. Behavioural Therapy (BT), as a treatment, evolved as a reaction against the Freudian psychodynamic paradigm that dominated psychotherapy. In the 1950s, the Freudian approach was held up to question by scientific psychology as an unproven theory that lacked effectiveness.

The most spectacular development in behavioural therapy occurred 1950–1970. Inspired by the Learning Theory of Ivan Pavlov, the behavioural approach gained therapeutic significance. The main idea held by behaviourists was that what happened inside a person's mind was not strictly observable and brought about unmeasurable change to scientific study. Behaviourists focused on finding associations between observable events, particularly between *stimuli* (features or events in the environment) and *responses* (observable and measureable reactions from the people and animals being studied)

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(Westbrook, 2009). Learning theory searched for general principles to explain how organisms can learn new associations between stimuli and responses. Behaviourists completely rejected the role of the unconscious process in influencing behaviour, and used learning theory to modify unwanted behaviour and emotional reactions.

Behavioural Therapy was successful in neurotic disorders, psychotic disorders and autism; however it had little success in treating depression. Nevertheless, BT became very popular, partly because it kept its roots in scientific psychology, which allowed it to present empirically valid evidence in relieving anxiety problems. In addition, BT was far more economical than the traditional psychotherapy, because it usually lasts for only six to twelve sessions. Recently, the behavioural approach is losing its novelty and popularity due to the new “cognitive revolution”. Devised by Aaron Beck and Albert Ellis, cognitive approaches include behavioural elements and interventions and principally concentrate on existing problems. To begin with, the cognitive method was strongly rejected by behaviourists for using “mentalist” concepts such as thoughts and cognitions. Ellis’ system, originated in the early 1950s, was called Rational Therapy, and may be called the first form of Cognitive Behavioural Therapy. Aaron Beck, inspired by Ellis, developed Cognitive Therapy in the 1960s. After publication of his book on Cognitive Therapy for depression, which showed that CT was as effective in the treatment of depression as anti-depression medication, the demand for Cognitive Therapy increased rapidly (Westbrook, 2009). This approach quickly became the most popular intervention as a subject for academic study in psychotherapy research. Between 1980 and 1990, cognitive and behavioural treatments were combined into what is now recognized as Cognitive Behavioural Therapy.

2.4.2.1 Cognition as a core element of the cognitive behavioural approach

There are many different concepts and levels of cognition; CBT reorganizes levels of cognition and tries to analyse them; this helps to explore the layers of the client’s perceptions and mindfulness of his or her emotions. During the process of cognition, many levels of conscious and unconscious thinking are explored and analysed. Some of

them are familiar and easy to explain, but others may be unknown to the patient and therefore difficult to reveal. Three levels of cognition are commonly examined in the process of CBT: core beliefs, negative automatic thoughts, and dysfunctional assumptions.

CORE BELIEFS

Core beliefs (*Fig. 2.5*) influence the development of an intermediate class of beliefs, which often consist of attitudes, rules and assumptions (Beck, 1995), for example:

Attitude: “It is terrible to be incompetent.”

Rule/expectation: “I must work as hard as I can all the time.”

Assumption: “If I work as hard as I can, I may be able to do some things that other people can do easily”.

In this case, beliefs influence an individual’s view of a situation, which in turn influences feelings and behaviour. The relationship between intermediate beliefs is very strong.

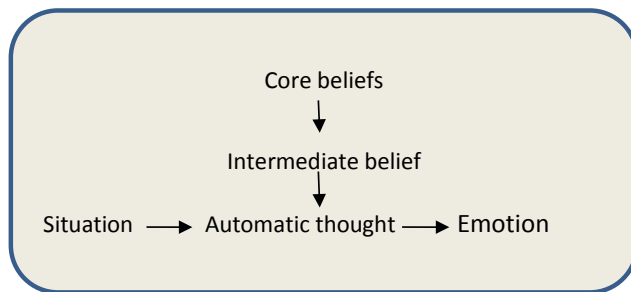


Fig. 2.5 Core beliefs, according to Beck (1995)

Core beliefs are the most important part of the self; some authors compare them to schemas. However, Beck (Beck, 1995) presents schemas as a part of cognitive structures in the mind, which in turn account for core beliefs. Also, Beck divided core beliefs into two categories, associated with helplessness and with unlovability. Core beliefs are created in childhood and most of the time they remain positive. Negative core beliefs usually develop only during psychological distress, but in some severe personality disorders, negative core beliefs may be continuously activated. It is difficult to reveal the

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core beliefs of an individual and the therapist is often the person who “peels back” the layers and helps to articulate the core beliefs of the patient.

Core beliefs represent patients’ fundamental beliefs about themselves. The main features of core beliefs are as follows (Westbrook, 2009):

- they are not immediately accessible to consciousness
- they present themselves in the absolute statement
- they are usually formed in early childhood and shaped through experiences; they may change later in life as a result of severe trauma
- they require more time to be analysed since they are difficult to change with short-term therapy; however, if there is a severe personality disorder, it is important for the therapist to look closely into them.

NEGATIVE AUTOMATIC THOUGHTS

Negative automatic thoughts (NATs) are described by Beck (Beck, 1995) as a stream of automatic thoughts, which co-exists with a more manifest stream of thought; they are a fundamental focus of CBT. NATs are common to everyone, not only to people who are in therapy and suffer from stress or anxiety. They usually are like unconscious, unnoticed thoughts, but they gradually become apparent and available for a patient and therapist to work on. For example, they may surface as thoughts such as *“The dinner party did not go well: it was my fault for being tense and causing others to feel uncomfortable”*, or *“Two students left my lecture early: I must have been boring”* (Westbrook, 2009). Bringing NATs “alive” can be stressful, and patients may not be eager to engage with them, but CBT evaluates such thoughts in a conscious, structured way, especially when patients are in distress.

Automatic thoughts work together with core beliefs. Once identified, NATs can be easy to predict and the therapist can create a kind of schema to base the therapy on. As mentioned before, automatic thoughts can be negative, which can lead to distorted perceptions of reality or interfere with the patient’s social or personal life. Automatic thoughts are usually fleeting and do not describe deeply stressful situations. Frequently,

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patients start by describing their feelings and emotions, and later the negative automatic thoughts (or assumptions) are explored. Emotions are connected to the automatic thought process; it is similar to a stimuli and reaction path.

To fully understand and analyse automatic thoughts, therapists have to uncover the “shorthand” form and involve the patient in the therapeutic process. NATs or automatic thoughts have a direct impact on a patient’s mood from moment to moment, and so they form an important part of CBT.

DYSFUNCTIONAL ASSUMPTIONS

The final level of cognition consists of dysfunctional assumptions, which bridge the gap between core beliefs and NATs. Dysfunctional assumptions (DAs) are an individual’s assumed rules for living, more specific than core beliefs, but not as precise as NATs. Most commonly, they appear in the form of conditional statements, with the structure “if ... then”, for example “*If I have a panic attack, then all eyes are upon me. They will think I am crazy*”, or in a stronger form with “should” ... “must”, (Westbrook, 2009). Unfortunately, they usually are associated with negative core beliefs and, in turn, may cause NATs to develop. DAs are not obvious and have to be uncovered during therapy. Some of them may be culturally reinforced and, in this case, may be difficult to modulate.

Even though DAs create a connection between core beliefs and NATs, therapists usually work on them later in the therapy, after the patient has developed enough strength to confront and challenge his/her NATs. The reason for this is that working on DAs may help patients become more resistant to a future relapse (Westbrook, 2009). Once the patient is sufficiently strong, the therapist may go on to uncover any DAs, in order to make the patient fully aware of them and more able to resist any deterioration in the future.

2.4.2.2 Subjects of CBT sessions

Because of the nature of the two-way relationship between therapist and patient, the main subjects of CBT sessions can be flexible and adjusted to the needs of the patient. Central to the successful use of CBT is the development of a formulation (often known as a case conceptualization), which paints a specific picture of the individual client's problems. Assessment and formulation will include describing current problems, asking why these issues have become problematic, and analysing the process that has created the dysfunctional thinking (Westbrook, 2009). Cognitive Behavioural Therapy embraces the patient's situation and issues such as core beliefs; it requires a lot of attentiveness and empathy to work with a patient who is disturbed by previous experiences.

The process of assessment is lengthy and may be disturbed by new thoughts and beliefs. The main role for the therapist is to make sense of the information coming from the client and to build up tentative ideas of which ideas may be important in the final formulation. This process continues until the therapist obtains enough information to begin to discuss it with the client (Westbrook, 2009).

After formulation, the next session usually focuses on the patient's thoughts and feelings about the problem and their impact on the patient's behaviour. The model A-B-C is introduced and discussed with the patient, where:

- A = the situation or event that a patient is in now and leads to
- B = the patient's thoughts, beliefs, perceptions and expectations about the situation or event (in this case, tinnitus) and produces
- C = the patient's emotions, feelings and behaviours.

It is essential for the patient to understand this connection and later to be able to change the emotions which influence their behaviour. The thoughts that people have in response to danger or unusual situations and events, such as tinnitus, are powerful determinants of how they feel and perceive themselves, and what defines their behaviour to some extent. According to Cognitive Theory, emotions and feelings are individual, so for some clients

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tinnitus can lead to depression and social withdrawal and for others the effects of tinnitus will be barely noticeable.

The third session in this study explains how the process of negative thinking leads to Negative Autonomic Thoughts (NATs), which cause distress and can worsen the perception of tinnitus. The model of interacting systems or core beliefs can be helpful in exploring the process of negative thinking. Negative thoughts are likely to have negative, pessimistic or distressing effects on the person's emotions, feelings and behaviour (Henry et al., 2001). These thoughts can lead to various negative, inadequate behaviours which, during the therapy, are analysed and re-adjusted into positive and productive ways of comprehending the situation.

The fourth session follows on very closely connected from the previous one, where the subject of negative thinking is explored. The sessions are closely connected, but in the fourth, patients try to challenge their thinking, in order to amend their perception of tinnitus. During this session, relaxation technique is explained and, slowly, practical exercises are introduced to the therapy process.

During the fifth session, patients attempt to control and manage negative thoughts and feelings without help from the therapist and to change them into constructive thinking.

All sessions begin with a summary of the previous session. It is common for the therapist to give the client homework, which is discussed during later sessions. A Sleep Diary and a Thoughts and Feelings Diary are part of the programme (see Appendices 12 and 13).

The last session includes a summary and overview of the therapy, its effect and achievements. As mentioned before, in CBT the patient and therapist build a relationship together, to create openness and a creative environment in which it is easier to work. In a successful therapy, both participants feel comfortable and know that they can be understood. Usually CBT lasts for up to eight sessions, but may change if the patient requires more or less therapy.

2.5 Tinnitus and cochlear implants

“... I am just as deaf as I am blind. The problems of deafness are deeper and more complex, if not more important, than those of blindness. Deafness is a much worse misfortune. For it means the loss of the most vital stimulus – the sound of the voice that brings language, sets thoughts astir and keeps us in the intellectual company of man.”

Helen Keller, 1905/²

This quotation illustrates how difficult it is to be deaf and how many emotional problems it can cause. Most social problems associated with deafness begin with the isolation and withdrawal from family life stressed by Keller: *“blindness cuts us off from things, but deafness cuts us off from people.”* (Wilson, 2008).

Cochlear implants (CIs) are essentially a recent invention; thirty years ago, there was no such effective treatment for deafness or severe hearing problems. The effectiveness of cochlear implants resulted in them being widely used and they are regarded as one of the most important achievements in modern medicine (Wilson, 1998). In this study, participants were cochlear implant users. As mentioned before, one aim of the study was to investigate how and if cochlear implants help patients to cope better with tinnitus. So far, it is known that cochlear implants work differently in different patients, and their reactions towards tinnitus as a newly perceived sensation, or tinnitus heard via CIs, may create anxiety and be a source of stress.

(In section 2.5.2, the role of cochlear implants in reducing the sensation of tinnitus and results of other studies into tinnitus and cochlear implants are presented in detail.)

² Helen Keller was an American author, political activist and lecturer. She was the first deaf-blind person to earn a Bachelor of Arts degree.

2.5.1 Cochlear implants

Cochlear implants are surgically implanted auditory devices that are designed to provide some degree of hearing to those with severe and/or profound hearing loss: *“The cochlear implant is often referred to as a bionic ear. Unlike hearing aids, the cochlear implant does not amplify sound, but works by directly stimulating any functioning auditory nerves inside the cochlea with an electric field.”* Cochlear implants restore some form of hearing by bypassing damaged hearing cells, therefore stimulating residual neural elements directly (Wilson, 2008).

Person(s) or event	Year	Comment or outcome
Merle Lawrence	1964	“Direct stimulation of the auditory nerve fibres with resultant perception of speech is not feasible.”
Blair Simmons	1966	Rated the chances that electrical stimulation of the auditory nerve might ever provide “uniquely useful communication” at about 5%.
Harold Schuknecht	1974	“I have the utmost admiration for the courage of those surgeons who have implanted humans, and I will admit that we need a new operation in otology, but I am afraid this is not it.”
Bilger et al.	1977	“Although the subjects could not understand speech through their prostheses, they did score significantly higher on tests of lip-reading and recognition of environmental sounds with their prostheses activated than without them. (This was a study, founded by the National Institute of Hearing Research (NIHR), of all 13 implant patients in the United States at the time.)
First NIHR Consensus Statement	1988	Suggested that multichannel implants were more likely to be effective than single-channel implants, and indicated that about 1 in 20 patients could carry out a normal conversation without lip-reading. (The world population of implant recipients was about 3,000 in 1988.)
Second NIHR Consensus Statement	1995	“A majority of those individuals with the latest speech processors for their implants will score above 80% correct on high-context sentences, even without visual cues.” (The number of implant recipients approximated 12,000 in 1995).
Gifford et al.	2008	Reported that over a quarter of CI patients achieve 100% scores on standard sentence material and called for more difficult material to assess patient performance. (The cumulative number of implant recipients now exceeds 120,000.)

*With permission of B. Wilson, obtained 07.07.12

Table 5 Development of the cochlear implant, according to Wilson (2008)

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The development of the cochlear implant as a device which restores and improves hearing ability took a long time (*Table 5*) and efforts continue to improve implants, in order to obtain the best quality hearing for patients. Enormous progress has been made in their design and practicality; nevertheless, some patients still complain about poor results in speech understanding, mainly in noisy environments. Also, there are some limitations, such as difficulty in listening to music or telephone conversations. However, there is currently no other device that can restore hearing to such a degree.

2.5.2 Role of cochlear implants in tinnitus

There are many studies that show the relationship between cochlear implants (CIs) and tinnitus. Many published researchers suggest that cochlear implants have a suppressive effect on tinnitus in most implanted sufferers. Although the risk of developing or worsening tinnitus after implantation, as a result of CI surgery, is generally low, it is still reported in studies. However, the causes still remain unclear. Studies show that incidence of such cases ranges from 3% to 13% (Souliere et al., 1992; Kompis & Pelizzone, 2012). On the other hand, reports of complete suppression after cochlear implantation range from 15% to 83% in one study (Bovo et al., 2011).

Cochlear implantation may be suitable for tinnitus sufferers, because they can restore hearing and help to suppress tinnitus. Many profoundly hearing-impaired individuals cannot benefit from traditional hearing devices, such as hearing aids where there is a smaller chance of suppressing tinnitus, but can benefit from CIs. Another factor that led to increasing interest in tinnitus suppression via implantation was the observed improvement in speech perception in implanted patients. This was a valid reason to implant individuals who had a lower degree of hearing loss. Tinnitus alone is not an acceptable reason for implantation; for instance individuals who have mild to moderate hearing loss and suffer from distressing tinnitus are not candidates, based on the National Institute of Hearing Research (NIHR) licence or the National Institute of Clinical Excellence (NICE, 2011) appraisal guideline 166 in the UK. Indeed, Thedinger

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(Thedinger et al., 1985) advocated that patients who received cochlear implants when tinnitus was the sole reason did not benefit from it, or they experienced only minimally successful outcomes. Conversely, there are studies that show tinnitus occurring as a result of cochlear implantation (*Table 6*). Current literature supports the idea that cochlear implants help to suppress tinnitus; however, in about 4% of patients tinnitus may be aggravated or may be heard for the first time (Baguley & Atlas, 2007).

House (House, 1982)	First reported that a single-channel cochlear implant eased tinnitus in “more than half of implanted patients.”
Berliner (Berliner, 2008)	Reported that in 48 out of 90 (53%) patients, tinnitus decreased; in 32 (36%) it was unchanged; and in 10 (11%) tinnitus increased.
Souliere (Souliere, Kileny et al., 1992)	Investigated the effect of cochlear implantation in 33 patients, where 28 (85%) had tinnitus. In 20 patients (71% of the 28 with tinnitus), it was confirmed that the tinnitus had decreased. Many patients described a significant reduction in tinnitus loudness and annoyance.
Hazell (Hazell et al., 1989)	Reported partial or total suppression of tinnitus in the implanted ear in 57% of patients.
Ito (Ito & Sakakihara, 1994)	Presented 54 cases where for 40 patients (74%) cochlear implantation was very effective; in 10 cases (19%) it was effective; and for 4 (7%) it remained unchanged.
Mo (Mo et al., 2002)	Presented 59 cases where for 32 (54%) cochlear implantation resulted in better tinnitus management; for 21 participants (36%) it did not change their tinnitus perception; for 5 (8%) participants cochlear implantation made tinnitus worse; but for 1 (2%) it resulted in total suppression of tinnitus.
Kompis (Kompis & Pelizzone, 2012)	Presented 44 cases where 36 individuals (72%) reported improvement in tinnitus management; in 2 cases (5%) cochlear implantation did not make any change in tinnitus management; and in 6 cases (13%) cochlear implantation resulted in worse tinnitus perception. Moreover, in 2 out of 15 patients (13%) who did not have tinnitus pre-operation, tinnitus developed in the first 6 months of device use.
Yonehara et al. (2006)	Reported total suppression in 2 patients (33%) and partial suppression in 8 patients (37%) – 30% of patients were not included in the overall results.
Bovo et al. (2011)	Included 36 participants, where 36% reported total loudness suppression and another 42% reported a reduction of tinnitus – 22% of patients were not included in the overall results.

Table 6 Influence of cochlear implantation on tinnitus

A review by Quaranta et al. looked at 32 published papers, where the effect of cochlear implants on tinnitus was clearly described (Quaranta, 2004). however, there is still discussion about the mechanisms by which CIs suppress tinnitus. Baguley & Atlas (Baguley & Atlas, 2007) suggested that it is important to consider the duration of tinnitus suppression by cochlear implants. According to them, if tinnitus suppression happens

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straightaway after implantation, it can be explained by the new auditory stimulus, made possible by the CI, masking the tinnitus. Conversely, if tinnitus suppression is not immediate, then a process of plastic reorganization or cortical reorganization of the auditory system may occur (Kim et al., 1995; Mirz et al., 2002; Moller, 2006). In some studies, positron emission tomography (PET) has been used to show that CIs reduce signs of tinnitus activity in primary auditory areas, as well as in parts of the CNS associated with emotion (limbic system) and attention (Neurophysiological Model of Tinnitus). In a further study by Osaki et al., (2005), with the help of PET for three patients, cochlear implantation resulted in tinnitus suppression. These three cases were closely examined and it was found that the patients' right anterior, middle and superior temporal gyri showed signs of activation after implantation. For this reason, residual suppression of tinnitus is closely associated with central processes of auditory higher-order processing, memory and attention. Baguley & Atlas (2007) stressed the need for further research in this field because these possible mechanisms are not mutually exclusive. Furthermore, they stated that most of the available studies do not report exact information about tinnitus (type and definition of tinnitus reported by the patients) and how exactly it was suppressed. In addition, it was suggested that a validated tinnitus questionnaire should be used, such as the Tinnitus Handicap Inventory (THI) or Tinnitus Questionnaire (TQ). For these reasons, it is difficult to estimate which type of tinnitus was bothersome.

Overall, according to the literature, cochlear implants are probably the best devices to restore hearing ability and, at the same time, may influence tinnitus perception. However, based on the evidence, CIs may not suppress tinnitus and may, in fact, provoke its occurrence. A study by Souliere et al. (1992) resulted in 28% of patients with tinnitus distress not benefiting from cochlear implantation. In Mo et al., (2002), where 59 participants were involved, cochlear implantation did not change the tinnitus perception of 21 participants, and for 5 participants cochlear implantation definitely made their tinnitus worse. A study by Kou et al., (1994) included in a review article by Quaranta (Quaranta, 2004), showed that 26% of participants developed tinnitus as a result of implant surgery. Pan et al. (Pan, 2009) presented a study where 12% of participants, who did not have tinnitus before implantation, developed tinnitus as a result of the

intervention. The authors suggested that patients with a shorter duration of hearing loss are more likely to develop tinnitus as a result of cochlear implantation.

Most of the studies show only the final results, where tinnitus remains at the same level or its perception increases or decreases as a result of cochlear implantation. A study by Andersson et al., (Andersson, 2009) aimed to address this gap in the literature by using validated questionnaires (THI) to measure the tinnitus handicap experienced by 111 individuals implanted with CIs. The results showed that the majority of participants experienced a decrease in their tinnitus handicap score as a result of implantation. Nevertheless, 25% of participants in the study showed moderate to severe scores, indicating a tinnitus handicap after implantation. The authors strongly suggested that this group of individuals who, after cochlear implantation, developed tinnitus or still experienced a high perception of it, should be examined in future research. They suggested that some types of interventions or tinnitus management strategies may need to be changed, to remedy their limitations. This study took on board all suggestions made by Andersson et al. when defining the aims of this study (see 1.1).

2.6 Summary of research questions developed for this study

There is a gap in the research concerning the absence of evidence-based management strategies for cochlear implant users whose tinnitus remained bothersome after implantation (Andersson, 2009). Andersson's study also highlighted the absence of any randomized controlled trial studies looking at possible alternative treatments for this group of patients. This study seeks to answer that gap in the research by investigating Cognitive Behavioural Therapy in cochlear implant users and its effectiveness for tinnitus management in a randomized controlled study.

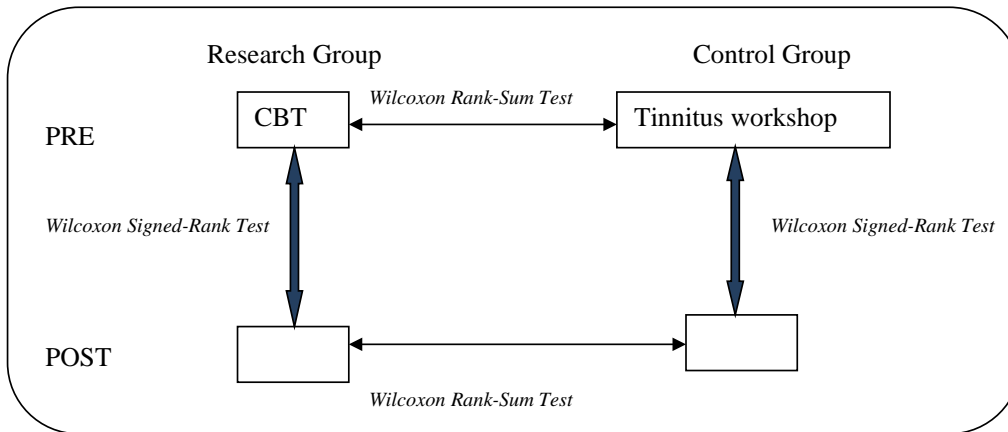
Hypothesis

- Tinnitus distress and annoyance experienced by participants in the control and research groups will decrease as a result of the Tinnitus Workshops and Cognitive Behavioural Therapy.
- Cognitive Behavioural Therapy will result in higher decrease of tinnitus distress than a Tinnitus Workshop.
- Cochlear implantees will respond differently to tinnitus than tinnitus sufferers who are not cochlear implant users.
- Cochlear implant users will need the same protocol of CBT used in the treatment of all tinnitus patients.
- Both interventions will need adjustments for cochlear implant users who suffer from tinnitus concurrently.

Investigating the hypothesis

- In the study, CBT is provided for the research group and a Tinnitus Workshop for the control group. To assess whether either intervention decreases general tinnitus distress, the same diagnostic tools are used: TQ, SF-36, VAS and HADS.
- The study investigates how and if CIs help patients to cope better with tinnitus.
- Both interventions are based on the Psychological Model of Tinnitus and applied conditions are evaluated in terms of their effectiveness.
- Open Questions are filled in by participants before attending any interventions. The Open Questions are analysed, to create a general profile of a typical tinnitus sufferer with a cochlear implant.
- Cognitive Behavioural Therapy and Tinnitus Workshops are investigated as suitable treatments for cochlear implant users. If they are not, it is investigated what kind of adjustments are required.

This project follows the following structure of statistical analysis:



Chapter Three - Methodology

Five cochlear implant centres were involved in this project: The South of England Cochlear Implant Centre (SOECIC), Southampton; the Royal National Throat, Nose and Ear Hospital, London; the John Radcliffe Hospital, Oxford; the Queen Elizabeth Hospital, Birmingham; and Central Manchester University Hospitals. The process of inviting post-implant participants ran from January 2010 until February 2012. Before sending letters of invitation to prospective participants, we applied to the Ethical Committee and obtained an agreement to conduct our research (a few changes were made to the process of recruiting and contacting participants). The principal investigator obtained prior commitment from each hospital to participate in the project. Then the principal investigator was allowed to contact the participants through the centres, by sending information packs and consent forms.

In the beginning, we aimed to recruit 40 participants and allocate them equally into two groups. However, during the process of recruiting, some difficulties arose. First of all, communications between the hospital – a potential participant – and the principal investigator was too lengthy and time-consuming. During consultations with the specialist concerning cochlear implantation, information about the project might have been overlooked or forgotten. Another problem was the time required to attend the Cognitive Behavioural Therapy (up to six sessions, each of 1-1.5 hours). At this point, we decided to introduce Open Questions and transform the nature of this project to one collecting more descriptive and anecdotal evidence. Moreover, the title of this study mentioned tinnitus as a distressing symptom in cochlear implant users; therefore, answering Open Questions allowed patients to give personal descriptions and contribute an informative input to the subject. Together with the supervisor, the principal investigator decided to close the recruiting process after two years.

3.1 Description of this study

The methodology of this study is presented in the figure below (*Fig. 3.0*). The study was divided into two distinct parts: a comparison between CBT and Tinnitus Workshops and collection of a series of responses to Open Questions. The first part of the study is presented using statistical methods, with a clear account of outcome measures. The second part analyses and summarizes the individual patients' reactions to tinnitus.

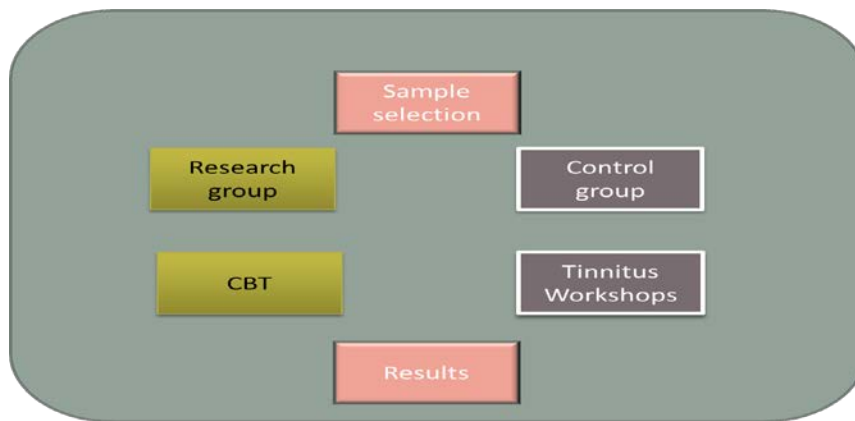


Fig. 3.0 Methodology of the project, in which cochlear implantees undergo one of two different interventions: Cognitive Behaviour Therapy or a Tinnitus Workshop

Once the potential participants agreed to take part in the research, double randomization was applied, and the control and the research groups were created according to those results. The next step was to send a series of questionnaires consisting of the Tinnitus Questionnaire, the Visual Analogue Scale, the Hospital Anxiety and Depression Scale, the Short Form 36 Health Survey and Open Questions. The questionnaires were used to assess tinnitus distress and annoyance before the interventions. After the questionnaires were completed and returned, the participants were invited to take part in a Tinnitus Workshop or Cognitive Behaviour Therapy, depending on randomization results. Initially, we intended to provide all the interventions in a “group” setting, but this was not possible because of patients' personal and work commitments.

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The Tinnitus Workshops took place in the South of England Cochlear Implant Centre, or SOECIC (3 workshops), the Oxford Deaf and Hard of Hearing Centre (2) and the Royal National Throat, Nose and Ear Hospital in London (1). Three workshops were conducted as group sessions and the rest were one-to-one sessions.

Cognitive Behaviour Therapy took place in SOECIC. Five participants were allocated to CBT conducted in groups, and three participants were given therapy individually. Two of the individual participants requested individual treatment and this was accepted because of their personal circumstances.

One week after finishing the interventions, the same set of questionnaires, as well as an additional evaluation form, was distributed to the participants.

3.2 Procedure of the Tinnitus Workshop

Each of the Tinnitus Workshops were conducted in a way that allowed participants to take an active role, ask questions and raise their concerns at any time. Each workshop consisted of tinnitus education, relaxation exercise techniques, a distraction exercise and educational sleep hygiene.

This intervention was presented using a slide projector, which enabled participants to see an agenda, with the aims of the study and educational slides about tinnitus, and to fully understand the programme, despite their hearing difficulties. The principal investigator focused on speaking clearly and slowly to make the workshop easier to understand for participants with limited hearing. Also, the rooms where the Tinnitus Workshops took place were carefully chosen to obtain the best acoustics, where possible. After the workshops, basic handouts were given to each participant.

Education

The aim of the Tinnitus Workshop was to educate the participants, by informing them about tinnitus and co-existing symptoms, in a straightforward way. The neurophysiological and psychological approaches to tinnitus were described in understandable terms. In addition, the physiology and anatomy of the auditory and related systems were explained, along with their effect on tinnitus. This part of the workshop focused on assuring participants that tinnitus is only a symptom and that there are a large number of people who have tinnitus, but who do not suffer from it. When participants identified their coping strategies, they were encouraged to continue them and make them habitual, or incorporate them into their daily routines. The negative idea that there is nothing that can be done about tinnitus was constantly dispelled.

Relaxation

The principal aim of this part of the workshop was to enable participants to cope better with their physiological and mental reactions to tinnitus, which can cause anxiety and tension. It is well known that persistent suffering from tinnitus can lead to anxiety disorder or depression, through increased arousal of the autonomic nervous system (ANS). Relaxation techniques are based on reducing ANS arousal, which, in turn, influences muscle tension and leads to increased general wellbeing. During this part of the workshop, elementary descriptions of the ANS and stress arousal were discussed. Two subdivisions within the ANS were introduced, using an example taken from McKenna et al. (McKenna, 2010).

Progressive Muscle Relaxation (PMR) and abdominal breathing instructions were presented; they help in stressful situations and help to keep the body free of stress. It was strongly emphasized that the aim of relaxation is not to decrease tinnitus, but to cope better with its symptoms. Tuition on abdominal breathing exercises involved informing participants about bodily reactions and muscles involved in breathing. Differences between relaxed and stressed breathing were illustrated and discussed. Patients were instructed that relaxation is a skill, which requires practice and perseverance, and given further instructions to take home.

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The main purpose of the PMR exercise was to show participants how they can control their own muscles and so control their body tension when stressed. They were told about the differences between tensed and relaxed muscles. They practised the PMR exercise for a short time and were asked if they noticed any change. By doing this simple exercise, they could each become aware of their body, reduce their stress and, therefore, decrease their perception and awareness of tinnitus.

Distraction exercise

The aim of this section was to show the participant how easily their attention could be diverted towards a more pleasant or interesting event. According to Hallam et al. (Hallam, 1984) and Wilson and Henry (Wilson, 2000), distraction techniques, with the help of imagination, allow sufferers to think about tinnitus in more positive way, thus alleviating anxiety. In general, distraction techniques should be interesting and easily accessible. The distraction exercise used in this project was based on showing a famous British television sitcom for about five minutes, with instructions to memorize as much of it as possible. Later, a few questions were asked about the programme, then the participants were asked whether they had thought about or heard their tinnitus while watching the sitcom.

Sleep hygiene

Sleep problems are one of the most common difficulties that tinnitus sufferers experience. The sleep-hygiene element of the workshop focused on giving participants an insight into the physiological function of sleep. The effects of sleepless nights or insomnia were discussed; this included explaining the differences between Rapid Eye Movement (REM) and non-rapid Eye Movement (NREM). The importance of sleep and its benefit to our bodies was also explained. The cognitive process model was covered during the explanation of the sleep process, with topics such as arousal, distress, distorted perception and constant night-time worrying. Finally, instructions on a good sleep routine were given to participants; these described how to benefit from sleep and how to maintain the most effective sleep process.

3.3 Procedure of Cognitive Behavioural Therapy

CBT involved, on average, between five and six sessions, each lasting about one and a half hours. Each participant received about eight hours of CBT in total. Some sessions, such as sessions 3-5 (see Overview of CBT programme, below), required precise preparations and were followed up with homework. Each session began with a short summary of the previous session, then the therapist and a participant, or group of participants, set an agenda for the session. Participants were informed about the subject of the session and their homework for the next session. The therapist strongly emphasized the importance of doing the homework and practising the exercises. Regular practice of all the techniques was crucial to participants gaining skills that could be applied outside the therapy. Most of the participants were provided with a Thoughts and Feelings Diary, which was widely discussed later.

Overview of the CBT programme

Session 1 General introduction; psychological approaches to management of tinnitus; education about tinnitus.

Session 2 The effect of thoughts on feelings and behaviour; the A-B-C model; homework.

Session 3 Thinking and tinnitus: challenging and questioning Negative Automatic Thoughts.

Session 4 Identifying styles of Negative Thinking, relaxation training (educational), homework.

Session 5 Controlling Negative Thoughts: thought management techniques.

Session 6 Overview and summary of the programme.

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Before starting the therapy, each participant was informed of the confidentiality of the research and assured that their names would neither be mentioned in the final results nor published. Although the therapist conducted CBT according to the above schedule, some of the subjects were treated with greater flexibility, for their comfort. Dr L. McKenna supervised the CBT therapist; the therapist met him, if needed, or spoke to him on the phone (5 consultations in London and 1 telephone supervision).

3.4 Participant recruitment and inclusion

In total, 357 letters of invitation (Appendices 6, 7, 8) were sent to all participating cochlear-implant centres. Candidacy criteria for cochlear implantation were based on NICE technology and guidelines, and included severe to profound hearing loss with limited benefit following reasonable trials with hearing aids, as well as speech perception test scores of <50-60% at 65dB. The inclusion criteria for this study were: cochlear implant (unilateral or bilateral), residual bothersome tinnitus, and an age of 18 years or older. The date of the implantation was not taken into account. We did not specify exclusion criteria because we wanted to involve all patients interested in the project. As a first step, the audiologists from the centres approached potential participants. Prospective participants were sent letters explaining why they had been contacted and what the project involved. Then, if any candidate agreed to take part and returned the consent form, the set of questionnaires was sent, along with a stamped, addressed envelope.

As well as the participating centres, we decided to increase interest through use of social media (Facebook), and by advertising through the British Tinnitus Association, which announces the latest information on tinnitus and details current research and opportunities for public involvement. Furthermore, we were invited to write articles for the self-help magazines *Quiet* (Winter 2011) and *Hearing Times* (March 2011), which cover information on tinnitus and hearing problems. In both articles, we invited readers to take part in our research.

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Altogether, we received 62 consent forms: 3 from Birmingham, 5 from London, 16 from Oxford and 38 from SOECIC. The most common reasons for participants not wanting to engage in the project were: unspecified, unable to travel, already learnt how to cope with tinnitus/control tinnitus, problem with English language, lack of tinnitus, improved hearing and tinnitus perception post-CI, other arrangements, death of the potential participant or lack of support (potential participant was the only carer of his/her spouse).

The second stage of the project involved randomized allocation into two proposed intervention groups: invitation letters were sent offering participation in either Cognitive Behavioural Therapy or a Tinnitus Workshop. Among those who refused the workshop (12 received), the most common causes appeared to be: travel time, health conditions and previous engagements. We received 6 official refusals of CBT, in which the most common reasons given were travel and dealing with tinnitus without any problems. However, a few participants flatly refused to attend CBT because they felt they were “*not suitable for this kind of treatment*”. After randomization and allocation to the research and control groups, 22 participants progressed no farther in the project (most without giving a reason), 2 officially withdrew and 1 participant died during the recruiting process. Overall, 20 participants were randomly allocated to the research and control groups.

However, after the recruiting process, it appeared that in the control group we treated 12 participants and in the research group we managed to treat 8 participants. The main causes of drop-out from the research group were travel issues and work commitments. We also received letters of complaint from some participants, who had hoped to join the CBT group, felt disappointed when they were allocated to the control group, and decided not to proceed any farther. Some patients, on the contrary, were afraid to take part in the CBT because they thought that psychological help would not contribute anything to, and might even aggravate, their tinnitus.

Statistics for the control group are as follows: 5 men and 7 women; mean age of 60 (SD=2.6, age range = 46-79). Implant duration ranged from 2-17 years, with a mean

period of 7 years ($SD=5.5$). Cochlear implants were implanted only on the right side ($N=6$), and only on the left side ($N=4$). Two participants were implanted bilaterally ($N=2$). Mean duration of deafness or severe hearing problems in these participants was 27 years ($SD=15.7$ and ranged from 4-59 years). Mean period of tinnitus was 29 years ($SD=18$ and ranged from 5-54 years). Cause of deafness included meningitis, Ménière's disease, accident, infection and nerve problems; in some cases, participants did not state the cause of deafness (*Table 7*). One of the participants received tinnitus treatment prior to this research. Four patients complained about vertigo and occasional, severe headaches as symptoms of their tinnitus. Most of the participants pointed out that stress and tiredness make their tinnitus worse. Also one patient complained about musical ear syndrome (MES), which is a condition seen in people who have hearing loss and subsequently develop auditory hallucinations. It is comparable to Charles Bonnet syndrome (CBS), which is associated with visual hallucinations in visually impaired people. Furthermore, participants complained about tinnitus preventing them from interacting well in social situations, as well as impeding their ability to sleep.

Statistics for the research group are as follows: 4 women and 4 men; mean age of 59.1 ($SD=13.4$, range = 37-76). Implant period ranged from 4-16 years. Six participants were implanted on the right side ($N=6$) and the remaining 2 on the left side ($N=2$). Duration of deafness was extremely varied, from 2-66 years. Two participants indicated that they had become progressively deaf since birth. Causes of deafness included nerve deafness, otosclerosis, congenital hearing loss, childhood abscesses, deafness from birth and meningitis, with one participant unable to provide the cause of deafness (*Table 8*). Duration of tinnitus varied from 7-64 years and one participant complained that tinnitus had started since implantation. Two participants in this group underwent a different kind of tinnitus treatment: pharmacological intervention and a support group.

Subject	Age	Implanted ear	Implant year	Affected ear	Cause of deafness (*)	Duration of deafness	Duration of tinnitus
1	46	R	2009	R+head	wide vestibular aqueduct	40	30
2	59	L	2009	L+R	infection	10	15
32	68	L	2008	L+R	flu	40	54
7	59	R	2009	R+head	nerve deafness	30	33
8	66	L	2004	R	heredity	30	45
26	60	R+L	2004	R+L	meningitis	7	6
14	63	L	1994	R+L and head	Ménière's disease	24	5
10	59	L	2009	R+L	u/k	52	49
42	50	R	2009	R	u/k	4	5
11	76	R+L	1999/2002	R	u/k	30	9
49	49	R	1995	R+L	accident	15	31
41	59	R	2003	L	u/k	30	20

Table 7 Profiles of the participants in the control group (*data according to the participants, taken at the time of the Tinnitus Workshops in 2011)

Subject	Age	Implanted ear	Implant year	Affected ear	Cause of deafness(*)	Duration of deafness	Duration of tinnitus
54	37	R	2010	R+L	nerve deafness	progressive from birth	25
23	61	R	2008	L+R	unknown	2	7
21	72	L	2008	R	otosclerosis	40	43
29	59	R	2009	R+head	congenital hearing loss	progressive from birth	~20
6	76	R	2006	R+L	childhood abscesses	66	64
22	56	L	1998	head	born deaf	56	since implantation
27	44	R	1994	R+L and head	meningitis	10	27
31	68	R	2007	R+L	u/k	12	4 years in R, longer in L

Table 8 Profiles of the participants in the research group (*data according to the participants)

3.5 Questionnaires

A number of standard questionnaires were used to measure the outcome of this project; these were the Tinnitus Questionnaire (Hallam, 2008), Visual Analogue Scale (Wewers and Lowe, 1990), Short Form 36 Health Survey (Jenkinson, 1996), and the Hospital Anxiety and Depression Scale (Sanaith, 1994). In addition, we created Open Questions to gain wider insight into each participant's situation concerning tinnitus, how they coped with it and how (or if) cochlear implantation changed their perception of tinnitus.

3.5.1 Tinnitus Questionnaire (Appendix 1)

The Tinnitus Questionnaire (TQ) is the main instrument used to measure the entire impact of tinnitus on individuals. It was developed during research at the Royal National

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Throat, Nose and Ear Hospital in London (1981-1988), as a method of measuring the annoyance and emotional distress that tinnitus may cause (Hallam, 2008). TQ was used (1) as a screening instrument, (2) to evaluate any change after the intervention, and (3) to examine the relationship between different facets of the complaint and other psychological variables. The questionnaire was also used to explore how each complaint relates to the audiometric properties of tinnitus, such as pitch, loudness match and minimal masking level.

Individuals may experience different ranges of feelings and consequences of having tinnitus. These include: annoyance resulting from unwanted intrusion into awareness; interference with hearing and sleeping; emotional instability such as anxiety, anger, depression; difficulty with mental concentration; worries about future health and wellbeing. The questionnaire was designed to distinguish distress specifically associated with tinnitus from any broader, clinical state of anxiety or depression (Hallam, 2008).

The main aim of TQ is to perform a rapid assessment of the chief psychological effects of tinnitus. The questionnaire also highlights any negative beliefs that sufferers commonly express about the significance of tinnitus, as well as emphasizing the role of Cognitive Behavioural Therapy in treating tinnitus symptoms (Zachariat, 2004; Goebel et al., 2006). The full version of the Tinnitus Questionnaire contains 52 items, but answers to only 41 are included in the total score. TQ assesses five key complaint categories: Emotional distress (19 items), Intrusiveness (7 items), Auditory perceptual difficulties (7 items), Sleep disturbance (4 items) and Somatic complaints (4 items).

“The first and the largest of the TQ complaints is *Emotional Distress*, it comprises a collection of worries about the persistence of noises and their significance for mental and physical health, an inability to cope, a low mood, irritability and anger, a sense of unfairness and victimisation. There appears to be a large cognitive component in this factor ... The second subscale, *Intrusiveness*, reflects an evaluation that tends to be more sensory than emotional; the noises are perceived as loud and unrelenting, constantly intruding into awareness, and as inescapable and impossible to ignore. The *Auditory*

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perceptual difficulties factor relates to the effect of tinnitus on the ability to converse, to discriminate speech, to appreciate music, and to locate sounds. The *Sleeping disturbance* factor identifies those individuals who report problems in getting to sleep, walking in the night, and early morning awakening. The *Somatic complaints* factor indicates the presence of ear or head pain, and muscle tension, especially in the face and neck.” (Hallam, 2008) TQ responses are scored as 2, 1, and 0, with 2 corresponding to “true”, 1 being “partly true”, and 0 “not true.” According to Hallam, the interpretation of the subscales is entirely dependent on the clinical assumptions of the study.

The Tinnitus Questionnaire is a popular device to use because of its presentation, which seems to be easier to answer than other tinnitus questionnaires and, therefore, older (less able) participants do not have problems with filling it in. Total TQ scores have been found to have a high internal consistency (Cronbach’s $\alpha = 0.95$). In addition, each of the individual subscales of the TQ has been found to have test-retest reliability (Hallam, 2008). TQ subscale scores demand an individual approach in interpreting the obtained results; the interpretation depends on the clinical purposes to which TQ is put. It is suggested that clinicians should generate their own criteria. In the German TQ, a total score of 47 and above is regarded as a clinically significant level of distress (range = 0-84). The English TQ interpretation (*Table 9*) was suggested by Hallam (2008).

SCALE	0-25% moderate	26-50% medium	51-75% less severe	76-100% severe
Emotional distress	0-8	9-19	10-27	28-38
Aud. Percept. Difficulties	0-3	4-6	7-9	10-14
Intrusiveness	0-7	8-10	11-13	14
Sleep disturbance	0	0-3	4-6	7-8
Somatic complaints	0-3	4-5	6-7	8
Total TQ	0-24	25-43	44-58	59-82

Table 9 Distribution of TQ subscale scores by quartiles, Hallam (2008)

3.5.2 Visual Analogue Scale (Appendix 3)

A Visual Analogue Scale (VAS) is a psychometric response scale based on subjective response, which can be used in questionnaires; it helps to measure a characteristic or attitude to something (in this case, tinnitus) that cannot be objectively measured. Participants indicate the intensity of their tinnitus and their reaction towards it, using a mark on a horizontal, 100mm line. Answers are indicated on a sliding scale, from 'low' to 'very high' pain or no pain (depending on the study's subject).

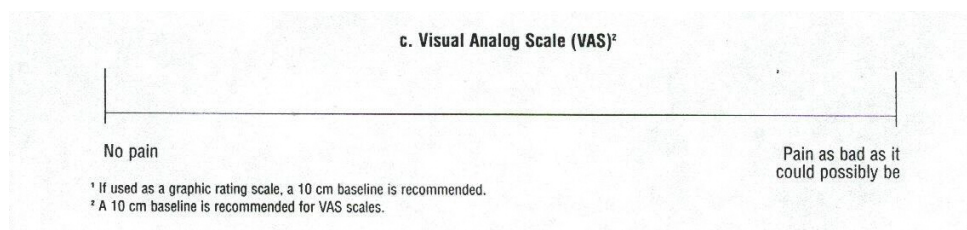


Fig. 3.1 Example of Visual Analogue Scale

VAS is useful in tinnitus measurement, because it can measure various aspects of tinnitus, such as loudness and annoyance. It is important to know that VAS is not an objective measurement on its own, but, combined with other instruments, it is recommended for use in tinnitus research (Andersson et al., 2005). The main advantage of this device is its simplicity, so it is likely to be completed by patients. Brazier (Andersson, Porsaeus et al., 2005) reported a 90% completion rate for VAS. It also has been found that it correlated to the Tinnitus Handicap Inventory questionnaire as an outcome reassurance for tinnitus (De Azevedo, 2007). Hallam (Hallam, 2008) also found that VAS correlated to the Tinnitus Questionnaire. Nevertheless, VAS has limitations, due to its superficial method of assessing, which could be influenced by cultural, intellectual and psychological factors. The principal investigator was advised to use it as a standard and easy way in assessing tinnitus distress.

3.5.3 Quality of Life, Short Form 36 Health Survey (Appendix 4)

The SF-36 is a multipurpose, short-form health survey, which consists of 36 questions (see Appendix 4). It produces an 8-scale profile of physical- and mental-health scales: physical functioning (10 items); role limitations due to physical health (4 items); bodily pain (2); general health perceptions (5); vitality (4); social functioning (2); role limitations due to emotional problems (3); and mental health (5). Scores from each of these domains are obtained by totalling up the item responses and, with the use of a scoring algorithm, transforming these raw scores into a scale, from 0 for poor health to 100 for a good health. It is a generic measure without any limitation of age, disease or any specific targets. Therefore, SF-36 has proven useful in surveys of general and specific populations. The authors suggested that the questionnaire should take about five minutes to complete and evidence from its use in the UK proves this assumption, since response rates in postal surveys using SF-36 are high (Jenkinson, 1996). SF-36 has been used widely and documented in nearly 4,000 publications.

3.5.4 Hospital Anxiety and Depression Scale (Appendix 5)

The Hospital Anxiety and Depression Scale (HADS) is a screening device for measuring the severity of anxiety and depression separately. With this instrument, anxiety is described as a state of generalized anxiety, not necessarily focused on a particular situation or event. The concept covers the states of anxious mood, restlessness and anxious thoughts. Depression also includes many states: states of grief, demoralization, low self-esteem and pessimism. It contains only 14 questions to determine the presence and severity of both anxiety and depression simultaneously, while allocating a separate score for each. It is validated for tinnitus, and provides points to indicate whether someone is 'within the normal range', or in a 'mildly', 'moderately' or 'severely' disordered state (see Appendix 5). The results are presented in two scales that give an estimate of irritable mood disorders and help to identify particular areas of anxiety concern.

HADS was designed as an emergency aid for clinicians, to estimate the psychological state of a patient. Initially, its use was expected to be confined to non-psychiatric hospitals and clinics, but the popularity of HADS was such that it became a useful and reliable instrument in other situations. Zigmond and Snaith (1994) carried out a measure of internal consistency, and item-subscale correlation showed a significant association of between 0.76 and 0.41 for the A-scale and between 0.60 and 0.30 for the D-scale. Also Moorey and Green (Moorey, 1991) confirmed HADS' internal consistency in their research, where Cronbach's alpha was 0.93 for the A-scale and 0.90 for the D-scale. The validity of this instrument was confirmed by Moorey using a factor analysis of the responses of 568 cancer patients.

3.5.5 Open Questions (Appendix 2)

The Open Questions aimed to gain as much information as possible about tinnitus and the way the participants cope with it. We wanted to investigate their behavioural and emotional reactions to tinnitus in general. There were also questions which covered such

aspects as tinnitus history, cochlear-implant experience, emotional reaction to tinnitus, possible coping strategies and behavioural reactions. The Open Questions made it possible to categorize typical reactions to tinnitus and any altered behaviour. During the analysis, the most common answers of this group of participants were considered. The questions were based on an example in the *Tinnitus Handbook*, edited by Tyler (2000), where the most common interview standards were described. It was important for the project to get an insight into each participant's experience of tinnitus and CI. The Open Questions have been approved by the Ethical Health Committee.

During analysis, the Open Questions were divided into two main categories: *Tinnitus* and *Cochlear implant and tinnitus*. The first category aimed to gather the individual's description of tinnitus, data which enabled us to define the characteristics of tinnitus in cochlear implantees. The second category focused on the impact of the cochlear implantation on tinnitus; we asked if implantation, and to what degree, the cochlear implant influenced the perception of tinnitus. Moreover, one subcategory, *Tinnitus and informative factors*, was created, which in particular focused on determining the coping mechanisms used by the participants and factors which increase or decrease tinnitus.

3.5.6 Evaluation Forms (Appendices 10, 11)

The evaluation forms were included in the project as an assessment of two interventions: CBT and the Tinnitus Workshop. For the Tinnitus Workshop, the evaluation form consisted of two parts. One part assessed whether the intervention was successful in helping the participant to cope with tinnitus and if it helped to re-adjust their thoughts about tinnitus. The second part assessed the effectiveness of the methodology of the workshop.

The evaluation form for CBT was similar to, but shorter than, the one used to assess the Tinnitus Workshop. It consisted of only one section, which aimed to assess the usefulness of this kind of help, that is, especially created for cochlear implant users who additionally suffer from tinnitus.

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The evaluation forms were sent to the participants a week after both interventions finished. Participants were told that the evaluation forms were anonymous in order to ensure frank comments.

Chapter Four - Results

Twenty participants in total took part in this study. The reasons for this were explained in Chapter Three. Because of the amount of data obtained, the power and quantitative value of the study was not as great as was hoped. However, the use of Open Questions added the qualitative value to the project and data gathered from the participants has provided an additional, descriptive and anecdotal dimension to the thesis.

Data was analysed as follows:

- The non-parametric tests were used for all submitted questionnaires.
- To investigate if pre- and post-intervention results were significant, the Wilcoxon Signed-Rank Test was carried out on all questionnaires completed by participants.
- To investigate the differences between the control and research groups, pre- and post-interventions, the Wilcoxon Sum-Rank Test was employed.
- *Spearman's Rank Order Correlation* was calculated to investigate any correlation between the measured outcomes.
- The Kruskal-Wallis Test was performed, to investigate if factors such as time of implantation had effects on the total scores in questionnaires completed by participants.
- The effect size calculated.
- The .05 significance level was used for all statistical tests.
- All data was analysed using SPSS (Version 19).
- A summary of the questionnaires' results was drawn up.
- A summary of the responses to the Open Questions was drawn up.
- A summary of the responses to the Evaluation Forms, from the Tinnitus Workshops and the CBT, was drawn up.

4.1 The control group

Descriptive profiles of participants in the control group

Participant 8

The participant attended the Tinnitus Workshop on 30 June 2011, in SOECIC. She was the only one who joined the intervention that day. The participant was stressed and oversensitive, because of her experience the day before the meeting, when there was a burglary at her house. She was particularly worried by the event, since she could have been at home at the time, sleeping without her CI processor on and completely cut off from the outside world. Because of this, she found quite difficult to listen to our lectures. However, we realized that she did not want to listen to any negative or even new information concerning tinnitus because it made her anxious. She claimed that she had reached the point where tinnitus does not disturb her very much in everyday situations; however, when she is stressed and tense, she perceived her stress to be higher and more intrusive. During the workshop, the participant did not ask many questions, she was relatively passive and working with her was rather difficult. She commented that the workshop was organized for her too late: she would have benefitted from it more, if she had attended earlier, shortly after receiving her cochlear implant.

Participant 41

The participant was the only one who could attend the Tinnitus Workshop on 16 August 2011 in Oxford. The participant received a cochlear implant about 10 years ago in the right ear. She confirmed that the implant gave her good hearing and since then she is able to communicate. However, the CI is the main cause of her tinnitus. Before implantation, she did not experience any unpleasant sounds in either the ears or the head. She was very involved in the intervention and asked many questions about the psychological site of tinnitus. Her main issue was that she had become very dependent on her device; she thought of it as fragile with the possibility of breaking down and this caused her tension and need to constantly check that it was working. She was anxious about staying overnight in a new place, because she feels very vulnerable during the night. She

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admitted that she avoids loud places and she is slowly withdrawing from social life due to her tinnitus. She was the only participant who owns a hearing dog, which helps her to notice the source of a sound and is a great help when her CI processor is off. The participant told a couple of stories to illustrate how problematic it is to be a hard-of-hearing person. For example, one day, a taxi driver thought that she was impolite and threatened her, but she simply had been unable to hear him.

Participant 11

The participant attended the tinnitus intervention on 06 July 2011 in SOECIC with another participant (32). Unlike other participants, he was implanted in both ears, consecutively. He admitted that he does not suffer from tinnitus very often, but when he does it can be really difficult for him. He realized that stress could be a factor that influences his well-being and usually could increase his tinnitus. Also, his personal situation has an impact on tinnitus perception. Similarly, strong physical exertion creates difficulties for him in coping with tinnitus. The participant was interested in the workshop because he had previously taken part in several studies concerning tinnitus and/or cochlear implants. His point of view was scientific and he was able to explain a lot of issues to the other member of the workshop. Since there was more than one participant, the workshop was mainly structured around discussion between them; this created an informative atmosphere and gave us many ideas for future workshops. It also confirmed that a workshop organized for a group could be more beneficial for participants.

Participant 2

The next participant attended the tinnitus workshop on 23 August 2011 at the Royal National Throat, Nose and Ear Hospital in London. He was recruited via an advert in *Quiet* magazine. This participant was very pleased to attend the tinnitus intervention, because he described himself as suffering greatly from tinnitus and had not so far received any help with it. The participant was implanted about 4 years ago and there is a possibility that he will receive an implant in his other ear. The participant still relies on lip-reading and sign language most of the time. The participant's biggest problem with

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tinnitus is when his CI processor is switched off; in this situation, he cannot stand the loudness and intensity of his tinnitus. Because of this, he experiences severe sleep problems and, on top of that, during sleepless nights he drinks a lot of tea or coffee. On one occasion, he was advised by a hearing therapist to adhere to the rules of sleep hygiene; however, he did not follow the routine.

Because of the difficulties in communicating with this participant, it was not possible to present to him all the prepared information and presentations. The participant was more interested in sharing his own experiences and problems with us than in learning about tinnitus. We covered the neurophysiological approach, some of the psychological approach, relaxation and sleep hygiene. We also advised him to read our handouts. Because of his emotional condition, as well as his problem in communicating with other people, it was suggested that he attend CBT for tinnitus patients. It is interesting that the participant was strongly considering adopting a hearing dog to help him organize his daily life (he lives on his own). He believed that having a dog would help him socialize and allow him to be more open towards other people and also towards other sufferers of deafness and tinnitus.

Participant 32

This participant attended the Tinnitus Workshop held on 06 July 2011 at SOECIC, along with participant 11. She was implanted in the left ear. Thanks to the implantation, she has learned to cope much better with her tinnitus. She acknowledged that her biggest problem is her inability to understand speech, and to admit this to everyone, rather than her tinnitus. Her husband was very supportive, conducting conversations on her behalf. Now, she has just started to do things on her own and tries to challenge herself. She was very open towards the other participant, talked mainly about her feelings about tinnitus and how it is to be hard of hearing. Again, this confirmed our observation that the atmosphere was more conducive to effective exchange of information, and therefore more beneficial, where the intervention involves more than one participant.

Participant 26

This participant attended the Tinnitus Workshop along with three other participants (14, 1 and 7) on 05 July 2011 in ISVR at the University of Southampton. As was the case with participant 11, she was implanted in both ears, but simultaneously. The participant described her tinnitus as a constant noise that does not stop. After years of trying to ignore it, she found that playing puzzles brings her huge relief, because she is concentrating so much that she is not able to hear her tinnitus. She complained about difficulty getting to sleep; however, when she managed to fall asleep, she enjoys it since it is time when she does not hear tinnitus. The participant took part in a discussion about problems that arise because of tinnitus. She came with a friend (who also suffered from tinnitus, but did not use CI or hearing aids). This guest's attendance was agreed to by other participants before starting the intervention.

Participant 14

This participant attended the tinnitus intervention together with three others (1, 7 and 26) on 05 July 2011 in ISVR at the University of Southampton. It became clear to us that she suffered terribly from tinnitus; however, she was not able to talk to us about it. It could have been that the group intimidated her or her introverted personality. However, she did admit that she cannot stop thinking about tinnitus and is constantly annoyed by it, causing her to be irritated and anxious. She had tried to get help, but it had not been successful. We tried to give as much attention as possible to her and her particular problems. We gave her handouts to read and suggested she join a self-help organization or get a referral to CBT for tinnitus sufferers.

Participant 1

The next participant attended the tinnitus workshop as one of four participants (14, 7 and 26) on 05 July 2011 in ISVR at the University of Southampton. This participant surprised everyone by stating that she likes her tinnitus. This is because she treats her tinnitus as just one, natural sound that originates from her own hearing system. The participant was born deaf, which may explain her positive attitude. She offered an alternative and fresh

view on tinnitus and its consequences, creating a discussion that influenced the rest of the group positively.

Participant 7

This subject attended the Tinnitus Workshop as part of the group (14, 1 and 26) described above, on 05 July 2011 in ISVR at the University of Southampton. She was extremely active and tried to engage with other participants. She was very involved and dedicated to problems caused by tinnitus. She agreed that she copes with it and that her life did not change much because of it. She instead describes using a CI as a major change in her life, which involved lots of compromise and adjustment.

Participants 7, 14, 26 and 1 (plus the friend of 26) benefited from the Tinnitus Workshop enormously and thanked each other. The discussion and questions that arose during the intervention were extremely helpful to them.

Participant 42

The participant attended a tinnitus intervention along with participant 49 on 17 October 2011 at the Oxford Deaf and Hard of Hearing Centre. Immediately, both attendees found some common ground and started sharing their tinnitus and CI experiences. Participant 42 was immensely interested in tinnitus because he also works with a group of students on the same subject as this study. He was implanted about four years ago. Before the implantation, he suffered from tinnitus; however, after the operation, his tinnitus evolved into a range of different sounds. It was similar to music and he was diagnosed with musical ear syndrome, or auditory imagery (Coles, 1997), which co-occurs with profound hearing loss. It is common for this to develop into auditory hallucinations. He learnt to cope with tinnitus very well, but because of his work feels stressed and overworked, which in turn aggravates his tinnitus and then his coping strategies fail. He was aware of his coping mechanisms and when we talked about safety behaviours, he was open about his “escapes” to avoid increasing his tinnitus, giving up sometimes his friends or social meetings he had wanted to attend.

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Both participants shared their experiences of being implanted and invented a phrase – identity of deafness. This was very interesting and gave a new perspective to the complexity of the problem.

Participant 49

This participant attended the Tinnitus Workshop along with participant 42 on 17 October 2011 at the Oxford Deaf and Hard of Hearing Centre. The participant was implanted 18 years ago after being deaf (due to a motorcycle accident) for about 10 years. Understandably, his speech was slightly affected by this, although he admitted that have a CI gave him a second life, a second chance. His tinnitus is intrusive, but he had got used to it and tries to ignore it. The participant's attitude changed after being implanted and then his tinnitus became insignificant. This participant was particularly interested in the psychological aspect of tinnitus and depression that may occur as a result of it. He admitted that losing his hearing was a traumatic experience, equally affecting his social and personal life, because some people could not cope with him being deaf.

With both participants, we talked about deaf communities and their rejection of CI implantees as people who deny their deafness. It provoked an interesting conversation on the differences between cochlear implant and hearing-aid users.

Participant 10

The next participant attended a control intervention on 1 July 2011 at SOECIC. He was interested in tinnitus from the pathophysiological aspect, as it was part of his job. His curiosity and knowledge was impressive, which was reflected in the questions he asked. During the workshop, this participant discovered the psychological side of tinnitus, which surprised him since he identified with many aspects of this type of emotional discomfort. According to him, being deaf had caused him to remain single, because he could not find anyone who could understand his situation. His family also does not seem to be supportive. As well as this, he is the only one who looks after his mother. All these problems led to the participant being depressed and he perceives his tinnitus even more strongly. The subject had tried to get some help and he was offered CBT, but he did not

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like it. After our presentation, he was more interested in obtaining psychological help, particularly regarding core beliefs and the personal meaning of tinnitus. Because he had lost his hearing when he was 7, his speech and ability to hear using a CI are limited. As he was our first participant, this exercise was an important insight into how to communicate with people who are hard of hearing.

Results from the questionnaires completed by participants are shown in tables below (*Tables 10, 11*). These describe the outcomes pre-and post-intervention for each participant, where the scales of anxiety and depression derive from HADS subscales, and physical and mental health subscales derive from the SF-36 questionnaire. The HADS scores may be interpreted by dividing them into four ranges: 0-7 = normal, 8-10 = mild, 11-14 = moderate and 15-21 = severe. The results of the SF-36 are separated into two ranges: poor health = <50; good health = >50. The Tinnitus Questionnaire (TQ) evaluates change in tinnitus perception after treatment interventions and examines relationships between different facets of complaint and other psychological variables. Visual Analogue Scale measures individual perception of tinnitus.

Subject	TQ	VAS (cm)	Anxiety (HADS)	Depression (HADS)	Physical health (SF-36)	Mental health (SF-36)
41	59	7	14	7	35	44
2	69	8.2	13	8	36	33
1	13	1.6	2	0	94	84
32	21	4.8	12	3	95	85
10	37	5.6	9	4	68	68
7	28	0.7	8	0	95	83
11	44	0.3	2	0	45	87
8	49	3.6	13	7	50	64
14	51	10	6	2	58	59
26	82	4.8	5	4	68	78
49	25	1.5	5	3	35	69
42	28	3	9	7	81	70

Table 10 Pre-intervention scores in the control group

Subject	TQ	VAS (cm)	Anxiety (HADS)	Depression (HADS)	Physical health (SF-36)	Mental health (SF-36)
41	65	7	11	6	40	52
2	74	7.9	14	9	35	17
1	7	0.9	6	2	92	87
32	31	1.9	13	3	92	82
10	50	5.4	11	8	46	34
7	22	1.9	6	0	100	84
11	45	0.3	3	2	20	77
8	37	3.1	10	3	28	64
14	58	10	8	9	18	41
26	54	6	8	5	55	74
49	25	2.4	2	2	72	75
42	24	1.4	11	7	83	65

Table 11 Post-intervention scores in the control group

4.1.1 Results from questionnaires

Descriptive results were taken from the TQ, VAS, HADS and SF-36 questionnaires before and after each intervention (Tinnitus Workshop), as follows:

Table 12 Mean results from questionnaires pre-intervention in the control group

TQ	VAS	Depression (HADS)	Anxiety (HADS)	Physical health (SF-36)	Mental health (SF-36)
42.17 (IQR=40.50)	4.26 (IQR=41.00)	3.67 (IQR=3.50)	8.17 (IQR=8.50)	63.33 (IQR=63.00)	68.67 (IQR=69.50)

Table 13 Mean results from questionnaires post-intervention in the control group

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TQ	VAS	Depression (HADS)	Anxiety (HADS)	Physical health (SF-36)	Mental health (SF-36)
41.00 (IQR=41.00)	4.02 (IQR=2.75)	4.67 (IQR=4.00)	8.58 (IQR=9.00)	56.75 (IQR=50.50)	62.67 (IQR=69.50)

Non-parametric tests were used to analyse the questionnaires. The data from questionnaires was expressed in ordinal measures, since it is difficult to compare the results and scale them from questionnaires. Also, the final results obtained from the non-parametric statistic are exact probabilities, regardless of the shape of the population distribution from which the random sample was taken. The methodology used was also influenced by the fact that the sample used in the study was small.

The Wilcoxon Signed-Rank Test was performed to investigate whether there were any significant differences between pre- and post-intervention (Tinnitus Workshop).

- There were small, but insignificant, differences between pre- and post-intervention TQ scores: $z=-0.89, p>0.05, r=-0.26$
- VAS scores were lower after the intervention, but there were no significant differences between pre- and post-intervention: $z=-0.534, p>0.05, r=-0.15$
- There were no significant differences between pre- and post-intervention in HADS scores: in the anxiety subscale: $z=-0.396, p>0.05, r=-0.11$, in the depression subscale: $z=-1.34, p>0.05, r=-0.38$
- There were small, but insignificant, differences between pre- and post-intervention SF-36 scores, in the mental health subscale: $z=-1.468, p>0.05, r=-0.42$
- The SF-36 physical health scores were lower post-intervention, but the differences were insignificant: $z=-1.139, p>0.05, r=-0.32$

Explanation of the following figures

The figures in the next three pages show box plots combined with ladder diagrams, which illustrate all “raw” data gathered from the control group, together with descriptive statistics of the box plots.

- The top and bottom lines of each box are the 25th and 75th quartiles of the samples. The distances between the tops and bottoms are the inter-quartile ranges.
- The line in the middle of each box is the median. If the median is not centred in the box, it shows sample skewness (as in *Fig. 4.1*).
- The whiskers are lines extending either 1.5 times the inter-quartile range or the biggest (smallest) data point above and below each box (whichever is larger (smaller)).
- The notches indicate the 95% confidence interval of the median.
- Small, red crosses (as in *Fig. 4.5*) show outliers (more than 1.5 times IQR away from quartiles).
- The coloured lines show each individual participant’s results.
- The legend in the top right-hand corner indicates the participant’s number.

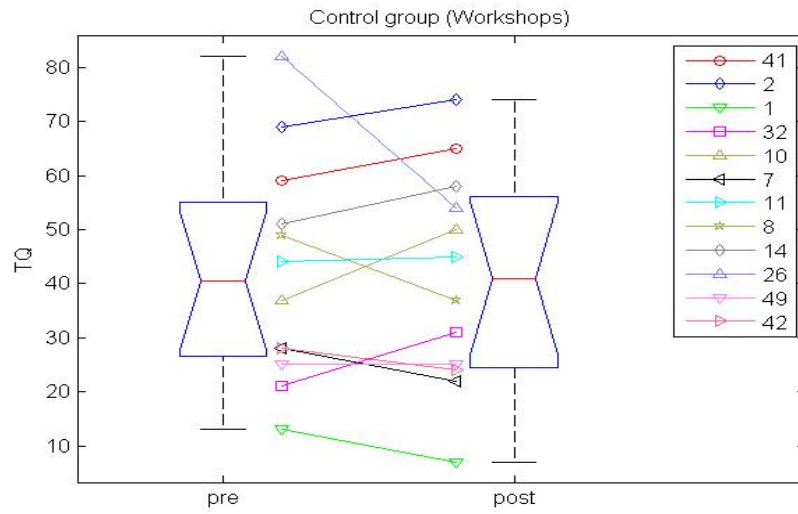


Fig. 4.0 TQ pre- and post-intervention in the control group

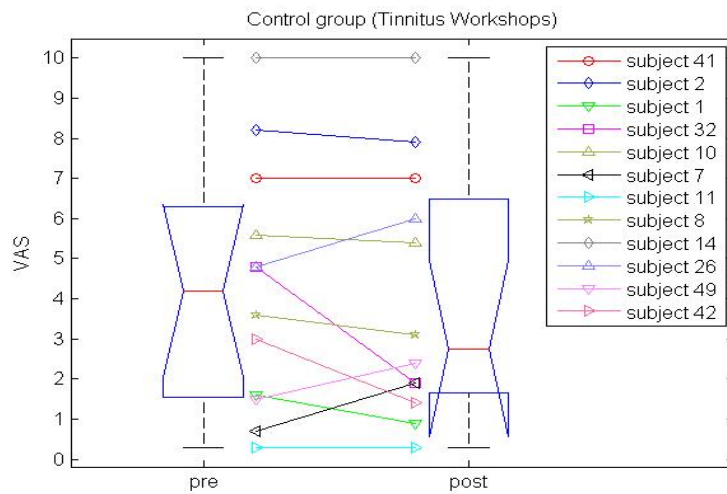


Fig. 4.1 VAS pre- and post-intervention in the control group

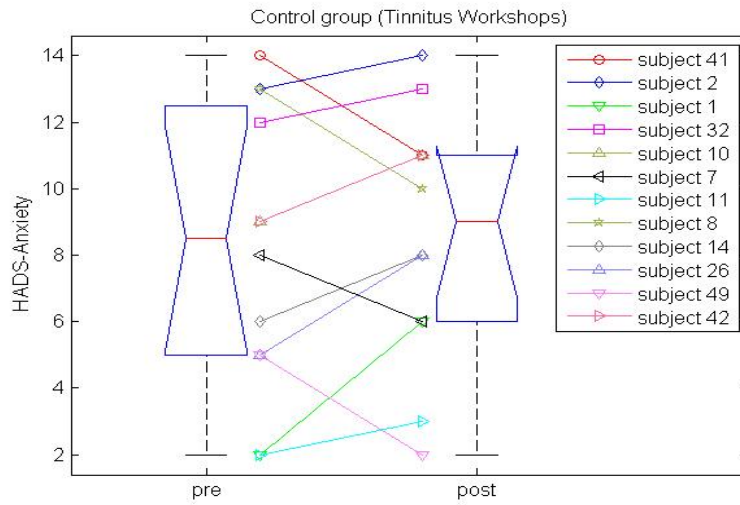


Fig. 4.2 Anxiety (HADS) pre- and post-intervention in the control group

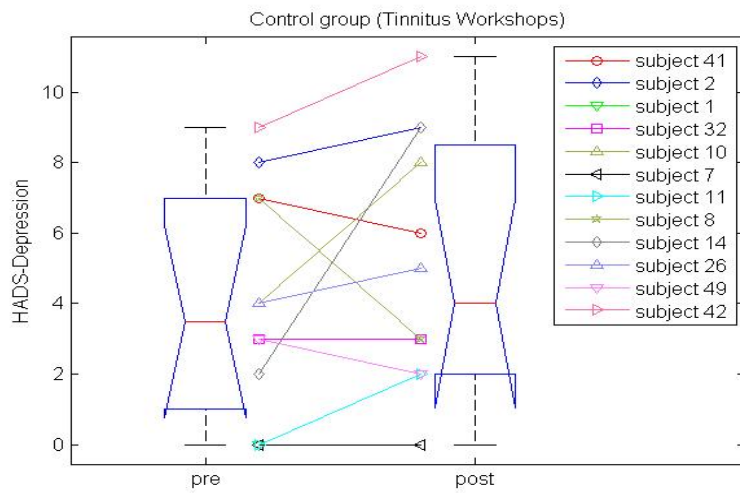


Fig. 4.3 Depression (HADS) pre- and post-intervention in the control group

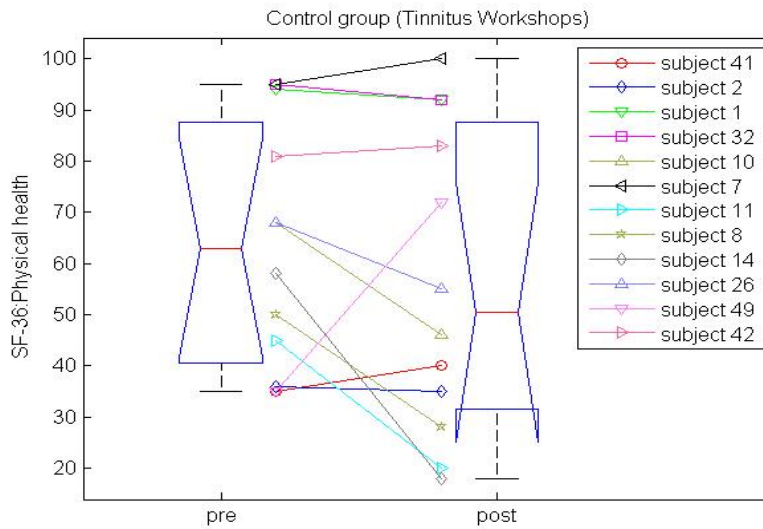


Fig. 4.4 SF-36: Physical health pre- and post-intervention in the control group

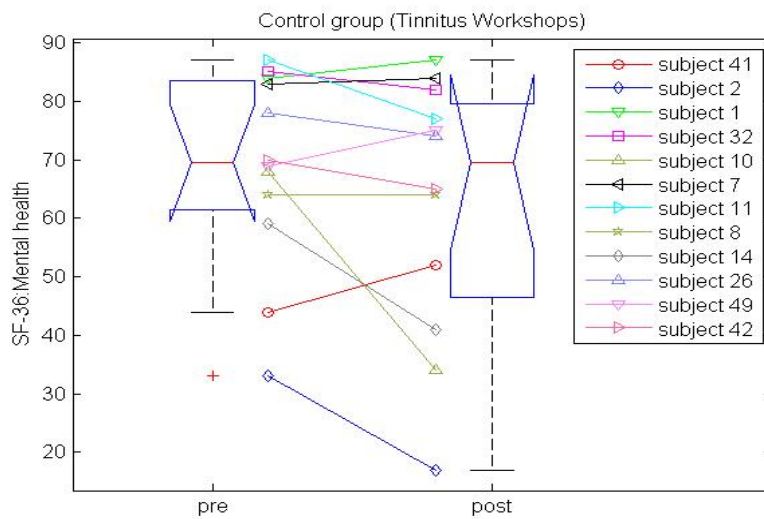


Fig. 4.5 SF-36: Mental health pre- and post-intervention in the control group

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Spearman's Rank Order Correlation was calculated to investigate any correlation between the measured outcomes. It appeared that:

- No correlation was found between the measures (TQ and VAS) in pre-intervention scores: $r(12) = 0.55, p > .05$

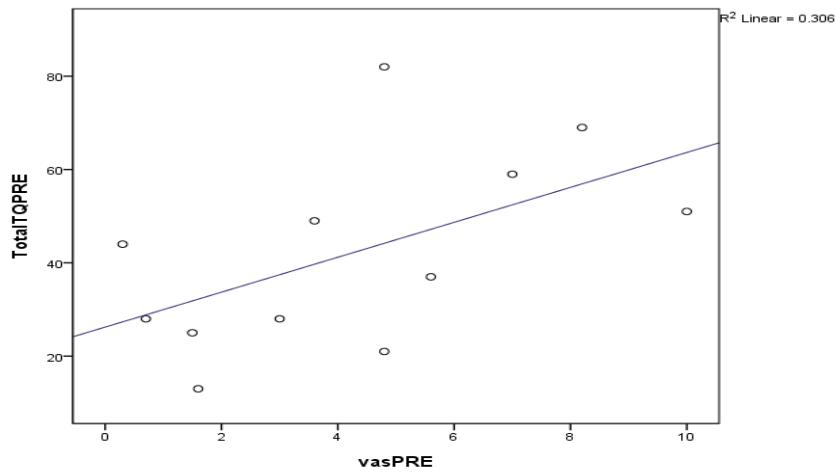


Fig. 4.6 Correlation between TQ and VAS pre-intervention in the control group

- There was a strong correlation between TQ and VAS scores post-intervention at the 0.01 level, where $r(12) = .819, p < 0.01$

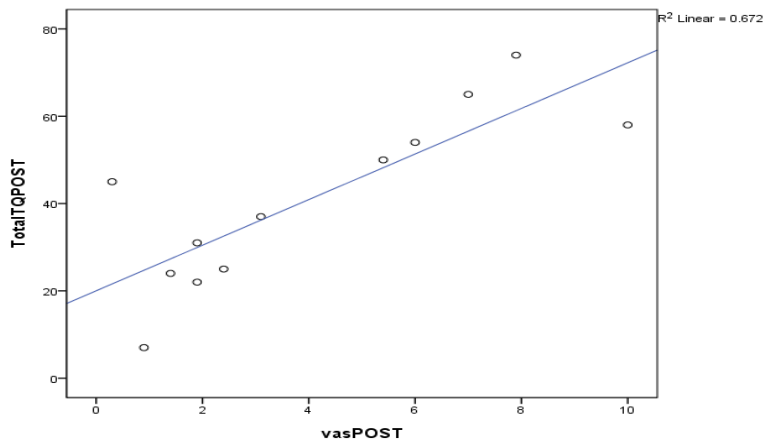


Fig. 4.7 Correlation between TQ and VAS scores post-intervention in the control group

- There was a strong correlation between VAS and depression (HADS) scores post-intervention at the 0.01 level, where $r(12)=.782, p<0.01$

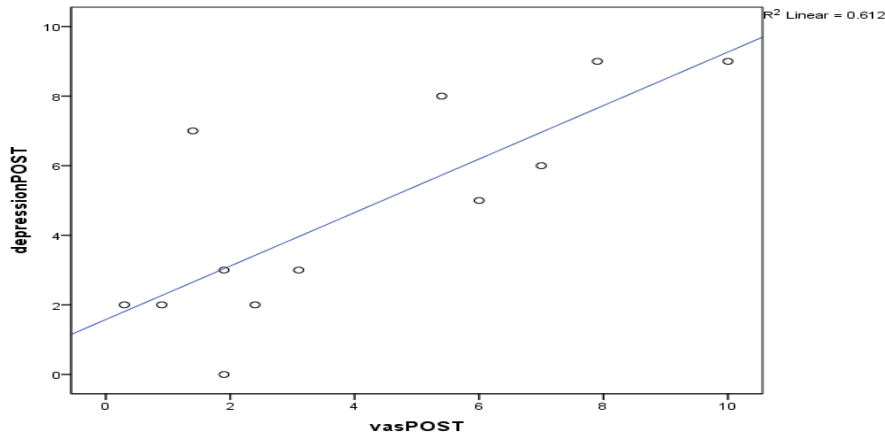


Fig. 4.8 Correlation between VAS and depression (HADS) post-intervention in the control group

To obtain insight into the participants' situations before the intervention, the Kruskal-Wallis test was carried out to investigate whether duration of use of cochlear implants could have an influence on the total results of TQ, VAS, depression and anxiety scales (HADS), as well as mental and physical health post-intervention. Results of this test were as follows:

- There was no significant effect on TQ scores: $H(2)=0.421, p>.05$
- There was no significant effect on VAS scores: $H(2)=0.501, p>.05$
- There was no significant effect on HADS anxiety scores: $H(2)=4.66, p>.05$
- There was no significant effect on HADS depression scores: $H(2)=2.075, p>.05$
- There was no significant effect on SF-36 physical health scores: $H(2)=1.195, p>.05$
- There was no significant effect on SF-36 mental health scores: $H(2)=0.742, p>.05$

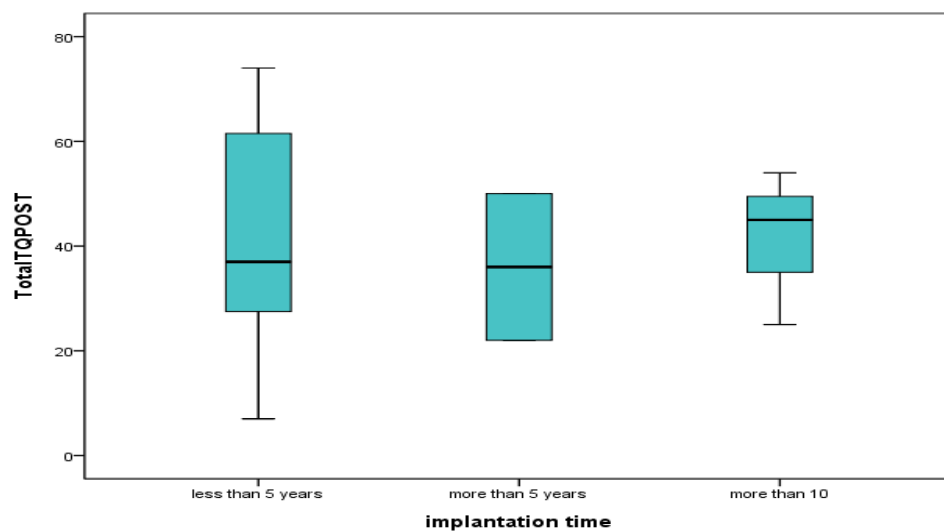


Fig. 4.9 Effect of duration of cochlear implant use on TQ post-intervention in the control group

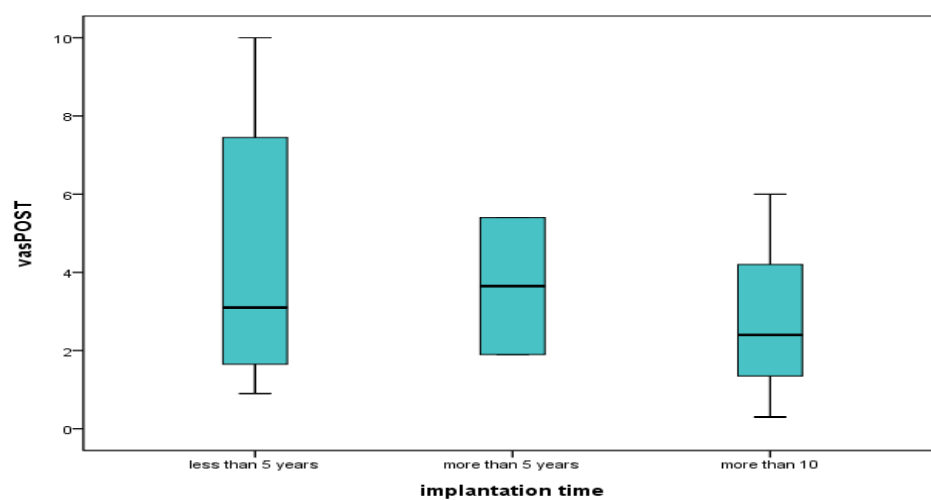


Fig. 4.10 Effect of duration of cochlear implant use on VAS post-intervention in the control group

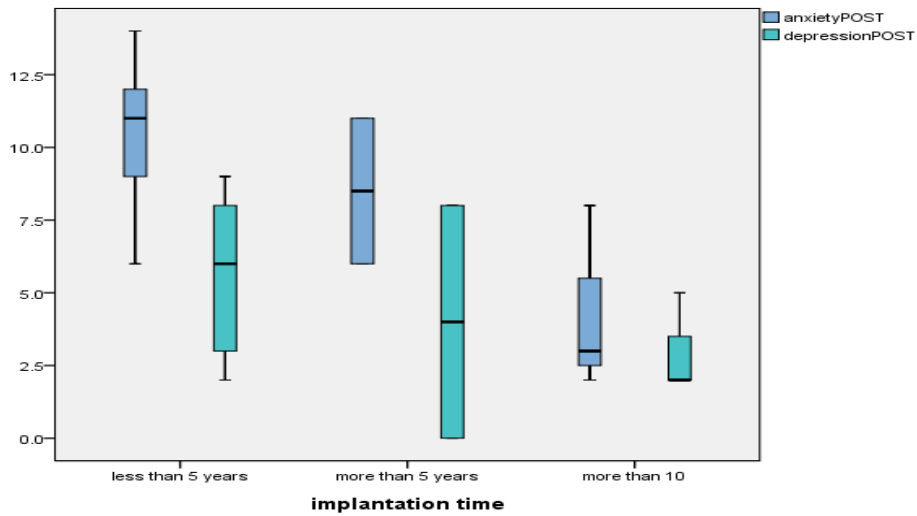


Fig. 4.11 Effect of duration of cochlear implant use on anxiety and depression (HADS) post-intervention in the control group

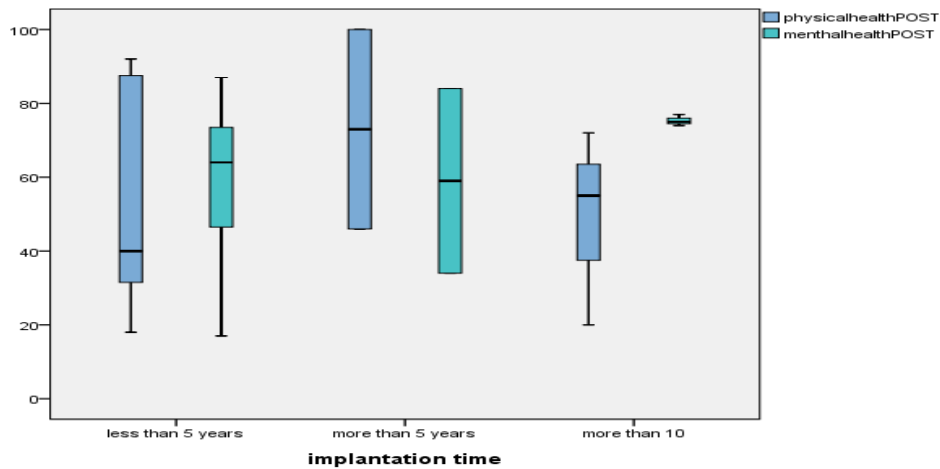


Fig. 4.12 Effect of duration of cochlear implant use on physical and mental health (SF-36) post-intervention in the control group

4.1.2 Summary of the questionnaires' results

Results from the completed questionnaires showed small, but not significant, differences pre- and post-intervention. After analysing the individual questionnaires (such as TQ, VAS or HADS), no major changes were found in tinnitus distress or anxiety and depression levels after attending the Tinnitus Workshop in the control group. This could be due to the small sample size or it may suggest that the Tinnitus Workshop was not very effective as a method of alleviating tinnitus. We measured if the duration of cochlear implant use had any significant influence on TQ, VAS, HADS and SF-36. No significant effects were found: this could be interpreted as the duration of cochlear implant use not having any significant meaning pre-intervention and did not influence the results from the questionnaires post-intervention.

4.1.3 Summary of the responses to Open Questions (Appendix 15a)

There were two main categories created from the open questions - *Tinnitus* and *Cochlear implants and tinnitus*. The tinnitus category aimed to describe a variety of factors and behaviours that can change the perception of tinnitus. In addition, one subcategory, *Tinnitus and informative factors*, was created to describe fully the subjective perception of tinnitus, such as its sound, the individual's reaction to tinnitus, and the factors that may influence the meaning of tinnitus to the individual which, in turn, may be significant in estimating subjective attitudes towards it. From the Open Questions, we obtained basic information about the participants' tinnitus, such as on which side they experienced it and also its severity. The responses were so varied that it is difficult to quantify whether the site of tinnitus influences the perception and magnitude of it; this has been confirmed in the literature (Davis, 1995). We also asked about the cause of deafness, which indirectly can explain the cause of tinnitus. Various aetiologies were presented; however, none of the participants was convinced that the cause of their deafness caused their tinnitus.

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We wanted to identify the emotions released and the coping mechanisms used when tinnitus increases. As we anticipated, participants used different coping mechanisms. Some were able to divert their attention, whereas others were too much involved with it and were not able to break the vicious circle. Some participants were unable to use any distraction mechanisms and separate their emotions from their tinnitus; that, in turn, made it even worse. According to House (1981), some personal traits may make one's natural defence mechanisms less efficient. Some participants displayed negative emotions towards tinnitus, such as frustration, anger and annoyance, but most of them had already adapted to tinnitus in their daily routine. During the Tinnitus Workshops, participants talked about the lack of understanding from families and deaf organizations. It seemed to be an important factor for tinnitus sufferers, since lack of understanding of their problems and rejection by the deaf community made them feel helpless and alone.

We asked about factors that both worsen and help to alleviate tinnitus. Most participants highlighted stress, loud noises and sleepless nights as the main factors which aggravate tinnitus perception. These results were similar to those found by Stouffer et al. (Stouffer, Tyler et al., 1991). Besides stress, participants suggested that some kinds of food and aspirin may influence their tinnitus. When tinnitus is louder, participants complained that they have difficulties with concentration and memory. Increased tinnitus perception resulted in greater anxiety and depression levels. Some participants, on the other hand, were able to find their own ways to keep themselves occupied and to divert their attention away from tinnitus, such as playing puzzles, sitting quietly and relaxing or getting involved in interesting activities.

We also investigated if tinnitus or its effects had any influence on the social lives of the participants. Most of them claimed that tinnitus made them more anxious and cautious when choosing places to go out. On the other hand, some participants questioned the effectiveness of cochlear implants in social situations. We were interested in whether cochlear implantation helped to alleviate tinnitus and most respondents confirmed that it is easier to ignore tinnitus with the help of implants, because of better masking.

Nevertheless, for five respondents, the perception of tinnitus did not change and they still suffer from tinnitus to some extent.

It is important here to emphasize that both categories (tinnitus and tinnitus in CI implantees) cover the same subjects, since the participants of this study were already implanted with CIs and the experiences with tinnitus they described were predominately viewed through the prism of cochlear implantation. Also, only two questions were strictly related to the experience of tinnitus through a CI and this subject needs more clarification.

4.1.4 Summary of the responses to the Evaluation Forms

Evaluation forms were sent to the participants to find out how useful the intervention was in reducing tinnitus awareness in general. The first part of the evaluation form consisted of six questions that asked about the emotional and behavioural attitudes of the participant towards tinnitus; whether the Tinnitus Workshop influenced their management of tinnitus; and about the effectiveness of the intervention in reducing tinnitus distress. Half of the participants confirmed that the intervention was successful in helping them to cope with tinnitus. They also expressed the view that the informative parts of the Tinnitus Workshops were the most useful, and that sharing their own experiences was very helpful and gave others fresh ideas about the management of tinnitus. Some participants claimed that this intervention was not helpful in reducing their tinnitus distress, because they felt too dominated by their tinnitus. Also, the ideas that were put forward seemed not to be enough to break the vicious circle of tinnitus distress. We asked the participants what they found to be most useful parts of the intervention. Most of them found the general information given about tinnitus and relaxation instruction to be the most interesting parts of the workshop. Also, sleep hygiene instruction, with the guidance on how to sleep when tinnitus is louder, was mentioned as useful.

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The second part of the evaluation forms aimed to assess the practical aspect of the intervention. We asked if the presentations were understandable, whether the speakers talked clearly enough and whether the atmosphere during the workshops encouraged participants to ask questions or to raise any points. Most of the comments were positive and some of the participants left feedback suggesting minor improvements, such as more frequent breaks and longer overall duration.

4.2 The research group

Descriptive profiles of participants in research group

Participant 23

The participant was implanted in 2008. Her deafness was sudden and happened when her father died, with whom she was close. She was emotional about these two experiences since both changed her life dramatically. She adapted to her CI very well. Her speech is clear, but she still lip-reads. Before the implantation, she joined lip-reading classes and found them helpful at a time when she was struggling with her profound hearing loss. Attending lip-reading classes gave her back her confidence and helped her to recover from depression (when she lost her hearing, she became depressed and was advised to take antidepressants). However, she did not feel comfortable with the medication and gradually stopped taking them. During this difficult time, she also had suicidal thoughts. She admitted that she had received a great deal of support from her husband and sister.

The participant complained about tinnitus as a factor that destroyed her “hearing world” and made her angry: *“If I did not have my tinnitus, I would benefit from CI.”* She described her tinnitus as similar to the noise a fridge makes, and that it is aggravated by other sounds. The participant is aware of her tinnitus all the time and reads a lot to try to ignore it. She complained about poor quality of sleep: *“Tinnitus makes me awake.”* Tinnitus is not so problematic, but it makes her worried about new situations, because she feels that she hears “through” the tinnitus, which in turn can be louder in a new and stressful social situation. In addition, when surrounded by noise she is tempted to switch

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her CI processor off, to be left hearing only her tinnitus since “*New sounds can scare me.*” As her objective for the therapy, she would like to be able to cope with a noisy situation, and to stop being angry about her tinnitus. During the therapy, she did not fill in the Thoughts and Feelings Diary because she felt it did not apply to her.

Participant 27

This participant took part in the assessment session on 26 August 2011 at SOECIC. She was assessed in a one-to-one session, because of travel problems; she could not attend her session with participant 23. The participant was implanted in 1994, and of all the participants, she has the longest implantation duration, apart from another participant who was implanted bilaterally. When asked about the experience and her feelings when she was implanted, she hardly remembered anything. However, the time that she became deaf was very traumatic for her. She felt depressed and low and did not have much support from her family. When the participant received her cochlear implant, the period of adaptation went well and she now benefits from it a lot. Moreover, the subject’s speech was excellent.

After the implantation, her tinnitus remained the same and she is aware of the sound all the time. She got used to it; however, when she is stressed she cannot control her tinnitus and it takes over. Because of the type of work she does, she often has to deal with stress and anger from clients, which affects her a lot. Her wish was to maintain tinnitus at a constant, controllable level that she can tolerate. Her tinnitus sounds similar to a single tone. At the beginning, her tinnitus used to wake her up, and this caused sleep problems. When it happened, she used put her CI processor on. At present, she does not have any problems sleeping, unless stressed. The participant complained that because of tinnitus, especially in stressful situations, her concentration and memory are affected which, in turn, affects her work and contributes to low self-confidence. She gets a lot of support from her partner and her line manager, who also has some difficulties in hearing. To relax after work she goes for walks with her dogs. During the therapy, she filled in the Thoughts and Feelings Diary.

Participant 6

The participant attended Cognitive Behavioural Therapy at the Royal National Throat, Nose and Ear Hospital in London on 31 October 2011. She was recruited to the project after the advertisement in *Hearing Times* was published. She wanted to participate because she benefits from a cochlear implant, but her tinnitus is still bothersome. The participant was very much involved with people with hearing problems: she works (currently part-time or as a volunteer) in the Cambridge Deaf Centre. She is also an active member of the Hard of Hearing Community. She is well-orientated in hearing problems and complications, which made the therapy more advanced. She asked a lot of questions about the side effects of cochlear implantation with regard to tinnitus.

The participant became deaf in 2006 and in the same year received an implant. She thinks that the “cochlear implant is a miracle”. However, since the implantation, she started having problems with her voice: according to her, it is different and she cannot accept its sound. In addition, she started having problems with her vision, which somehow she connects with implantation. Sometimes, the participant suffers from balance problems. Her main problem with tinnitus is sleep; she claims that she has to keep constantly occupied and in this way consciously make herself tired in order to go to sleep; otherwise she “would go mad because of tinnitus”. On the practical side, it was difficult to conduct a cognitive behavioural intervention because of her knowledge and experience in helping tinnitus sufferers. It was a struggle to convince her to use any defence mechanisms, since she questioned the theory behind them. During the therapy, she filled in the one-week Sleep Diary.

Participant 54

This person was recruited through John Radcliffe Hospital in Oxford, where he was implanted in 2010. He has been deaf since birth. As for the cause of his hearing problems, he mentioned the trauma his mother went through being pregnant with him. Since a child, he has had good use of two hearing aids, which was reflected in his excellent speech. Four years ago, he gradually started losing his residual hearing. His

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implantation was successful and the participant fully benefitted from the cochlear implant. In the near future, he aims to receive an implant in the other ear.

His perception of tinnitus definitely improved after the implantation, but in stressful situations he cannot control it and it really disturbs him at work. He also complains about his poor concentration and impatience caused by constant tinnitus. Sometimes, after a hard day, he has a problem getting to sleep because his tinnitus is louder. In addition, he becomes annoyed that he is unable to control it. The participant admitted that he likes to be in control and it is difficult for him to compromise, he feels that he has to compromise or rather “give up” a lot in turn to make his tinnitus bearable. During the CBT intervention, he filled in the Thoughts and Feelings Diary at the beginning and at the end of the therapy.

Participant 22

The next participant was treated individually, because of a communication problem due to his absolute deafness. The therapy was conducted by means of discussion between the participant and the conductor, usually written on a clipboard. After a few sessions, it became easier to understand him; however, the written form remained in use. The participant was recruited from SOECIC. At the beginning (before his particular condition was known), he was allocated to participate in group therapy; however, after an assessment session, it was agreed to conduct his therapy individually. The participant was implanted in 1998, but after seven years he rejected his implant, due to an increase in his tinnitus, and at present he is not a cochlear implant user. He never suffered from tinnitus before implantation. After the operation, he experienced various side effects, such as balance problems, vision distortion and severe headaches. These problems were so traumatic for him that he rejected cochlear implants in general, even when he was offered a re-implantation.

At the present time, the participant is absolutely deaf and sometimes uses one of his hearing aids to decrease tinnitus perception. He lip-reads well and that is why it was possible to continue with the sessions. It raises the question whether this participant

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should be involved in any future research as he is no longer a cochlear implant user. Nevertheless, it was interesting to explore the problems and consequences caused by implantation, as well as being able to confirm that CIs can provoke tinnitus to occur. I asked him to fill in the Thoughts and Feelings Diary, but he never returned it to me.

Participant 21

This participant attended group therapy at SOECIC along with participants 31 and 29. He was recruited through SOECIC and was implanted five years ago. Since then his life has changed dramatically. He has been deaf for 40 years, which has resulted in complete social withdrawal. The participant admitted that it was easier to tell everyone that he is deaf and avoid any complications about it. He called it the “fuss about being deaf”. During therapy, he was active and tried to act as an advisor to the rest of the group. He had suffered from tinnitus in his right ear before implantation. He struggled to accept it and it caused him many problems, such as tension and annoyance. According to him, his tinnitus is extremely loud and he can hear it all the time. About four months ago, a new type of tinnitus appeared in his implanted left ear. It is similar to a high-pitched whistle and so far is annoying because “it is a new sound”. He admitted that, because of his hearing and tinnitus, he has become stressed, but he tries to control it. He also confirmed that his wife supports him a lot, but in some ways he takes her for granted and allows her to do things for him. He remains distant from any social interaction, such as family discussions.

To deal with tinnitus, he tries to keep himself occupied and reads a great deal. He has found his own way to cope with tinnitus, but, as he said, “it is nice to meet people like me”. During the intervention, he talked extensively and was particularly supportive to another member of the group. Sometimes it was difficult to understand him, because he speaks loudly, as well as quickly. To express himself, he gesticulates a lot, which was difficult for the other participant who mainly lip-read. This participant did not fill in the Thoughts and Feelings Diary; he refused because he “does not have problems like this”.

Participant 31

The next participant attended group Cognitive Behavioural Therapy along with two participants (21 and 29) at SOECIC. The participant received his implant six years ago and appreciates his implant very much, although his tinnitus appeared just after implantation. He describes tinnitus as a range of noises, which may change during the day. He is focused on listening to these sounds and counts them, trying to organize and find their “daily routine”. He feels that tinnitus stops him from hearing better and is also preoccupied with the thought that “... if I did not have tinnitus, I would have a better life, would progress and would do things I like”. He confirmed that he did not accept himself as a person who cannot hear and that this might in turn stop him from fully benefitting from his CI. The participant is dependent on his wife in a lot of ways. He insisted that his wife should participate in the therapy, but this was declined by the other members of the group and the conductor.

The participant still has problems with understanding speech and his ability to lip-read definitely helps him to understand conversation. It soon became apparent that he was emotional and still “fragile” when talking about tinnitus and hearing loss. He was very disturbed by his tinnitus and still asked questions such as “why me?” One of the biggest problems for him was that people he meets in everyday life do not accept or do not understand that he is deaf. It appears to be a problem for him, because somehow he wants to be identified as a hard-of-hearing person but, on the other hand, he struggles with labelling himself as such. Although he is aware of his tinnitus at all times, he surprisingly does not have any problems with sleeping. The way he deals with tinnitus during the day is to keep occupied. He claims that tinnitus impedes his concentration and memory. It is difficult to assess which problem is more disturbing for him: being deaf or being a tinnitus sufferer. During the intervention, the participant filled in the Thoughts and Feelings Diary. Unfortunately, he lost the first version of the Diary Form, which caused him a huge amount of distress because of the personal information it included.

Participant 29

The following participant was initially allocated to participate in the CBT intervention with another participant (participant 22); however, due to logistic difficulties she was allocated to join a therapy session at SOECIC with participants 21 and 31. She received an implant a few years ago because of gradual hearing loss. Before implantation, she used hearing aids and suffered from tinnitus. She claims that, at the beginning, it was difficult to accept hearing loss and tinnitus at the same time and she mentioned that she had had a short episode of depression. At present, she benefits a great deal from the cochlear implant and she has learned how to cope with her tinnitus. Sometimes she has problems sleeping, especially when she is tired or stressed. She described her sleeping experiences in the Thoughts and Feelings Diary. After the assessment session, it became clear that this participant is more advanced in experience of tinnitus and in her coping strategies. She presented herself as a perfect example of how to overcome tinnitus. During therapy, she was enthusiastic with other members of the group and always talked about her experiences, using practical examples which were helpful for the others.

As mentioned above, she filled in the Thoughts and Feelings Diary.

Results from the questionnaire are shown in *Tables 14, 15* (below) and describe the outcomes pre- and post- intervention for each participant, where the scales of anxiety and depression are calculated by HADS, and physical and mental health scales are calculated by the SF-36 questionnaire. The HADS scores may be interpreted by dividing them into four ranges: 0-7 = normal, 8-10 = mild, 11-14 = moderate and 15-21 = severe. The interpretation of results of SF-36 is separated into two ranges: poor health = <50 and >50 = good health. The interpretation of the Tinnitus Questionnaire suggested by Hallam divided the total scores into 4 categories, where over 50 % of the total score is regarded as clinically significant: 0-24 = 25%, 25-43 = 26-50%, 44-58 = 51-75% and 59-82 = 76-100%. The TQ evaluates change in tinnitus perception after treatment interventions and examines relationships between different facets of complaint and other psychological variables. Visual Analogue Scale (VAS) measures the individual perception of tinnitus.

Subject	TQ	VAS (cm)	Anxiety (HADS)	Depression (HADS)	Physical health (SF-36)	Mental health (SF-36)
31	54	6	3	8	65	71
27	30	7	11	5	93	79
22	64	0	9	7	42	33
6	43	4.6	9	1	89	90
29	18	0.7	7	3	89	93
21	18	7.7	2	4	100	95
23	54	6.8	3	6	97	93
54	58	8.3	14	14	71	30

Table 14 Pre-intervention scores in the research group

Subject	TQ	VAS (cm)	Anxiety	Depression	Physical Health	Mental Health
31	37	8.4	7	4	70	54
27	29	3.1	6	1	94	82
22	61	10	7	6	49	73
6	42	6.1	7	2	87	84
29	22	1.8	5	2	77	94
21	16	7.2	4	4	98	90
23	38	1.9	4	2	85	96
54	31	1	4	2	90	89

Table 15 Post-intervention scores in the research group

The descriptive results were taken from the TQ, VAS, HADS and SF-36, before and after intervention (Cognitive Behavioural Therapy), as follows:

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Table 16 Mean results from questionnaires, pre-intervention, in the research group

TQ	VAS	Depression (HADS)	Anxiety (HADS)	Physical health (SF-36)	Mental health (SF-36)
42.38 (IQR=48.50)	5.138 (IQR=6.40)	6.00 (IQR=5.50)	7.25 (IQR=8.00)	80.75 (IQR=89.00)	73.00 (IQR=84.50)

Table 17 Mean results from questionnaires, post-intervention, in the research group

TQ	VAS	Depression (HADS)	Anxiety (HADS)	Physical health (SF-36)	Mental health (SF-36)
34.50 (IQR=34.00)	4.938 (IQR=4.600)	2.88 (IQR=2.00)	5.13 (IQR=5.50)	81.25 (IQR=86.00)	82.75 (IQR=86.50)

The Wilcoxon Signed-Rank Test was performed to investigate whether there were any significant differences between pre- and post-intervention (CBT).

- TQ scores were lower after the intervention, but showed no significant differences between pre- and post-intervention: $z=-1.823$, $p>.05$, $r=-0.64$
- VAS scores were lower after the intervention, but showed no significant difference between pre- and post-intervention: $z=-0.140$, $p>.05$, $r=-0.04$
- Anxiety (HADS) scores were lower after the intervention, but showed no significant differences between pre- and post-intervention: $z=-1.063$, $p>.05$, $r=-0.37$
- There were significant differences between pre- and post-intervention in depression (HADS) scores: $z=-2.058$, $p<0.05$, $r=-0.72$
- There were no significant differences between pre- and post-intervention in physical health (SF-36) scores: $z=0.0$, $p>$, $r=0$

- There were no significant differences between pre- and post-intervention in mental health (SF-36) scores: $z=-0.421$, $p>0.05$, $r=-0.149$

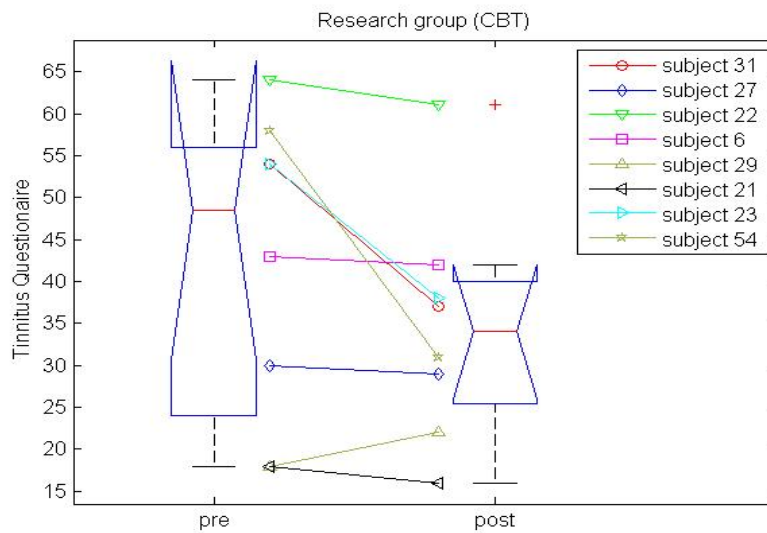


Fig. 4.13 TQ pre- and post-intervention in the research group

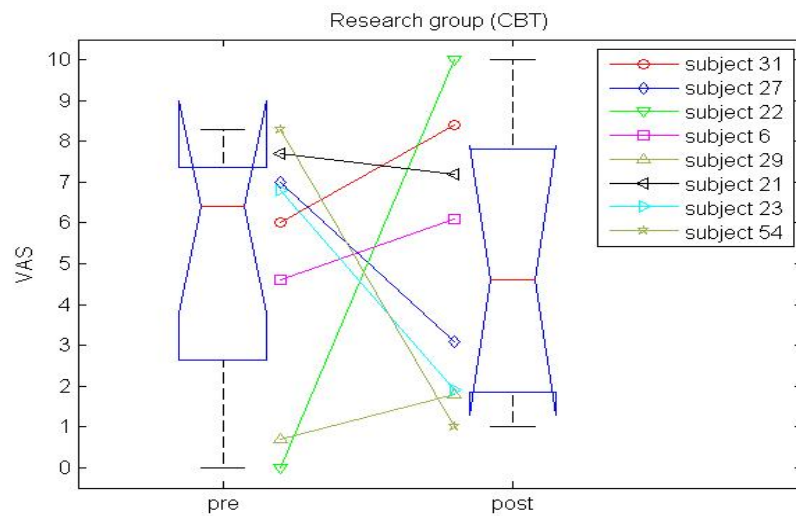


Fig. 4.14 VAS pre- and post-intervention in the research group

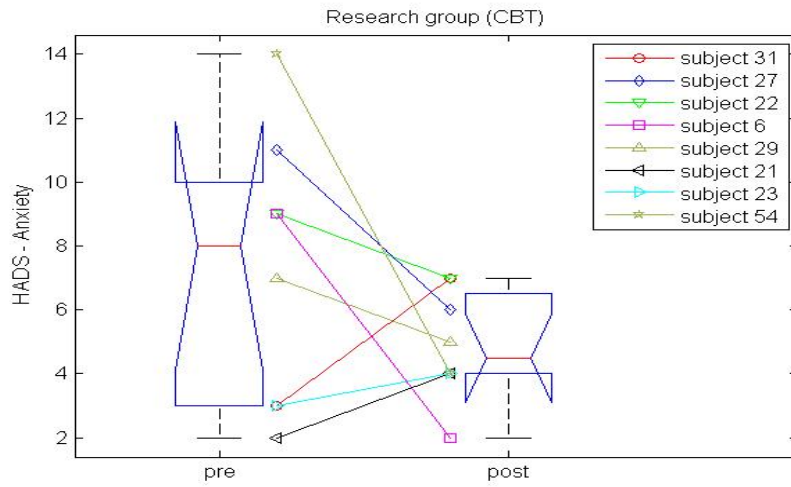


Fig. 4.15 Anxiety (HADS) pre- and post-intervention in the research group

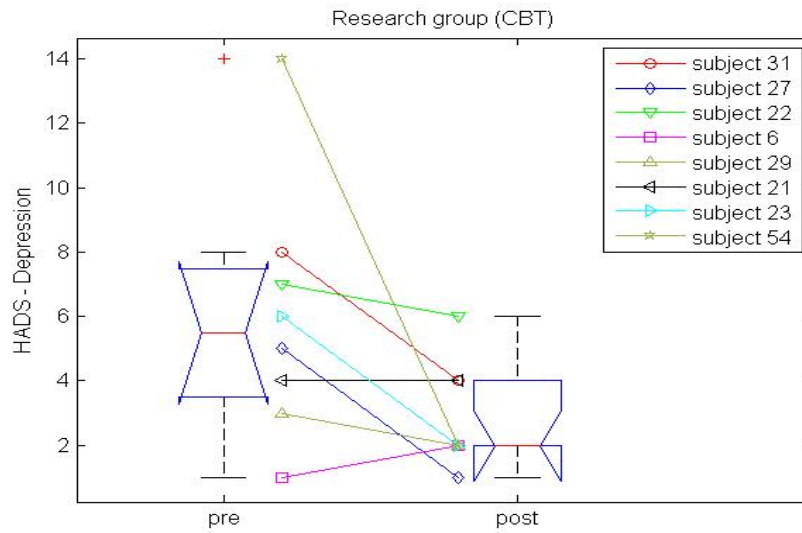


Fig. 4.16 Depression (HADS) pre- and post-intervention in the research group

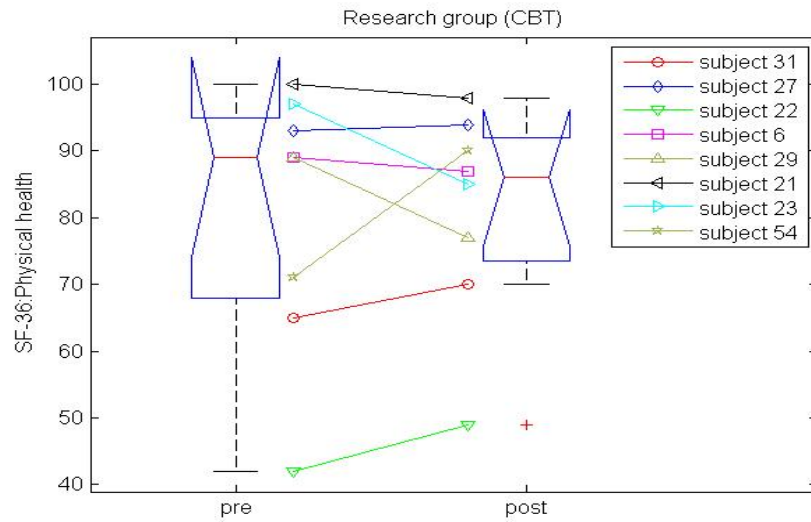


Fig. 4.17 SF-36: physical health pre- and post-intervention in the research group

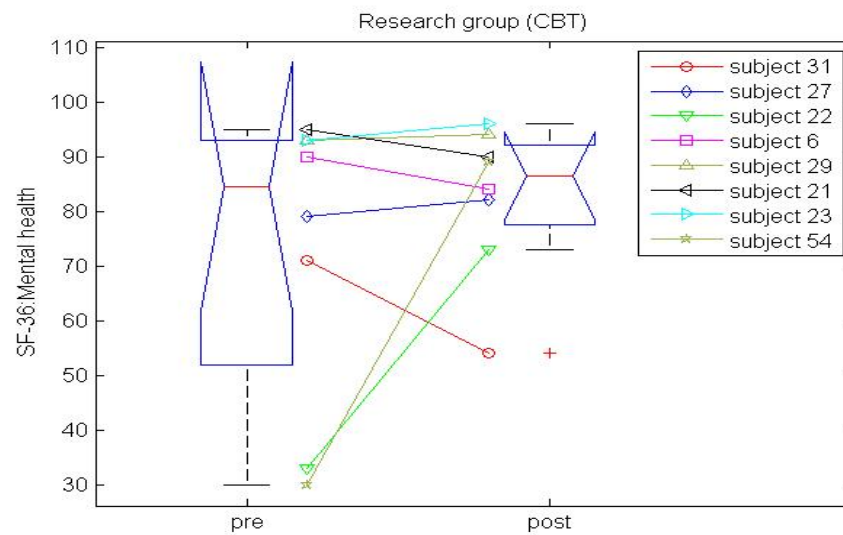


Fig. 4.18 SF-36: mental health pre- and post-intervention in the research group

Spearman's Rank Order Correlation was calculated to investigate any correlation between the measurements. It appeared that:

- No correlation was found between the measures (TQ and VAS) in pre-intervention scores: $r(12) = 2.48$, $p > .05$

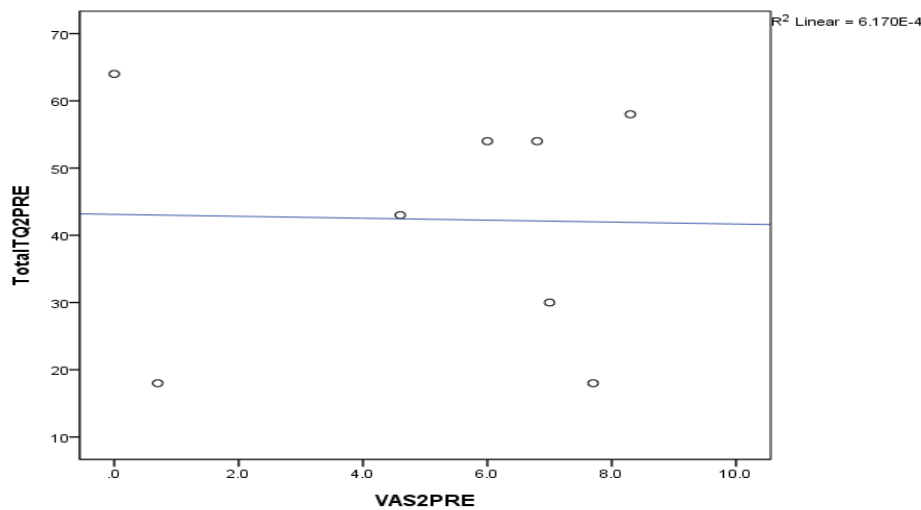


Fig. 4.19 Correlation between TQ and VAS pre-intervention in the research group

- No correlation was found between the measures (TQ and VAS) in post-intervention scores: $r(8) = 0.243$, $p > .05$

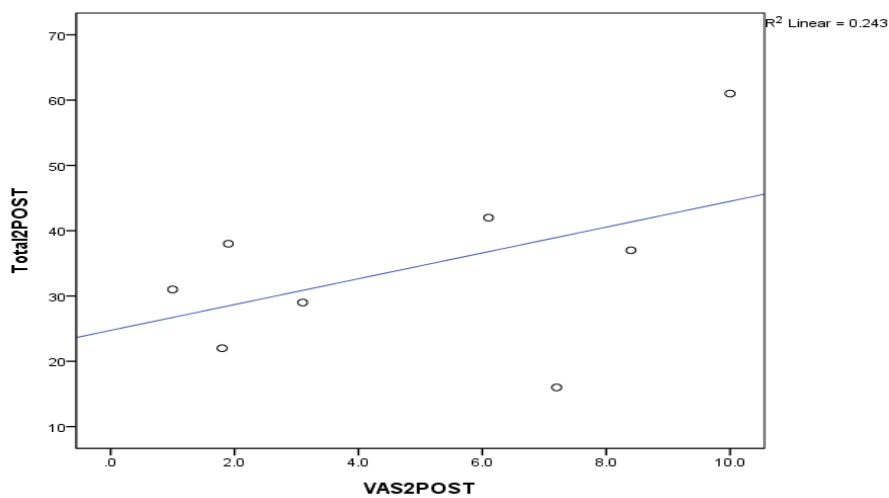


Fig. 4.20 Correlation between TQ and VAS post-intervention in the research group

- There was a medium correlation between VAS and anxiety (HADS) post-intervention at the 0.05 level, where $r(8)=.676$, $p<0.05$:

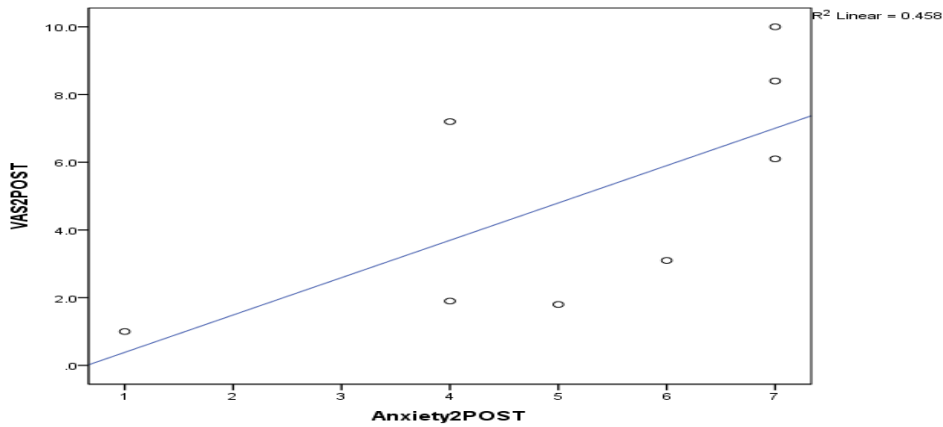


Fig. 4.21 Correlation between VAS and anxiety (HADS) post-intervention in the research group

- There was a strong correlation between VAS and depression (HADS) post-intervention at the 0.05 level, where $r(8)=.852$, $p<0.05$:

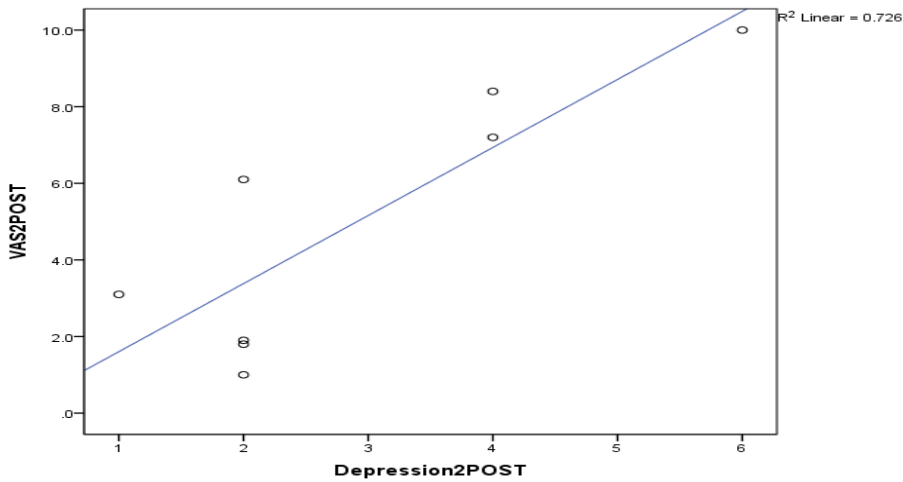


Fig. 4.22 Correlation between VAS and depression (HADS) post-intervention in the research group

To obtain an insight into the participants' situations before the intervention, the Kruskal-Wallis test was carried out to investigate whether the duration of implantation could influence the total results of TQ, VAS, depression and anxiety scales (HADS), as well as mental and physical health (SF-36) scales, post-intervention in the research group.

Duration of using cochlear implants (period of implantation) did not have a significant effect on any of the results obtained from the participants:

- There was no significant effect on TQ scores: $H(2)=4.050$, $p>.05$
- There was no significant effect on VAS scores: $H(2)=0.67$, $p>.05$
- There was no significant effect on anxiety (HADS) scores: $H(2)=1.98$, $p>.05$
- There was no significant effect on depression (HADS) scores: $H(2)=0.288$, $p>.05$
- There was no significant effect on physical health (SF-36) scores: $H(2)=0.42$, $p>.05$
- There was no significant effect on mental health (SF-36) scores: $H(2)=5.25$, $p>.05$

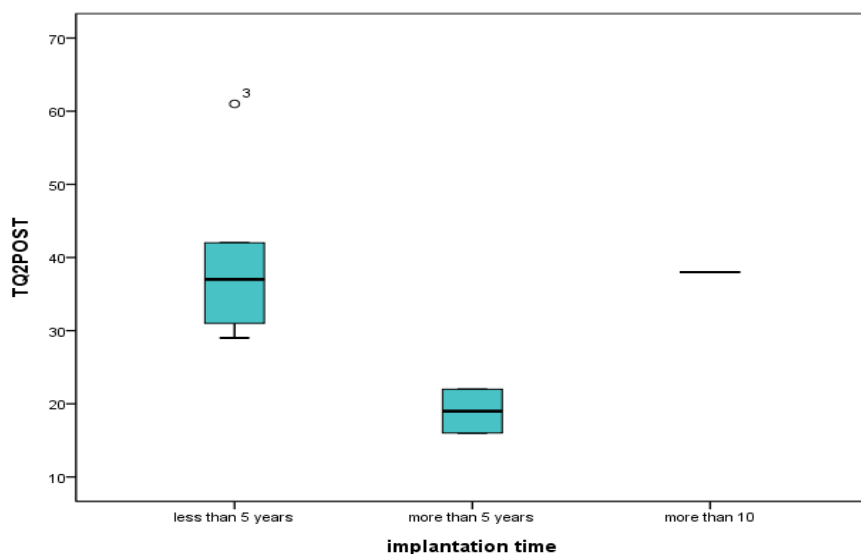


Fig. 4.23 The effect of duration of implant use on TQ in the research group post-intervention

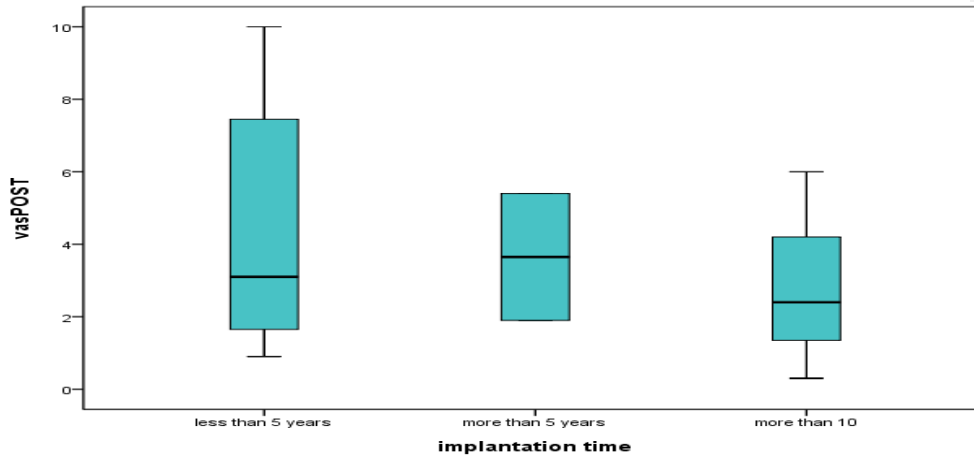


Fig. 4.24 The effect of duration of implant use on VAS in the research group post-intervention

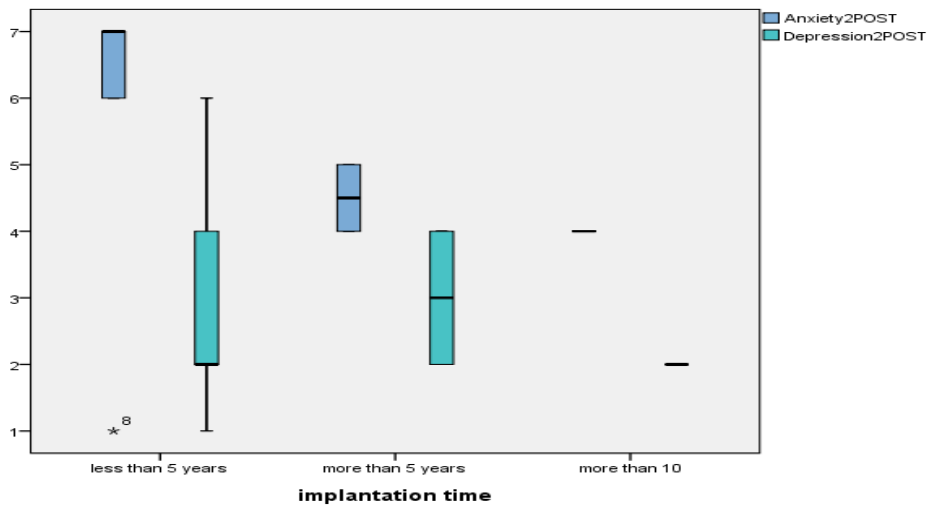


Fig. 4.25 The effect of duration of implant use on HADS subscales in the research group post-intervention

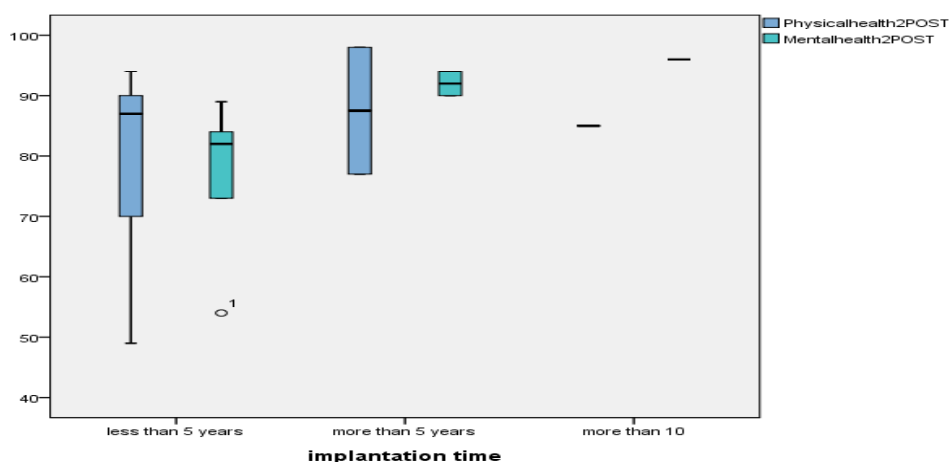


Fig. 4.26 The effect of duration of implant use on SF-36 subscales in the research group post-intervention

4.2.1 Summary of the questionnaires' results

There were no significant differences in TQ, SF-36, VAS and HADS anxiety subscale pre- and post-CBT. There was, however, a significant difference in HADS depression subscale pre- and post-intervention. We measured if the duration of implant use had had any significant influence on the questionnaires used: no significant effects were found.

4.2.2 Summary of the responses to Open Questions (Appendix 17a)

Exactly as in the control group, the Open Questions in the research group were divided into two main categories: *Tinnitus* and *Cochlear implants and tinnitus*. However, it is important to emphasize that both categories applied, so when participants were asked about their personal experiences with tinnitus, they were already implanted and this fact had a significant impact on both categories. Moreover, one subcategory was created: *Tinnitus and informative factors*, which aimed to identify the factors that influence

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tinnitus perception. The category of *Tinnitus* fully described the subjective perception of tinnitus, such as its sound, the individual's reaction to tinnitus, and factors that may have an impact on one individual's attitude to tinnitus. Basic information was obtained from the participants, such as the area of the head where they perceive tinnitus and the current sound of their tinnitus. Half of the subjects claimed that they could hear tinnitus in both ears. A couple of participants perceived their tinnitus as coming from their heads. As confirmed in the literature, the side of tinnitus or its sound does not affect tinnitus perception (Davis, 1995). Hearing loss and trauma were recognized most often as the trigger for tinnitus; however, in one case tinnitus occurred after cochlear implantation. With the help of Open Questions, we wanted to identify individual feelings about tinnitus and the coping mechanisms used when tinnitus increases. The diversity of tinnitus management illustrated that some of the participants were affected by tinnitus more than others. Some participants tried to ignore it and divert their attention to something more engrossing, but a few participants displayed despair and resignation because they were not able to stop tinnitus from ruining their day. They claimed that, because of the duration of their tinnitus and poor management at its beginning, their attitude to tinnitus had become second nature and they were unable to change it. According to House (1981), it can be due to some predispositions, such as pessimism, in the personalities of tinnitus sufferers may lead to the use of ineffective coping strategies, resulting in higher levels of tinnitus-related distress.

Most participants displayed negative feelings about tinnitus, such as "*a threat to my health*" or "*I never stop hearing it*". Nevertheless, they managed somehow to adapt to tinnitus by almost accepting it into their daily routines; some even appeared to be able to control and manage it. This subject was widely discussed during the therapy sessions. Participants felt free to talk about their problems concerning tinnitus. They also expressed their anxieties in the Thoughts and Feelings Diaries, which were analysed during the sessions.

Although participants in the research group exhibited moderate anxiety and depression levels, we investigated if tinnitus affected their mood and outlook for the future. Most

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respondents responded negatively to this question, but equally they confirmed that it was not tinnitus, but hearing loss, that limits their life, mood and social interaction. During CBT, participants talked about the difficulties they constantly experienced (similar to the control group) with their families, deaf organizations and everyday situations, such as eating in restaurants and travelling. We also discussed depression, which may arise as a result of tinnitus. Some participants confirmed that losing their hearing and then having to cope with tinnitus as well caused depression and increased anxiety, which, in turn, influenced their general well-being and created fear about the future.

We also investigated the changeability of tinnitus and which factors can alleviate or aggravate it. The respondents claimed that some kinds of food can influence their tinnitus perception, but most of them suggested that stress and sleepless nights are the most common factors affecting their tinnitus. Stress as a cause of tinnitus aggravation was widely discussed during the sessions; however, the results showed that it was difficult to ascertain if tinnitus on its own was the source of stress, or if tinnitus only exacerbated stress that originated from a different cause. When tinnitus was louder, most participants tried to occupy themselves by doing something else, such as listening to music or reading. Nevertheless, they confirmed that it was impossible to completely stop hearing tinnitus and most focused on controlling, rather than fighting, it.

The second category of the Open Questions aimed to identify tinnitus in cochlear implants. Some participants reported slight improvements just after implantation, but after a while tinnitus reverted to its original level. The remainder of the respondents claimed that tinnitus had become worse, and one of the participants even claimed that it was triggered by cochlear implantation. Overall, the participants agreed that cochlear implants had improved their quality of life; however, tinnitus prevented them from benefitting fully from cochlear implantation. An important issue discussed was “hearing identity”; some participants were unsure whether to identify themselves with those of normal hearing or to group themselves with those of limited hearing. This problem was widely debated and showed how emotional, and sometimes traumatic, was the process of cochlear implantation and the ensuing adaptation to a “new perception of hearing”.

This category and the participants' description of tinnitus showed that tinnitus in this group was very similar to non-cochlear implant users described in the literature review (Tyler, 1983) and problems they experienced every day. It was confirmed by the participants in the research group, who agreed that CIs improved their hearing ability, but the intensity of their tinnitus remained the same.

As mentioned before, both categories apply to a similar area from a different perspective. The participants who attended this study were already implanted and all their current experiences concerning tinnitus were viewed through the prism of cochlear implantation. Moreover, the Open Questions included only two direct questions that asked about their experiences of cochlear implants; so this subject needs further investigation.

4.2.3 Summary of the responses to the Evaluation Forms

After the intervention, evaluation forms were sent to the participants to find out how useful CBT was in reducing tinnitus awareness in general. There were only five questions that aimed to assess CBT as a procedure that eases tinnitus perception, and influences behaviour and cognitive function. Most participants considered CBT to be a useful tool in coping with tinnitus, but they did not find it useful in decreasing tinnitus perception. CBT influenced their emotional attitude to tinnitus and, thanks to the educational element of CBT, certain participants understood better what tinnitus is and how to manage it. Most respondents were happy to meet other tinnitus sufferers and found it helpful to share common problems with each other.

4.3 Comparison of the research and the control group

The Wilcoxon Rank-Sum Test was carried out to investigate differences between Cognitive Behavioural Therapy for the research group and a Tinnitus Workshop for the control group. The following results were found:

TQ

- There were no significant differences in TQ scores between research- and control-group pre-interventions: $W_s=124.00$, $z=-0.154$, $r=-0.03$
- There were no significant differences in TQ scores between research- and control-group post-interventions: $W_s=74.50$, $z=-0.73$, $r=-0.16$

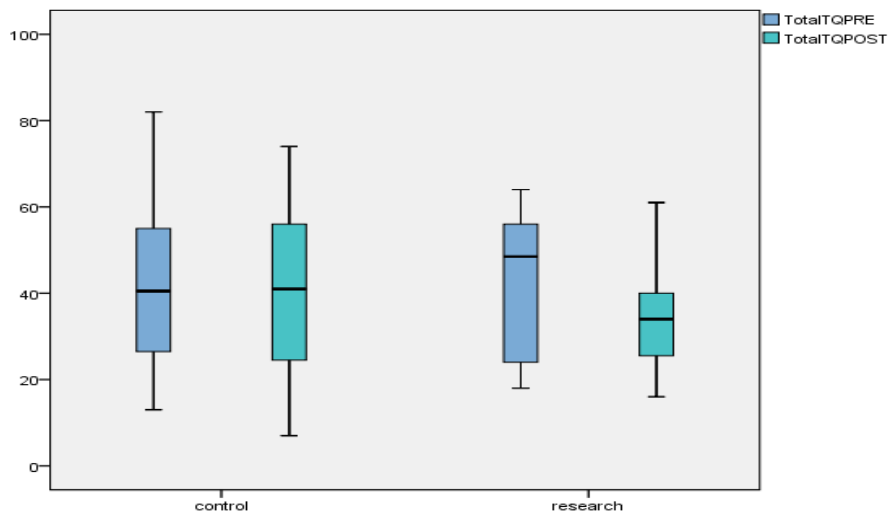


Fig. 4.27 Differences in TQ scores between the groups pre- and post-interventions

VAS

- There were no significant differences in VAS scores between the research- and the control-group pre-interventions: $W_s=118.00$, $p>.05$, $r=-0.138$
- There were no significant differences in VAS scores between the research- and the control-group post-interventions: $W_s=117.00$, $p>.05$, $r=-0.155$

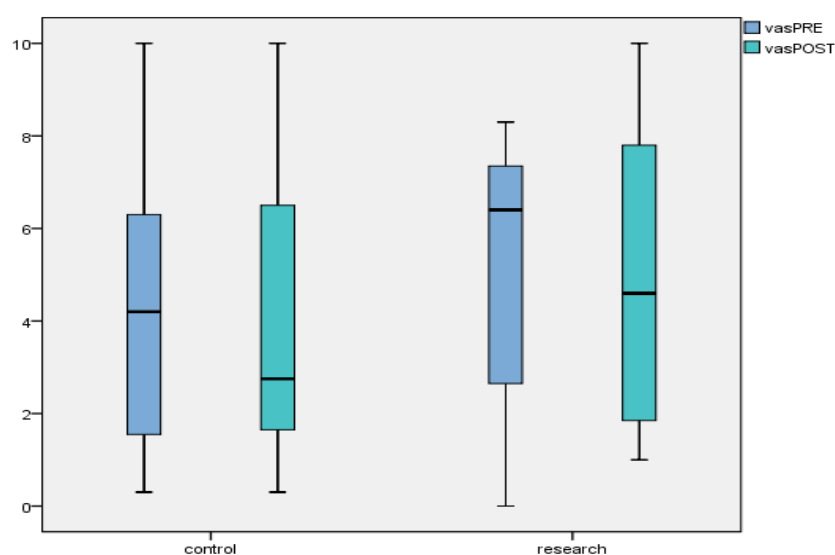


Fig. 4.28 Differences in VAS scores between the groups pre- and post-interventions

HADS: anxiety

- There were no significant differences in the HADS: anxiety subscale scores between the research- and control-group pre-interventions: $W_s=79.50$, $p>.05$, $r=-0.07$
- There were no significant differences in the HADS: anxiety subscale scores between the research- and the control-group post-interventions: $W_s=59.00$, $p>.05$ ($p=.052$), $r=-0.43$

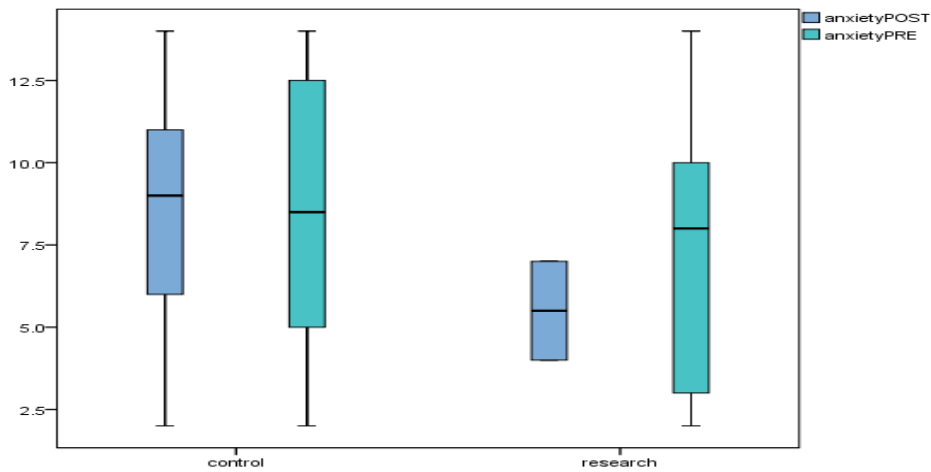


Fig. 4.29 Differences in anxiety (HADS) scores between the groups pre- and post-interventions

HADS: depression

- There were no significant differences in the HADS: depression subscale scores between groups pre-interventions: $W_s=109.50$, $p>.05$, $r=-0.28$
- HADS: depression subscale scores were lower between the groups post-intervention, but the difference was insignificant: $W_s=66.50$, $p>.05$, $r=-0.3$

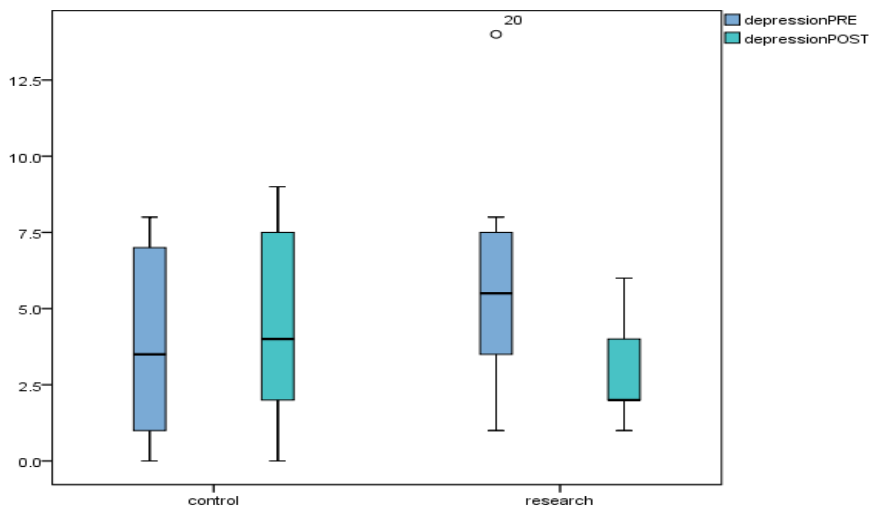


Fig. 4.30 Differences in depression (HADS) scores between the groups pre- and post-interventions

SF-36: physical health

- There were no significant differences in SF-36: physical health scores between the control and research group pre-interventions: $W_s=106.00$, $p>.05$, $r=-0.34$
- There were no significant differences in SF-36: physical health scores between the control and research group post-interventions: $W_s=104.00$, $p>.05$, $r=-0.379$

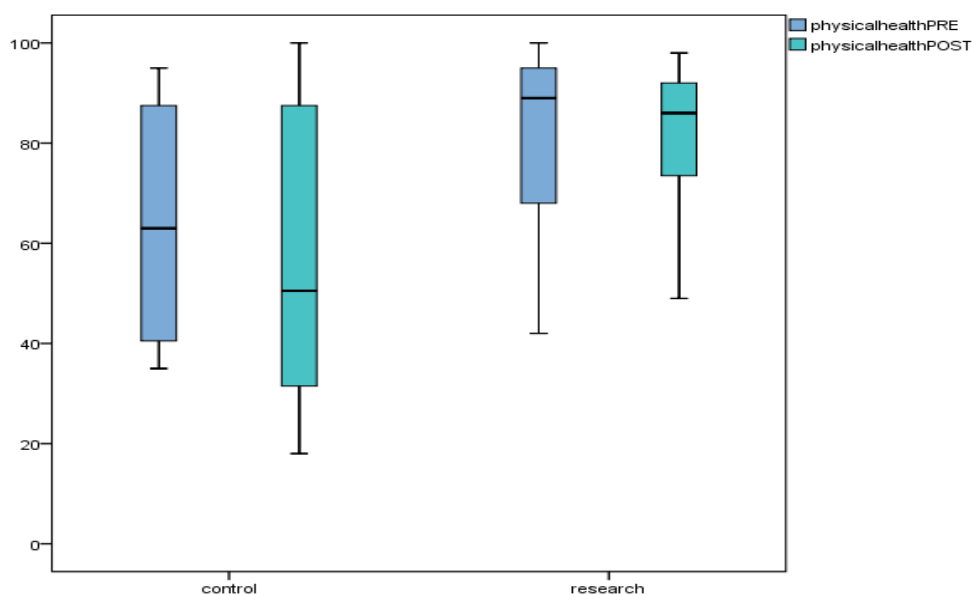


Fig. 4.31 Differences in SF-36: physical health scores between the groups pre- and post-interventions

SF-36: mental health

- There were no significant differences in SF-36: mental health scores between groups pre-interventions: $W_s=66.50$, $p>.05$, $r=-0.309$
- There were no significant differences in SF-36: mental health scores between groups post-interventions: $W_s=110.50$, $p>.05$, $r=-0.266$

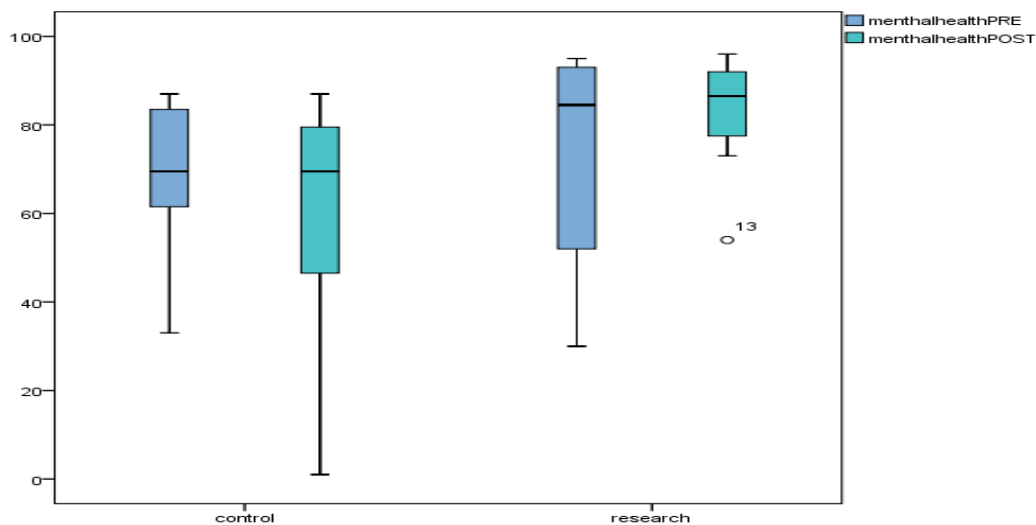


Fig. 4.32 Differences in SF-36: mental health scores between the groups pre- and post-interventions

Analysis was also conducted on gender as a factor that could significantly influence tinnitus perception in general, as well as physical and mental health. The results showed the following.

- There were no significant differences in TQ scores, pre- and post-intervention, relating to the gender of the participants: TQ pre: $W_s=108.50$, $p>.05$, $r=-0.11$; TQ post: $W_s=111.00$, $p>$, $r=-0.07$

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- There were no significant differences in HADS scores, pre- and post-intervention, according to the gender of the participants: anxiety pre: $W_s=89.50$, $p>.05$, $r=-0.08$, anxiety post: $W_s=87.00$, $p>.05$, $r=-0.12$. For depression pre: $W_s=94.50$, $p>.05$, $r=-0.37$, depression post: $W_s=97.00$, $p>.05$, $r=-0.32$
- There were no significant differences in SF-36 physical and mental health scores pre- and post-interventions according to the gender of the participants: physical health pre: $W_s=74.00$, $p>.05$, $r=-0.34$, physical health post: $W_s=84.00$, $p>.05$, $r=-0.178$. For mental health pre: $W_s=76.00$, $p>.05$, $r=-0.31$, mental health post: $W_s=79.00$, $p>.05$, $r=-0.26$
- There were no significant differences in VAS scores pre- and post-interventions according to the gender of the participants: VAS pre: $W_s=94.00$, $p>.05$, $r=-0.08$, VAS post: $W_s=110.50$, $p>.05$, $r=-0.085$

4.3.1 Summary of the questionnaires' results

Results from the completed questionnaires, when compared between both groups, did not show any significant differences. However, in the research group, the TQ scores after intervention (CBT) decreased compared with TQ scores before intervention. Such a change was not observed in the control group, whose intervention consisted of a Tinnitus Workshop. Also, the results from HADS: anxiety, post-intervention, were of borderline significance, so it may be concluded that, in general, CBT, and its methods of intervention, was an effective tool in reducing tinnitus-related distress in participants, but that the sample size was not large enough for any significant differences between the research and control groups to be confirmed absolutely. Results obtained from other questionnaires did not show such clear differences as did the Tinnitus Questionnaire.

We also investigated whether factors such as the duration of implant use and the gender of the participants would have any influence on tinnitus distress; however, analysis of the completed questionnaires did not find any significant differences between the groups.

It may be concluded that neither CBT nor the Tinnitus Workshop changed tinnitus-related distress and are not the best tools to be used for tinnitus patients. Both interventions, though, influenced tinnitus perception, since results obtained from the questionnaires varied pre- and post-intervention, and in some cases led to an improvement in tinnitus distress.

4.4 Tests of the hypothesis and power of the study

The results of the analysis did not support two points of the hypotheses: firstly, that tinnitus distress and annoyance, as measured with TQ, VAS, SF-36 and HADS, would decrease as a result of Cognitive Behavioural Therapy and, secondly, that CBT as an intervention for the research group, would result in a higher decrease of tinnitus distress than the Tinnitus Workshop. This may have been due to several reasons. The small sample size could have prevented any significant statistical results from emerging. Both interventions showed changes in tinnitus distress, but none of them were significant. With regard to the Tinnitus Workshop, the lack of significant results could be due to the duration of the intervention (workshops were conducted in only one session), whereas CBT was conducted in several sessions over 4 to 8 weeks. Therefore, a single Tinnitus Workshop may possibly have been insufficient to achieve any significant changes in tinnitus distress. Moreover, most findings based on psychological interventions involve non-CI users who suffer from tinnitus which, in turn, may suggest that CBT needs some modification, but the results of this study need to be replicated in future studies to support this theory.

The hypothesis that cochlear implantees would respond differently to tinnitus than would tinnitus sufferers who are not cochlear implant users was not supported by any significant findings. The Open Questions used in this study indisputably confirmed that cochlear implantees struggle with tinnitus in a similar way to non-cochlear implant users. They experienced the same problems, such as loss of concentration and memory and difficulties with sleep, and to a comparable degree.

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While conducting CBT with the research group, it became clear that the protocol of the treatment needs some modification for this type of tinnitus sufferer. Overall, both interventions need adjustment for cochlear implant users who also suffer from tinnitus. This is discussed further in Chapter 5.2.

Since the results were not significant, we calculated the statistical power of the Tinnitus Questionnaire as the main tool for measuring tinnitus distress and annoyance and for VAS, as an individual measure of tinnitus distress. The results showed that, for TQ, the total sample size, where effect size was $(r) = .03$, should be 28,778 subjects to achieve a power of 80%. For VAS, the total sample size, where effect size was $(r) = .13$, should be 1,362 subjects for 80% power. Total results show that this study is not statistically highly powered, but could be viewed as an indicator of what further research might establish.

Chapter Five – Discussion

The main aim of this study was to investigate if providing either Cognitive Behavioural Therapy for the research group or a Tinnitus Workshop for the control group would improve general tinnitus distress. Completed questionnaires showed small, but not significant, differences pre- and post-intervention in both groups. However, there was a significant difference in depression (HADS) scores in the group that attended CBT. Such results might be expected, given the number of participants, but it does not mean that these intervention methods do not influence tinnitus distress. Both interventions are useful tools in helping people to alleviate tinnitus: CBT takes longer and its effect can last longer; it should be used with patients who are very distressed, but emotionally open to psychological intervention. The Tinnitus Workshop lasted only two hours and can be compared to the directive counselling used in TRT. This method could be implemented with patients on waiting lists or those who are not greatly disturbed by tinnitus and expect a succinct, quick advice session on how to cope with tinnitus.

Open Questions used in this study provided more information in the form of qualitative results. The personal interpretations and experience of the participants made it possible to create a profile of tinnitus in cochlear implantees, describe the influence of cochlear implants on tinnitus and explore the effectiveness of both treatments.

5.1 Tinnitus in cochlear implant users

One of the primary aims of this study was to investigate whether cochlear implantation changes an individual's perception of tinnitus and influences the general physical and mental condition of tinnitus sufferers. We also wanted to create a typical profile of tinnitus in cochlear implantees.

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A review by Andersson et al. (Andersson et al., 2001), illustrated the magnitude of psychological problems caused by tinnitus – anxiety, depression, social isolation and sleep deprivation have been found in tinnitus sufferers. Lack of concentration and memory disturbance were also mentioned in an earlier article by Tyler and Baker (Tyler, 1983).

There is great interest in investigating the psychological aspect of tinnitus and a large number of studies have been published recently, mainly concerned with the psychological effects of tinnitus on sufferers. Also, there is some interest in individuals who complain about tinnitus after having cochlear implants. However, no study before this has investigated whether the psychological problems observed in tinnitus sufferers are also present in cochlear implantees with troublesome tinnitus or, if problems are present, of what magnitude they are and how they may be treated.

Results from Open Questions

The Tinnitus category was designed to obtain comprehensive descriptions of each individual's perception of tinnitus, such as its sound, their reaction to tinnitus, aspects that may influence tinnitus and its significance to the individual, which, in turn, are significant factors in assessing subjective attitudes towards tinnitus.

We requested basic information from the participants about their tinnitus, such as on which side they experienced tinnitus and its sound. The responses were so varied that we cannot confidently state whether the site of tinnitus influences its perception and magnitude; this result has been confirmed in the literature (Davis, 1995). Some of our respondents claimed that they have tinnitus in both ears and sometimes they have a sensation of tinnitus in their heads as well. The site of tinnitus did not affect tinnitus perception. We also asked about possible origins of tinnitus: hearing loss and trauma were the most common triggers; however, in one case, tinnitus occurred after cochlear implantation.

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The descriptions of tinnitus sounds were very diverse, from buzzing and disparate, high-pitched noises to musical sounds. However, as demonstrated in the literature, intensity of individual tinnitus perception was not reflected in tinnitus questionnaires such as the Tinnitus Questionnaire and Visual Analogue Scale.

As expected, participants used different coping mechanisms and, therefore, some were affected more by tinnitus than others. The sound and intensity of tinnitus did not have any significant impact on how it affected sufferers; it was rather the duration and the degree of hearing loss. We noticed that participants who had been suffering for a long period of time displayed better coping mechanisms than those who had lost their hearing either a few years ago or suddenly. Differences in coping mechanisms can be influenced by individual sufferers' differences in sensitivity or tolerance thresholds and personalities (House, 1981; Budd & Pugh, 1996). Reactions to tinnitus from our participants included comments such as *“get going and do something as interesting as possible, keep occupied”* to *“sometimes I cannot stand the noise”* or *“annoying and frustrating. I don’t get the full benefit from my cochlear implant because of the noises”*. Some participants seemed to cope well with their tinnitus and somehow accepted it and integrated it into their lives. However, others expressed their despair and resignation about tinnitus and regretted that their cochlear implants had not changed their perception of tinnitus. To investigate individual reactions to tinnitus, we asked questions about its fluctuation. Participants claimed that noisy environments, stress and tiredness make their tinnitus louder. A study by Stouffer et al. (Stouffer et al., 1991) found similar results. Respondents in this study suggested factors that can alleviate tinnitus, such as to *“be occupied”*, to switch off the implant or to mask the tinnitus with music.

Stress plays a huge role in exacerbating tinnitus. When asked about stressful situations, the majority of participants responded that it makes their tinnitus even more intense. In stressful situations, most participants could not control their tinnitus and were unable to concentrate or do something else to divert their attention from it. In addition, and especially during CBT, we noticed that the participants in our study were stressed by other factors, rather than directly by their tinnitus. Most participants admitted that sources

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of stress, such as work, family problems and negative thinking, increase tinnitus and make it less controllable in general. The results from anxiety (HADS) scores gave us a full picture of this situation and confirmed that more than half of the participants were anxious within a mild to moderate level. Similar findings have been discovered in studies such as that of House and Brackman (1981), which described the significance of stress on tinnitus perception.

Such a variety of coping mechanisms among participants highlights the complexity of the psychological reaction and mental processes involved in dealing with tinnitus. Erlandsson et al. (Erlandsson et al., 1992), emphasized that an individual's beliefs may influence the way they cope with tinnitus. Each participant's upbringing and individual ways of dealing with their personal problems and self-esteem issues play a huge role in their general view of tinnitus and methods of coping with it. Unfortunately, some participants displayed great anxiety when dealing with tinnitus, which resulted in social withdrawal and feelings of isolation. For example, during therapy, one participant clearly suggested that he was not able to share his problems with tinnitus with his family, because "*it is my problem*". Some participants also claimed that they are simply misunderstood, because most people think that a cochlear implant fixes all hearing issues. This, in turn, builds up anxiety levels and may lead to depression.

Inner control plays a vital part in tinnitus management, since it allows individuals to cope better with tinnitus. Participants who thought that tinnitus takes them over felt anxious and depressed. Results from the questionnaires and Open Questions suggest that only a few participants felt this way: "*Nothing I can do*"; "*it is difficult to cope with the devil*". Lack of control and anxiety act to decrease self-esteem and may result in depression. Some results showed that general wellbeing scores are below average for some participants. However, most participants confirmed that although tinnitus is a problem, it does not significantly affect their mood or general wellbeing.

This study highlighted the existence of different coping mechanisms for tinnitus distress, of which some are more or less effective. Effectiveness may depend on the duration of

tinnitus or on an individual's attitude to it. In either case, respondents claimed that it is difficult to break the vicious circle in which tinnitus triggers specific psychological reactions, which may lead to mood decline, increased stress and anxiety, which then, in turn, set it off once more. As with findings from the literature, we conclude that problems reported under the *Tinnitus* category by CI users are very similar to problems reported by non-cochlear implant users.

The subcategory *Tinnitus and informative factors* was created to explore the complexity of tinnitus from a psychological aspect, as well as from the perspective of everyday life and routines and general factors that influence perception of tinnitus. We looked into general health, which may be reflected in tinnitus management, and whether any other parts of life are affected by tinnitus. All participants complained about tension headaches: *"I have headaches, sometimes a piercing pain with my tinnitus"*; *"headaches when tinnitus recedes"*. Most participants connected headaches with tinnitus; for example, some experienced headaches as result of increased tinnitus. Importantly, one of the TQ subscales describes somatic complaints as part of the total tinnitus severity dimension. The questionnaires' results clearly showed that fewer than half the respondents suffer from somatic maladies. In addition, a few participants complained about vertigo, although it is difficult to say whether it was caused solely by tinnitus and cochlear implantation or by other, unknown, causes: *"Vertigo, I got used to it, but I am off-balance a lot. Walk like a drunk."* In this study, only one participant absolutely confirmed that cochlear implantation caused his balance disability. Unfortunately, the vestibular history of the participants prior to implantation was not available. Although historically, balance problems after cochlear implantation have not been widely reported in the literature, our results recorded some incidents of balance problems in cochlear implantees. Similarly, Ito and Sakakihara (Ito & Sakakihara, 1994), reported in their study that 47% of the implanted participants experienced vertigo.

The next general question concerned sleep problems. In this study, only one quarter of participants reported sleep disturbances as a result of tinnitus. Statements such as *"Badly!! I use sleeping tablets"* did not appear frequently in our report. Indeed, the

National Institute of Hearing Research (NIHR) study, during the 1980s, found that only 5% of tinnitus sufferers experience sleep-disrupting tinnitus, and these results are well-supported in the literature (Tyler, 2005; McKenna, 2010). On the other hand, studies such as that of Flomer et al. (Flomer et al., 1999), have found that chronic sleep disturbance is associated with greater perceived loudness of tinnitus. Flomer et al.'s study also found that tinnitus severity was perceived as more intense when combined with insomnia.

We also investigated whether cochlear implantees were affected by tinnitus during any mental tasks. There is no evidence in the literature to suggest that tinnitus may weaken concentration or memory directly (McKenna, 2004), however, this issue still needs clarification. According to the participants of this study, problems with poor concentration occur very often: *“It can cause problems in meetings, on courses where I have to concentrate on what is being said, this [tinnitus] makes it worse”*; *“Yes, it can distract and ruin the concentration.”* Also, Andersson and McKenna (Andersson, 2006) found that poor concentration is one of the problems caused by troublesome tinnitus. Moreover, Rossiter et al. (2006), showed that tinnitus patients had some problems with tasks requiring a certain degree of concentration. During the CBT intervention in this study, a few participants commented that, because of their constant tinnitus, any challenge or task seems to be very stressful and makes working very tense for them.

To investigate the impact of tinnitus on the lives and daily routines of individuals, we asked participants about any limitations to their social lives caused by tinnitus. Andersson suggested that part of the cognitive and behavioural consequences of tinnitus is a gradual withdrawal from social life. People who experience tinnitus prefer to stay at home rather than go out, since they are convinced that outdoor noise will increase their perception of tinnitus (Andersson, 2009). Participants in this study experienced similar situations. Most of them confirmed that, as a result of tinnitus, their social life became limited: *“Yes because it reduces my sense of wellbeing and confidence and also reduces my hearing which I receive solely through my cochlear implant.”* Nevertheless, we can question these statements – such difficulties may be caused by cochlear implants and being hard of hearing, not by tinnitus in isolation. This theory was confirmed by the respondents who

felt that tinnitus was an issue they had to deal with, but that their main problem was adapting to deafness.

During both interventions of this study, the subject of depression and its consequences were widely discussed. Participants confirmed that suffering from tinnitus may cause depression and increase general anxiety. When asked about depression, most respondents admitted that they feel low when their tinnitus flares up. They have negative thoughts and assume that their tinnitus will remain in a heightened state. This negative thinking, high level of anxiety, and depression, were reflected in HADS scores for some patients, and in one of the TQ's subscales, emotional distress. Permanent stress and long-term depression may lead to even more severe emotional disorders, which may eventually lead to suicide. As we discovered, a high level of anxiety and depression were present among cochlear implantees; so, a question concerning suicidal thoughts provided a further step towards revealing this extreme psychological state. 15% of participants in the study confirmed that they had suicidal thoughts: *"Yes, stupid I know"*; *"Yes, in the first years but not too bad at the moment."* In the same way as depression, thoughts about suicide may be caused by both tinnitus and hearing loss. During the CBT intervention and Tinnitus Workshops, participants talked about the fear caused when hearing loss progresses and tinnitus intensifies. In that situation, it is extremely difficult to break the vicious circle that makes individuals give up and lose their inner control.

The second category in the Open Questions, *Cochlear implants and tinnitus*, covered cochlear implants as a device that restores hearing and may help in alleviating tinnitus. We asked about the advantages and disadvantages of the everyday use of cochlear implants in relation to tinnitus. Most respondents admitted that their tinnitus improved after receiving the cochlear implant: *"It has improved it, although initially it was moderately bad. Perhaps from the trauma after the operation"*; *"Helped subdue tinnitus"*. These results are reflected in the literature, where many studies confirmed the significance of cochlear implantation in reducing tinnitus (Ito & Sakakihara, 1994; Quaranta, 2004). Restoring hearing by cochlear implantation and, at the same time, masking tinnitus with external noises, proved that tinnitus could be suppressed. Also, it

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might be possible that, after their hearing has been restored, cochlear implantees do not pay attention or do not stay focused on tinnitus because of the other sources of distraction. In this study, two participants were implanted bilaterally and for both it was helpful in suppressing tinnitus: *“Severe tinnitus following the second implant in the right ear. Gradually subsided after 3 months. Now occasionally, if become stressed or tired.”* As mentioned in the literature review (see Chapter 2.5–2.5.2), tinnitus cannot be a reason for cochlear implantation (regulation in the UK); however, it is a proven way to relieve tinnitus while treating sufferers with profound hearing loss. Unfortunately, for some participants, their tinnitus perception did not change after implantation or even changed for the worse: *“Worse after the operation but gradually back to where it was before”*; *“It got worse.”* The circumstances in which tinnitus deteriorates after implantation still require clarification, as well as the cases where cochlear implantation results in tinnitus – one of the respondents in this study complained that his operation resulted in tinnitus. A similar example can be found in the literature, where 3-4% of implantations result in increasing tinnitus or trigger it (Ito & Sakakihara, 1994). It has also been suggested that cochlear implantees need support in dealing with tinnitus.

We wanted to investigate how cochlear implants affect an individual’s tinnitus in everyday routines. Some participants suggested that cochlear implantation was helpful in reducing tinnitus severity: *“The implant helps me to go through life with very little annoyance from tinnitus.”* But for others, implantation did not have an impact on tinnitus severity: *“Most of the time the noise I have to concentrate on means I do not pay too much attention to the tinnitus.”*

Again, there is clear indication that cochlear implantees need support in reducing the effects of persistent tinnitus, and although cochlear implants help to suppress tinnitus, they do not work in every case. As mentioned before, most of the cochlear implant users were not offered any treatment to reducing the side-effects of tinnitus. There are many reasons for this: tinnitus may decline just after the implantation, but shortly afterwards can increase; it is difficult to offer any type of therapy to cochlear implantees; there is a view that cochlear implants should help to reduce the tinnitus level but, if they don’t,

nothing else can be offered. This gap in studies was acknowledged by Andersson (2009) and Tyler (1990), who emphasized ongoing problems such as increased anxiety, depression caused by tinnitus, and low self-esteem among cochlear implant users.

In summary, the description of tinnitus obtained from the results of the control and research groups seems to be the same as in non-cochlear implant users. Presented problems, such as sleepless nights, problems with concentration, and instability of tinnitus are widely described in the literature and cause concern to tinnitus sufferers with or without any hearing devices (Tyler, 1983; Searchfield, 2005).

In his report, Andersson et al. (2009) discussed the most common problems and side-effects caused by tinnitus among cochlear implant users. Most of them, such as depression, anxiety and hearing problems, were presented in the research sample. It is presumed that cochlear implants restore hearing, but this does not necessarily mean that all hearing difficulties will disappear. Most participants, after cochlear implantation, still find conversation or social gatherings to be stressful situations and, very often, they rely on lip-reading. As well as this, tinnitus sometimes increases after implantation and this presents another source of stress, forcing sufferers to re-adjust. That is why, according to Andersson et al., cochlear implant users are candidates for specific therapy.

5.2 CBT for cochlear implant users

Cognitive Behavioural Therapy is one of the most generally recognized methods of treating the effects of tinnitus (McKenna, 1998) and is a widely practised form of psychotherapy. CBT focuses on what this person *thinks* about what is happening and on *what actually* is happening to a person. Indeed, it suggests that the individual's opinions and feelings about an event are more important than the actual event itself.

In this study, CBT was offered to cochlear implant (CI) users and aimed to relieve the emotional distress associated with tinnitus. However, during the intervention, it became difficult to identify the source of tinnitus distress: was it the tinnitus itself, or expectations

of CI functionality that were not met? Cochlear implant users in this study appeared to have been misled and expected better performance from their hearing devices than they actually received. The first few sessions concerned only effects of the CI and the modifications needed to incorporate it into the daily routine of the individual.

One of the major problems for cochlear implantees was interference with their hearing identity. Cochlear implant users found it difficult to adapt their hearing ability to the outside environment. Some participants questioned whether or not they were still deaf and stated that cochlear implants merely enabled them to communicate, or whether the implants made them “normal-hearing” individuals. This problem was connected with a feeling of rejection by deaf communities, as well as by family and friends, who simply could not comprehend the concept of cochlear implants. Participants complained of frequent misunderstandings and impatience when they were unable to hear. Also, they noticed that most people think that cochlear implants completely eradicate all hearing disability and that there is no need to treat them in a special way, which in turn challenged cochlear implant users even more to adjust to other issues, such as tinnitus or social gatherings. During CBT, these problems were discussed and highlighted the magnitude of the difficulties experienced by cochlear implantees. Participants also complained about lack of support from deaf organizations, which accuse CI users of denying their deafness and are reluctant to offer any help or support. For the participants, this meant that they do not feel part of any particular group: they are not normal-hearing people, but, at the same time, they do not want to be treated as hearing-impaired.

The next problem that became apparent during CBT related to adaptation to cochlear implants and tinnitus. Both created emotional distress, so it was difficult to decide which was more important to investigate first: stress after cochlear implantation, or tinnitus that increased or remained after implantation. Furthermore, during the therapy, it was difficult to establish the source of stress; some participants claimed that tinnitus was the main reason for emotional distress but, in other cases, the cochlear implantation was problematic and resulted in anxiety and depression. In this study, most participants were still experiencing stress and finding it challenging to adapt to their implants, despite

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having received implants several years ago. During therapy, some participants admitted that being implanted made them feel dependant on the CI implants in a way that limits their lives. Some were afraid of travelling and staying overnight in case their implants broke. Sometimes the thought that implants could fail made the participants very anxious and they felt that they are not able to control their emotional distress.

During therapy, it became clear that most of the patients were concerned about their cochlear implants and tinnitus, rather than tinnitus in isolation. Participants were more distressed about their new hearing device than the tinnitus, and were looking for help and advice. During the intervention, some participants were treated in a group and some individually, and we soon realized that it was more challenging to conduct therapy in a group. Firstly, some participants, despite using cochlear implants, struggled to follow the discussion and engage fully in conversation with the rest of the group. They complained about the noise and of being unable to concentrate on more the one speaker. Secondly, the speech of some participants was not clear enough to be understood by other cochlear implant users. Also, the room in which treatment was held became an important factor in creating acceptable conditions for conducting CBT. Most participants requested a quiet room with no echo (which would make speech even more difficult to understand).

Another issue that arose during the intervention was the element of CBT that looks at relaxation. Most participants in the study were not able to listen to music nor, therefore, engage in any relaxation activities accompanied by music. They claimed that music does not sound pleasant and tranquil through cochlear implants, so they stopped listening to it. Therefore, this element of CBT needs modification.

One of the participants was a former cochlear implant user who had rejected his implant because of severe tinnitus. The ensuing treatment and procedure for CBT exposed the limitations and lack of protocol in cases such as this. Due to his inability to hear, and our limited communication with him, CBT appeared as a weak and less than ideal treatment for this type of patient.

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Overall, some participants expressed disappointment in their cochlear implants and part of the CBT intervention had to be compromised in order to discuss this issue. Most participants felt that they could not benefit fully from cochlear implantation because of tinnitus and this created distress, which in turn, influenced their tinnitus perception.

Another issue related to a non-emotional attitude to tinnitus. Some participants exhibited troublesome tinnitus, but it was hard to uncover any feelings connected with it. This situation brought CBT into question as a treatment, since it is a procedure based on resolving feelings.

To conclude, Cognitive Behavioural Therapy for cochlear implant users mostly focused on issues concerned around cochlear implants together with tinnitus, rather than on tinnitus itself. Most participants were deeply concerned about their implants and their functioning properly; tinnitus was only an additional source of emotional distress. They were more concerned with post-cochlear implant treatment than in tinnitus treatment. We can deduce from this that cochlear implantation, and the restoration of hearing, is an extremely stressful event that requires a great deal of support, both pre- and post-implantation. Unfortunately, some participants complained about lack of support after implantation, which could be a cause of residual anxiety among cochlear implant users. During the intervention we realized that, although cochlear implants do restore hearing, further support is essential.

To summarize our findings, we concluded that:

- CBT can be used for cochlear implant users
- CBT as a treatment should deal with stress after cochlear implantation
- As well as dealing with stress associated with the cochlear implantation, CBT also should address tinnitus; however, an initial assessment should be carried out to provide better therapy to alleviate the individual's particular source of stress
- The effectiveness of CBT depends on the severity of tinnitus
- CBT requires emotional openness to psychological intervention. For example, some participants showed a non-emotional attitude to tinnitus, wanted a quick

solution to their tinnitus problems, and did not require a comprehensive psychological intervention

- Discussion of tinnitus in a group of participants can be overshadowed by problems with adaptation to their cochlear implants, such as anxiety about the implants, depression and isolation
- Relaxation (usually combined with music) as part of CBT for cochlear implant users should be modified, or different forms of relaxation should be provided, because most participants did not enjoy music or gathering in groups of more than three.

5.3 Tinnitus Workshop for cochlear implant users

A Tinnitus Workshop was organized as the intervention for the control group. Although the results of the statistical analysis did not show any significant evidence of a reduction in tinnitus distress, subjective evaluation forms used after the intervention revealed that most participants found this kind of treatment to be of some benefit. As was the case with CBT, the analysis showed that this type of intervention needs some modification.

One of the most problematic factors was the physical environment in which the workshops took place. It was difficult to configure a room in such a way that all participants were able to hear other speakers, so slides were shown in order that the participants could also visualize the presented information. Additionally, the workshop conductor had to speak clearly and slowly, to ensure that all attendees understood the subject matter of the workshops as fully as possible.

Another aspect of this kind of intervention that needs modification is the relaxation element. Initially, this part of the workshop was combined with music as a background while conducting relaxation exercises. However, most participants claimed that the music used during either intervention, as well as in general, was no longer relaxing and soothing. It had become rather unpleasant and could aggravate their tinnitus. As a result,

the relaxation element was restricted to an introductory talk on how to relax and advice on which exercises could help to alleviate tension.

During the intervention, participants showed great interest in the educational part of the workshop. Presenting information about tinnitus, its possible causes and ideas about tinnitus management created an interesting discussion among the attendees. Throughout the workshop, the participants were also interested in sleeping problems caused by tinnitus. The workshop's brief explanation of sleep patterns and advice about how to get to sleep was helpful for some participants, who had difficulties with sleeping because of louder tinnitus at night-time.

The hearing exercise performed during the workshop was also much appreciated by the participants³. Activities such as this may influence their idea of tinnitus as a condition – as one that is not so invasive – and show that there are moments where tinnitus does not completely take over and they are still able to remain focused on something more pleasant. On the other hand, some participants took this exercise in the wrong way: they complained that they were not able to hear anything and, therefore, could not participate, despite subtitles being shown. This showed how sensitive these subjects were (of being implanted and being able to hear and understand speech), but at the same time not being able to process the results. Incidences like this revealed the necessity for support during the rehabilitation process after implantation, as well as emphasizing the imperative need for further support in life-changing situations.

Overall, the Tinnitus Workshops showed that this kind of intervention was helpful in educating sufferers about symptoms and causes of tinnitus, but they did not influence tinnitus distress. One suggestion is that Tinnitus Workshops are used for patients on the waiting list for CBT, since they provide basic information about tinnitus and may help to

³ The participants were shown an extract from a British TV series and were asked to remember as much information as possible. Later they were tested about details of the series and demonstrated that, during any task, they do not focus on their tinnitus.

stop negative emotions and attitudes to tinnitus developing while patients are waiting for more suitable treatment.

5.4 Summary

Andersson (2009) highlighted some gaps in the literature, when he confirmed that cochlear implant users suffer from cognitive and behavioural problems after implantation. He suggested that their problems may be associated with stress and further rehabilitation after implantation. Our study aimed to fill this gap and examined the possible methods of treatment and post-implantation help for this type of patient.

In this study, Cognitive Behavioural Therapy and Tinnitus Workshops were used for the first time with cochlear implant users. As a result of the interventions, some adjustments to CBT and the Tinnitus Workshop are suggested. In both interventions, the qualitative comments were taken into consideration, since these formed the core of the study. In addition, the evaluation forms were included so they could also be taken into consideration if a similar study is performed in future.

Overall, Cognitive Behavioural Therapy is a useful tool in alleviating the symptoms of tinnitus. However, it has to be taken into consideration that CBT should be used only for patients who are deeply distressed by their tinnitus and are ready to undergo psychological treatment. Our study showed that not all participants were keen to attend this kind of intervention and were open to sharing their anguish. The Tinnitus Workshops, in turn, turned out to be a good interim treatment. We suggest that it could be used for patients on the waiting list, as well as for patients who are not convinced to participate in psychological treatment. Tinnitus Workshops are shorter and more similar to the directive counselling used in TRT, but for some patients it would be an effective treatment.

5.5 Limitations of this study

Tinnitus distress, in this study, was measured solely through self-reporting measures, such as the Tinnitus Questionnaire and VAS. Therefore, we did not obtain any comprehensive measures of tinnitus, such as pure-tone audiometry, pitch matching and loudness matching, which could give an objective assessment of an individual's tinnitus. However, CBT focuses on relieving tinnitus distress and influencing one's emotional attitude, so in this study such objective measures were not needed. Nevertheless, a lack of a means of grading tinnitus severity became another limitation. Tinnitus affects individuals in different ways. Some patients are able to cope with tinnitus and others cannot manage it, which in turn, results in various problems, such as depression, anxiety and disturbed sleep patterns. Having an objective grading system would help to recruit participants who have a severe problem with tinnitus and avoid recruiting those who have tinnitus, but do not suffer much from it, which happened in this study. Indeed, studies such as that of Robinson et al. (2008) have found that psychology-based interventions, such as CBT, are more effective for patients with distressing tinnitus. Also, having a grading system for tinnitus would show the degree of effectiveness of both interventions.

Although the TQ that was used in the current study is validated and in common use, it is questionable whether this measure can be used for cochlear implant users. There is a possibility that, because of the specific condition of each CI implantee, some statements were difficult or impossible for patients to respond to, such as TQ (2) *"I am unable to enjoy listening to music because of noises."* Some TQ statements assumed that all respondents had normal hearing, which was not the case in this study, where the majority of participants were hard of hearing or born deaf.

Because of the nature of this study, the Open Questions were created in order to obtain a more detailed picture of cochlear implant users who suffer from tinnitus. The Open Questions were based on the standard questions list used to assess tinnitus patients.

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However, after completion, it became apparent that some of the questions were not adequate and, overall, did not sufficiently test the subjects. For example, only two questions directly asked about perception of tinnitus after cochlear implantation.

The sample size used in this study was small. As a result of the high drop-out rate, the study consisted of 12 participants in the control group and 8 participants in the research group, which created an inconsistency in group size. Moreover, although few studies have proven gender differences in tinnitus susceptibility, the participants were predominantly female, so the results of the study are limited, and the external validity of the findings may be brought into question.

Because of the time-consuming nature of this study, it was decided that both interventions would be conducted in groups. However, high drop-out rates led to some participants being treated in groups and some individually. This could have created some bias and influenced the results.

Both interventions performed in this study have their limitations. We did not carry out an external validation of the Tinnitus Workshop, because there are no protocols of a similar tinnitus intervention that we could follow. That is the reason for lack of direct comparisons of the findings of this study to other studies – thus far, no studies have conducted any similar research. However, the effect of the workshops on tinnitus distress and annoyance were analysed using subjective feedback from the participants. Also, CBT was limited to only six sessions, which could be considered too short. As discussed in the literature, CBT has a positive impact in reducing tinnitus distress, but it is difficult to assess which aspect of the therapy is the strongest and reduces tinnitus distress the most. Similarly, this study did not assess which parts of the CBT intervention or the Tinnitus Workshop were most significant. However, some questions in the Evaluation Forms did furnish some indications of the participants' preferences.

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In addition, no follow-up sessions were conducted. In general, psychological interventions often take time to have an effect and having follow-up sessions in this study would have ensured that any benefits from CBT or the Tinnitus Workshop would have been sustained.

Chapter Six – Conclusions and future research

6.1 Areas for possible future research

Cognitive Behavioural Therapy for cochlear implant users is not widespread as a method of easing tinnitus distress and essential modifications are needed. First of all, there is a need to increase the popularity of this kind of treatment among CI users. The low take-up of CBT by cochlear implant users may be associated with the fact that they are excluded to some extent during the rehabilitation process, where the most important thing is to restore and rehabilitate hearing ability. Sometimes tinnitus is viewed as an insignificant symptom and is left to be treated later, when it becomes a distressing problem.

CBT as an effective treatment has been implemented in many health services, where it has been shown to be beneficial to patients. In this study, the Tinnitus Workshop was offered as an alternative means of support. Therefore, it would be beneficial for any future research to investigate this kind of treatment as an interim source of help for patients who may be on waiting lists or cannot attend CBT for other reasons. The practicality of conducting CBT was hampered by obstacles such as participants' difficulties with following CBT techniques and the venue, as well as the participants' hearing limitations. Most participants complained about the difficulty of listening to music through cochlear implants, as well as having to ease their tinnitus by masking it with music. Difficulty of CI implantees with listening to music in a pleasurable way is widely discussed in the literature and this area needs more scientific research. One element of the CBT programme includes relaxation methods; however, it was impossible to conduct any type of relaxation using background music because of this very problem. Therefore, relaxation methods for cochlear implant users should also be investigated further.

Further studies may reveal more details about tinnitus in cochlear implant users and may investigate why implantation sometimes results in severe tinnitus.

6.2 Conclusions

Main conclusions

- Cognitive Behavioural Therapy did reduce TQ scores, but the difference was not significant.
- The Tinnitus Workshop was not as efficient as CBT.
- CBT did reduce depression (HADS) scores.
- SF-36 was a weak tool, which did not influence the general conclusions in this study.
- TQ scores correlated highly with VAS scores post-intervention in the research group.
- This study could have been more highly powered.

1. Tinnitus in cochlear implant users

- In most cases, tinnitus increased after cochlear implantation and, in one case, the implantation resulted in severe tinnitus.
- The profile of tinnitus obtained from the Open Question results is similar to that of non-cochlear implant users.
- Coping strategies are similar to those of non-cochlear implant users. Participants who had been suffering for a long period of time displayed better coping mechanisms.
- Similarly to non-implantees, cochlear implant users complained about problems caused by tinnitus with sleeping and poor concentration.
- Stress is the most common factor that aggravates tinnitus.
- Anxiety and depression in implantees are more frequently associated with cochlear implants than with tinnitus itself.
- Deafness is a more important problem to participants than tinnitus.
- Cochlear implant users complain about lack of support from deaf organizations because of a conflict over deafness identity.

2. CBT for cochlear implant users

- It is difficult to pinpoint the source of stress in cochlear implant users: is it cochlear implantation or tinnitus itself?
- CBT addresses two main types of distress: distress associated with cochlear implantation and distress associated with tinnitus.
- Currently, CBT is not a treatment commonly offered to this group of tinnitus sufferers.
- There is no CBT protocol specifically directed at CI users suffering from tinnitus.
- There were practical and logistical difficulties in conducting CBT for this group.
- CBT needs modifying before being offered to CI users.

3. Suggestion for the CBT protocol for cochlear implant users

- Assessment of tinnitus perception before attending the treatment, using for example VAS or one of the popular tinnitus questionnaires.
- Provision of an adequate room: without echo-sound, quiet and, if needed, with a flip-chart.
- No more than three participants in any group session.
- Two main subjects to be covered in CBT: stress related to cochlear implants and stress related to tinnitus.
- More elements of CBT sessions relate to cochlear implantation as a major source of stress and a life-changing event, so this problem needs more time for discussion.
- A different kind of relaxation exercise, without background music, is required.

4. Tinnitus Workshop for cochlear implant users

- The Tinnitus Workshop, as an interim treatment for CI users, needs modification.
- As for CBT, the relaxation element needs to be modified to take account of hearing limitations.
- The most interesting aspects for participants of this kind of intervention are the educational elements (teaching about tinnitus) and relaxation techniques.

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Appendix 1: Tinnitus Questionnaire (TQ)

1. I can sometimes ignore the noises even when they are there.
2. I am unable to enjoy listening to music because of the noises.
3. It is unfair that I have to suffer with my noises.
4. I wake up more in the night because of the noise.
5. I am aware of the noises from the moment I get up to the moment I sleep.
6. Your attitude to the noise makes no difference to how it affects you.
7. Most of the time the noises are fairly quiet.
8. I worry that the noises will give me a nervous breakdown.
9. Because of the noises I have difficulty in telling when sounds.
10. The way the noises sound is really unpleasant.
11. I feel I can never get away from the noises.
12. Because of the noises I wake up earlier in the morning.
13. I worry whether I will be able to put up with this problem forever.
14. Because of the noises it's more difficult to listen to several people at once.
15. The noises are loud most of the time.
16. Because of the noises I worry that there is something seriously wrong with my body.
17. If the noises continue my life will be not be worth living.
18. I have lost some of my confidence because of the noises.
19. I wish someone understood what the problem is like.
20. The noises distract me whatever I am doing.
21. There is very little one can do to cope with the noises.
22. The noise sometimes gives me as a pain in the ear or the head.
23. When I feel low and pessimistic the noises seems worse.
24. I am more irritable with my family and friends because of the noises.
25. Because of the noises I have tension in the muscles of my head and neck.
26. Because of the noises other people's voices sounds distorted to me.
27. It will be dreadful if these noises never go away.
28. I worry that noises might damage my physical health.
29. The noise seems to go right through my head.
30. Almost all my problems are caused by these noises.
31. Sleep is my main problem.
32. It is the way you think about the noise, NOT the noise itself which makes you upset.
33. I have more difficulty following conversations because of the noises.
34. I find it harder to relax because of the noises.
35. My noises are often so bad that I cannot ignore them.
36. It takes me longer to get to sleep because of the noises.
37. I sometimes get very angry when I think about having the noises.
38. I find it harder to use the telephone because of the noises
39. I am able to feel low because of the noises
40. I am able to forget about the noises when I am doing something interesting.
41. Because of the noises life seems to be getting on top of me.
42. I have always been sensitive about trouble with my ears.
43. I often think about whether the noises will ever go away.
44. I can imagine coping with the noises.
45. The noises never let "up"
46. A stronger person might be better at accepting this problem.
47. I am victim of the noises.
48. The noises have affected my concentration.

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- 49. The noises are one of those problems in life you have to live with.
- 50. Because of the noises I am unable to enjoy the radio or television.
- 51. The noises sometimes produce a bad headache.
- 52. I have always been a light sleeper.

Appendix 2: Open Questions

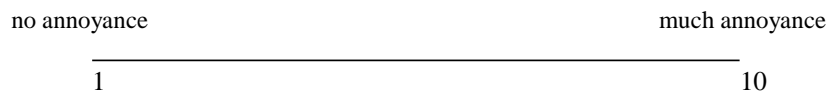
1. Background data:
 - date of birth:
 - when did you receive your Cochlear Implant?
 - in which ear do you have a Cochlear Implant?
 - how long have you been affected by hearing loss before implantation?
 - what is the cause of your hearing loss?
2. Tinnitus and CI
 - How did the implantation affect your tinnitus?
 - How does the implant affect your tinnitus now in everyday life?
3. Which ear is affected by tinnitus?
4. What kind of tinnitus treatment did you already receive?
5. What is your first reaction when your tinnitus gets worse?
6. When (in which situation or what time of the day) is your tinnitus the worst?
7. Are there any factors that appear to change the loudness of your tinnitus?
 - are there any factors that worsen your tinnitus?
 - are there any factors that alleviate your tinnitus?
8. When you are in a stressful situation, how do you perceive your tinnitus?
9. Have you ever been depressed because of your tinnitus?
10. Did you ever have thoughts about committing suicide?

Appendix 3: Visual Analogue Scale (VAS)

Instructions:

How severe is your tinnitus today?

Please mark a vertical mark on the line below to indicate how bad you feel with your tinnitus today.



Reference:

Andersson G., Baguley D.M., McKenna L., McFerran D., Self-report and interview measures of tinnitus severity and impact. In *Tinnitus – A multidisciplinary approach*. London: Whurr Publishers; 2005 (pp. 83-92).

Appendix 4: Short Form 36 (SF-36) Health Survey Questionnaire

1. In general, would you say your health is:
2. Compared to one year ago, how would you rate your health in general now?
3. The following questions are about activities you might do during a typical day.
Does your health limit you in these activities? If so, how much:
 - a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports
 - b. Moderate activities, such as moving a table, pushing a vacuum, bowling or playing golf
 - c. Lifting or carrying groceries
 - d. Climbing several flights of stairs
 - e. Climbing one flight of stairs
 - f. Bending, kneeling or stopping
 - g. Walking more than a mile
 - h. Walking half a mile
 - i. Walking 100yards
 - j. Bathing and dressing yourself
4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?
 - a. Cut down on the amount of time you spend on work or other activities
 - b. Accomplished less than you would like
 - c. Had difficulty performing the work or other activities (e.g. It took more effort)
5. During the past 4 weeks, have you had any of the following problems with your work or other regular activities as a result of any emotional problems (such as feeling depressed or anxious)?
 - a. Cut down on the amount of time you spend on work or other activities
 - b. Accomplished less than you would like
 - c. Didn't do work or other activities as carefully as usual

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6. During the past 4 weeks, to what extent have your physical health or emotional problems interfered with normal social activities with family, friends, neighbours or groups?
7. How much bodily pain have you had during the past 4 weeks?
8. During the past 4 weeks how much did pain interfere with your normal work (including work both outside the home and housework)?
9. These questions are about how you feel and how things have been with you during the past month:
 - a. Did you feel full of life?
 - b. Have you been a very nervous person?
 - c. Have you felt so down in dumps that nothing could cheer you up?
 - d. Have you felt calm and peaceful?
 - e. Did you have a lot of energy?
 - f. Have you felt downhearted and low?
 - g. Did you feel worn out?
 - h. Have you been a happy person?
 - i. Did you feel tired?
 - j. Has your health limited your social activities (like visiting friends or close relatives?)
10. Please choose the answer that best describes how true or false each of the following statements is for you:
 - a. I seem to get ill more easily than other people
 - b. I am as healthy as anybody I know
 - c. I expect my health to get worse
 - d. My health is excellent

Appendix 5: Hospital Anxiety and Depression Scale (HADS)

1. I feel tense or 'wound up'
2. I still enjoy the things I used to enjoy
3. I get a sort of frightened feeling as if something awful is about to happen
4. I can laugh and see the funny side of things
5. Worrying thoughts go through my mind
6. I feel cheerful
7. I can sit at ease and feel relaxed
8. I feel as if I am slowed down
9. I get a sort of frightened feeling like 'butterflies' in the stomach
10. I have lost interest in my appearance
11. I feel restless as if I have to be on the move
12. I look forward with enjoyment to things
13. I get sudden feelings of panic
14. I can enjoy a good book or radio or TV programme

Appendix 6: Consent form

Centre Number:

Study Number: 09/H0504/107

Patient Identification Number for this trial:

Title of project: Tinnitus in Cochlear Implants

Name of researcher: Eliza Tucker

1. I confirm that I have read and understood the information sheet dated 20/08/2010 (Version #4) for the above study. I have had the opportunity to consider the information, and any questions I may have had have been answered satisfactorily.

☐

(Signature)

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without my medical care or legal rights being affected.

☐

(Signature)

3. I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from the University of Southampton, from regulatory authorities or from the NHS trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

☐

(Signature)

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4. I agree to take part in the above study.

☐

(Signature)

Participant:

Date.....Print.....Signed.....

Researcher:

I confirmed that I have explained to the subject the purpose and the nature of the investigation which has been approved by the NHS Ethics.

Date.....Print.....Signed.....

Appendix 7: Letter of invitation

**Tinnitus in Cochlear Implantees. Cognitive Behavioural Therapy for Cochlear
Implant Users.**

Letter of Invitation

Dear Sir/Madam

You are invited to take part in a research study entitled 'Tinnitus in Cochlear Implantees. Cognitive Behavioural Therapy for Cochlear Implant Users'.

The study is part of a research programme at the Institute of Sound and Vibration Research at the University of Southampton. The aim of this study is to investigate tinnitus in cochlear implant users as well as how Cognitive Behavioural Therapy can help to decrease the symptoms of tinnitus. Cognitive Behavioural Therapy involves meeting with a psychologist, applying relaxation, imagery and distraction techniques, giving advice on listening techniques, management of sleep, and cognitive restructuring of thoughts and beliefs associated with tinnitus. In the beginning of the study we ask you to fill in questionnaires, we will then offer you to take part in Cognitive Behavioural Therapy to help you cope with your tinnitus better, or we will invite you to take part in an information session to inform you about your tinnitus.

There is more information about this study in the attached information sheet. Please take time to read the information sheet, which will help you decide if you are willing to help in the study. Your participation can lead to a better understanding of tinnitus and might help you to better cope with your tinnitus.

All information given to me will be kept in strict confidence. Confidentiality will not be breached at any time. Additionally, you will not be identified in any report or publication.

Appendices

If you would like further information before making a decision, please feel free to contact me either by phone on 0238059 4946, by returning the attached response slip in the franked envelope provided or by email: es@isvr.soton.ac.uk

I would like to thank you for your help. Your effort and time are greatly appreciated.

Dr Stefan Bleeck

Eliza Tucker

Appendix 8: Information sheet for research participants

Dear Sir/Madam,

You are invited to take part in the research study “Tinnitus in cochlear implant users. Cognitive behavioural therapy for cochlear implant users”. Before you decide if you want to take part, it is important to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. The study is being undertaken as a part of my PhD.

Purpose of the research

The purpose of this study is to investigate tinnitus in cochlear implant users and also if cognitive behavioural therapy helps in coping with tinnitus after cochlear implantation. This study is based on questionnaires, cognitive behavioural therapy for some participants and tinnitus information sessions. Cognitive behavioural therapy is a method that is used in the NHS to treat patients who suffer from tinnitus but it is not yet in use with cochlear implant users. The therapy includes discussions with other participants and with the conductor, sessions of relaxation, distraction techniques, listening techniques, management of sleep and cognitive restructuring of thoughts and beliefs associated with tinnitus.

Data from questionnaires and therapy sessions will be kept confidential. In case of stress of any kind during therapy sessions help is available immediately by contacting the chief investigator (details below). Participants have the right to withdraw at any time without consequences. If you are already involved in other research it will not impact your candidacy.

Why have I been chosen?

You have been invited to participate in this study because you have Cochlear Implant and you might suffer from tinnitus.

Do I have to take part?

Taking part in this study is entirely voluntary. It is up to you to decide whether or not to take part. If you decide to take part you will be asked to sign a consent form. A copy of your signed consent form and this information sheet will be given to you to keep. Even after deciding to take part, you are still free to withdraw at any time and without giving any reason. **A decision to withdraw at any time, or a decision not to take part, will not affect the standard of care you receive.**

What will happen to me if I take part and what will I have to do?

If you decide to participate in this study, you will be asked to complete 4 questionnaires and answer several open questions about your tinnitus. If you need any help in filling out the questionnaires, we will offer you our help and support. The questionnaires will be sent to you by post and when you fill them in, you will be asked to send them back using attached stamped addressed envelope.

Afterwards, you might be offered to attend up to 12 sessions (1 hour each) of cognitive behavioural therapy with other participants of this study or attend two hour educational lecture concerning tinnitus. Participation in this part of the study is entirely voluntary. After attending one of proposed activities you will be asked to complete once more the same set of questionnaires.

Expenses

All necessary travel costs will be paid.

What are the possible disadvantages and benefits to taking part?

The information we receive from this study may help us to offer better treatment for cochlear implant users suffering from tinnitus. If you are suffering from tinnitus, the therapy or the information sessions will help you to deal with it better.

Your participation can also lead to a better understanding of tinnitus in general and can make a difference to implant users that suffer from tinnitus. Participation in this research study will not require any lifestyle restriction; however in a few cases answering the personal questions may create some distress.

Will my participation in this study be kept confidential?

All information which is collected about you during the research and therapy will be kept strictly confidential. However if, there are any circumstances in which there is danger of harm to you or other persons, we are required to discuss this with appropriate service.

What will happen to the results of the research study?

The results of this research will be published in peer reviewed scientific journals which are accessible to the research participants. A brief report will be made available on request. You will not be identified in any report/publication.

Contact for further information

If you require any further information or clarification, please do not hesitate to contact me. My contacts details are as follows:

Co-ordinating Investigator:

Eliza Tucker

University of Southampton, ISVR

Email: es@isvr.soton.ac.uk

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Tel: 02380594946

I greatly appreciate you taking the time to read this information and hope that you will be willing to contribute to this study.

Yours sincerely,

Dr Stefan Bleeck
Eliza Tucker

Contact

If you have a concern about any aspect of this study, you should ask to speak to the researcher, who will do their best to answer your questions (Chief Investigator Dr Stefan Bleeck tel: 02380596682 and Eliza Tucker, tel: 07704121096)

If you remain unhappy and wish to complain formally, you can do this by contacting Dr Martina Prude, University of Southampton, tel: 023 8059 5058

Appendix 9: Research protocol in non-technical language

Background: The Institute of Hearing Research indicates that in the UK 10-15% of the adult population have experienced prolonged spontaneous tinnitus and in 1% of the population the tinnitus has a severe effect on the quality of life. There is currently no effective treatment to cure tinnitus, therefore most people suffering from troublesome tinnitus rely mostly on Cognitive Behavioural Therapy (CBT) as a treatment to learn to cope with the condition and thus improve their quality of life. Cochlear Implants (CI) often help to suppress tinnitus and facilitate habituation. Nevertheless, after implantation up to 25% of the patients still find tinnitus bothersome and difficult to cope with. We cannot explain why in some cases natural habituation does not occur. CBT has not been described in the treatment of CI users so far.

The purpose of this study is to investigate the effectiveness of CBT in CI users. We will offer half the CI-users in our sample that are suffering from tinnitus Group Cognitive Behavioural Therapy. As a control we will offer the other half a two hour information lecture to inform them about their tinnitus. Selection of the respective groups will be decided on a random basis. We will assess the success by questionnaires before and after treatment.

As a result of the research we aim to explore if CBT helps to suppress the symptoms of tinnitus in CI users and whether CI users who still have bothersome tinnitus after implantation should be treated using CBT. We furthermore aim to establish how CBT needs to be adjusted to be maximally effective for CI user.

Method: The method of this study is based on questionnaires carefully selected to minimise overlap and thus the time the participants spend on filling them in. Participants will also be asked to answer open questions to gather information concerning the history of their tinnitus.

We assume that some patients after implantation will still suffer from tinnitus. Attending CBT or the 2 hours tinnitus lecture is entirely voluntary. CBT takes up to twelve sixty minute sessions. As part of the therapy, patients will be asked to write a daily diary and to fill in self-report questionnaires. The treatments will provide applied relaxation, imagery and distraction techniques, listening techniques, management of sleep, and cognitive restructuring of thoughts and beliefs associated with tinnitus.

After finishing the therapy, all patients will fill in the same set of questionnaires again, but without the open-questions.

Participants: Participants are recruited from collaborating Hospitals and Centres. We aim to test participants between 18-80 years of age. Potential research participants will be approached by the Audiology staff from SOECIC and the Trusts involved. Once identified as a potential participant who meets the inclusion requirements of the study, which are cochlear implantation and bothersome tinnitus, a letter will be sent by the physician explaining why the subject is being contacted and what the research study is about. The potential participant will be asked if she or he is interested in taking part in the investigation and will be encouraged to contact the co-ordinating investigator (contact will be included in the letter) if they have any questions or concerns. Additionally, an

information sheet will be enclosed with the letter, which will give the potential participant more details of the project and additional information on what will be involved in the research. A reply slip will be attached to the letter and after receiving the contact details, the coordinating investigator will contact the participant. Upon receiving replies from potential participants, the co-coordinating investigator will contact the potential participant to set up a mutually convenient date and time for testing.

Procedure: Our study is mainly based on questionnaires and Cognitive Behavioural therapy. After identifying all potential participants we randomly split this population into two groups, one 'therapy' group and one 'information' (control) group of equal size. The therapy group will be offered to take part in the full CBT, lasting up to 12 sessions. CBT will be conducted by the co-ordinating investigator supervised by an experienced psychologist. The control group will be offered a 2 hour lecture concerning their tinnitus problem. After finishing both treatments, participants will be asked to fill in the same set of questionnaires.

Statistical analysis: The questionnaires will be analysed using appropriate statistical methods.

Ethical issues: Ethical issues arising from these interventions:

1. Participants can withdraw from the study at any time.
2. Participants will get information about the study in advance in the letter that we will write to them (attached). They will also be briefed individually before every part and they will get the opportunity to ask questions.
3. Participants will fill in a consent form (attached)
4. Because both interventions might cause stress to the participants due to the time commitments:
 - a. We have selected the questionnaires to maximise the amount of relevant information while minimizing the time needed to fill them in. Thus participants spend the shortest possible time with the questionnaires.
 - b. The CBT takes up to twelve hours in as many weeks. This time commitment is necessary for a successful therapy and cannot be shortened. Participants volunteer for it and are informed that there is no guarantee that they will get better.
5. After the study, the participants will have the opportunity to get information about the outcome and results.

Data protection and anonymity: The data resulting from the questionnaires will be pseudonymous and will be stored on computer systems belonging to the ISVR, University of Southampton for 10 years after publishing the results. Confidentiality of personal data will be ensured by allocating each patient a random subject number. Additionally, all data collected and related to the subject will be labelled with the subject number only. Records of patient attendance in this study will be held in the patient records' system of the ISVR Hearing and Balance Centre and the other collaborative centres in case of query from the participant's GP or another specialist.

Appendix 10: Evaluation Form for the Tinnitus Workshop

Dear Madam / Sir

We would like to take this opportunity to thank you for your recent participation in the Tinnitus Workshop conducted at the University of Southampton. As explained to you during the workshop, these workshops are part of a study that is looking at ways of helping people with tinnitus after cochlear implantation. We appreciate your participation and indeed your suggestions were of immense help to us in improving ways of helping implant users suffering from tinnitus.

As part of the study, we would like you to kindly fill the attached Evaluation Form. The Evaluation Form is anonymous and will not affect any future treatment you receive in the South of England Cochlear Implant Centre (SOCIEC) or other institutions.

Best regards,

Eliza Tucker

Jama Mohammed

Dr Stefan Bleeck

University of Southampton

ISVR

Tel 0238059 4946

1. Do you think the Tinnitus Workshop was successful in helping you to cope with tinnitus?
2. Did your perception of tinnitus change after attending the workshop?
3. Did your emotional attitude towards tinnitus change after attending the workshop?
4. Has your behaviour towards your tinnitus changed since the workshop because of the information you were given about:
 - a. general information
 - b. relaxation instructions
 - c. sleep hygiene instructions

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5. What was the most important thing you found out about your tinnitus or anything related to it during the workshop?
6. From a scale 1-5 with **1** being least helpful and **5** being the most helpful, please rate the following aspects of the workshops by putting a tick in the boxes below.

Workshop	1	2	3	4	5
General information about Tinnitus					
Relaxation information					
Sleep hygiene					
Distraction exercise					

7. Workshop presentations were carried out using PowerPoint slides, how did you find the presentations?
8. Was the information presented on the slides understandable?
9. Did the presenters speak with clarity during the workshops?
10. If you wanted to raise a point or ask a question did you do so without any hesitation?
11. If you did ask questions, was your question answered appropriately?
12. Do you think the duration of 3 hours for the workshop was appropriate?
13. Were there enough breaks?
14. Do you have any suggestions on how this workshop can be improved in the future?

Appendix 11: Evaluation Form for Cognitive Behavioural Therapy

Dear Madam / Sir

We would like to take this opportunity to thank you for your recent participation in the Tinnitus Cognitive Behavioural Therapy conducted at the University of Southampton. As explained to you before, the therapy sessions are part of a study that is looking at ways of helping people with tinnitus after cochlear implantation. We appreciate your participation and indeed your suggestions were of immense help to us in improving ways of helping implant users suffering from tinnitus.

As part of the study, we would like you to kindly fill the attached Evaluation Form. The Evaluation Form is anonymous and will not affect any future treatment you receive in the South of England Cochlear Implant Centre (SOCIEC) or other institutions.

Best regards,

Eliza Tucker

Dr Stefan Bleeck

University of Southampton

ISVR

Tel 0238059 4946

2. Do you think the Cognitive Behavioural Therapy was successful in helping you to cope with tinnitus?
3. Did your perception or understanding of tinnitus change after attending the therapy?
4. Did your emotional attitude towards tinnitus change after attending the therapy?
5. What was the most important thing you found out about your tinnitus or anything related to it during the therapy?
6. Do you have any suggestions on how these sessions can be improved in the future?

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Appendix 12: Sleep Diary

Sleep Diary

Name: _____ Date/Week Beginning: _____

	Example	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Time spent napping in the day	30 minutes							
Amount of medication or alcohol	7.5 mg of "Sleep Well"							
Bed time	10:45							
Lights out time	11:30							
Time taken to fall asleep	55 minutes							
Number of times you woke in the night	4							
Amount of time awake in the night	60 minutes							
Final wake-up time	6:00							
Time you got up	7:30							
Quality of Sleep	3							
0 = very poor sleep	10 = very good sleep							
Tinnitus Annoyance	7							
0 = no annoyance	10 = extremely annoying							
Time in Bed (TIB)	8hrs 45mins							
Total Sleep Time (TST)	4hrs 35mins							
Sleep Efficiency TST/TIB x 100	52%							
Daytime Functioning	7							
0 = very poor	10 = no problems							

Appendix 13: Thoughts and Feelings Diary

Thoughts & Feelings Diary

When you notice some distress associated with your tinnitus, fill in Column A (Event). Then complete Column C (Feelings). Then, try to work out the thoughts (Column B) which might be leading to the feelings you identified. Finally, try to develop some effective challenges to those thoughts which are unhelpful (Column D).

A: Event	B: Thought	C: Feeling	D: Dispute
Who was I with? What was I doing? Where was I? When was it? Was my tinnitus louder? Did my tinnitus interfere with what I was doing?	What was going through my mind just before I started to feel this way? What does this say about me? What does this mean about me? My life? My future? What am I afraid might happen? What is the worst thing that could happen if it is true? What does this mean about how the other person feels or thinks about me? What does this mean about the other person or people in general? What images or memories do I have in this situation?	depressed anxious angry guilty ashamed sad hurt embarrassed excited scared frightened irritated insecure panicky frustrated nervous disgusted cheerful happy disappointed enraged humiliated, etc.	What evidence do I have to support this thought? What evidence is there against this thought? Are there any alternative views I haven't considered? How would someone else view this situation? What is the effect of thinking in this way? If someone else had this thought, how would I say to help them dispute it? Does this thought help or hinder me in getting what I want? Am I concentrating on my weaknesses and forgetting my strengths? Am I blaming myself for something which is not my fault? Am I expecting myself to be perfect? Am I overestimating the chances of a disaster? Am I using a double standard - how would I view someone else in this situation? Am I fretting about the ways things ought to be rather than dealing with them as they come? What can I do to test out the truth of these thoughts?

Appendix 14: Hand-out for the Tinnitus Workshop



NEUROPHYSIOLOGICAL MODEL OF TINNITUS

- According to the neurophysiological model of Tinnitus, Tinnitus only becomes bothersome when it is associated to a negative meanings or experiences.
- Tinnitus is not bothersome to everyone that suffers from it. In fact 80% of people who experience tinnitus for the first time are not bothered it this is because in these people, tinnitus is not associated with any negative meanings or experiences and therefore it undergoes a process of habituation.
- Habituation of tinnitus means that the tinnitus-related neural activity is blocked from reaching the limbic and autonomic nervous systems and consequently there are no negative reactions to tinnitus.
- Tinnitus becomes bothersome when it becomes associated with something that is unpleasant or during a period of stress and/or anxiety. If this is the case, such individuals experience a higher level of annoyance linked to the meaning of the tinnitus. This results in an enhancement of the activity of the autonomous nervous system (ANS) and the limbic system. These individuals then start to monitor the tinnitus signal which further enhances its importance
- The Autonomous nervous system is responsible for our responses to threats (racing heart, sweaty palms, fight /flight response). Our limbic system is responsible for our emotional responses and memories.




PSYCHOLOGICAL APPROACH TO TINNITUS

The dominant psychological treatment model for tinnitus is a cognitive behavioural therapy. This model similar to the neurophysiological model focuses on the concept of habituation and provides the help to make habituation easier to occur. Hallam who created this model suggested that everyone is able to habituate to tinnitus. When someone

suffers from tinnitus, it means that something has interfered with the process of habituation. Psychologists who work in this field believe that the most important things that could disturb this process are:

-  Autonomic nervous system arousal due to stress caused by either the tinnitus or other problems.
-  The meaning or emotional reaction toward tinnitus.

If we want habituation to occur, the process has to be supported by:

-  Low arousal (relaxation).
-  We have to change the personal meaning of tinnitus.
-  We have to work to reduce the other sources of stress.

HOW CAN WE BECOME RELAXED?

We have to practise to be relaxed.

HOW TO CHANGE THE MEANING OF TINNITUS?

We can do it by changing our attitude towards tinnitus using the process of cognitive therapy. The focus of cognitive therapy concerns on individuals' interpretations upon events than on events on themselves.

The onset of tinnitus can create psychological distress. The psychological approach to tinnitus is focused why this distress occurred and how it is reinforced by patient's negative automatic thoughts.

What kind of automatic thought can appear in our head???

Imagine a situation (A) in which you are travelling on a crowded train and while you are standing someone pokes you in the back with an umbrella. Imagine this happens a number of times. How would you feel (C)? When asked this many people say they would feel annoyed. It is tempting to suppose that the feeling (C) is the result of being poked. (A). It is important to ask why you would feel annoyed (or if you experienced any other emotion). To find out we have to ask what exactly we thought when someone poked you in the back. In reality we have different thoughts: careless, doing this deliberately. But our opinion will change if you find out that this person who pokes you in your back was blind, our thoughts and emotion will change so quickly.

Thoughts (B) are referred to as “autonomic thoughts” because they occur quickly, without deliberate effort and often in shorthand form.

The way we feel (C) is associated with how we think about (B) the situation. The situation (A) itself does not determinate the emotion.

Tinnitus can create many different beliefs and emotions. Some people believe that tinnitus is due to their ageing and they do not have any strong emotion towards it. However, some people experienced such a strong emotions that they cannot cope with them at all. We have to add here that our automatic thoughts are also influenced by our core beliefs and assumptions that were created and modified by our experiences through the life.

HOW TO CHANGE OUR BEHAVIOUR?

Our behaviour as a result of our emotions can create or maintain anxiety or depression. If someone is overwhelmed by tinnitus, creates specific emotions which lead to specific behaviours. One person can think that tinnitus is much louder outside that at home, so the best result for him/her is to stay indoors. But does it solve the problem or rather make us even more deeply involved in tinnitus.

THE AIM OF THERAPY

Cognitive therapy seeks to identify and change negative thoughts about tinnitus and its impact on us. Therapy involves monitoring thoughts, discussion with therapist and “behavioural experiments” to discover the accuracy of these thoughts.

Appendix 15: Open Questions script – the control group

(Taken at the time of the Tinnitus Workshops in 2011)

QUESTION 1: BACKGROUND DATA

Nr participant	Date of birth	Year of implantation	Implanted ear	Time of deafness (years)	Cause of hearing loss	Personal status
1	17.05.1965	19.05.2009	Right	40	Wide vestibular aqueduct	Married
32	04.03.1943	2008	Left	40	Flu	Widow
7	23.10.1952	04.2009	Right	30	Nerve deafness	Married
26	28.09.1951	10.2004	Right +Left	7	Meningitis	
8	08.03.1945	2004	Left	30	Maybe hereditary	Single
14	24.11.1948	1994	Left	24	Menière's disease	
10 Man	13.02.1952	03.2009	Left	52	Jaundice	Single
2 Man	29.04.1952	2009	Left	10	Infection	Single
41	29.05.1952	2003	Right	30	Unknown	Widow
11 Man	25.09.1935	1999 +2002	Left +right	30	Unknown	Married
42 Man	19.05.1961	2009	Right	Totally deaf in left ear since birth, right since 2007	Unknown	Married
49 Man	26.11.1962	04.1995	Right	15	Motorcycle accident	Single

QUESTION 2: TINNITUS AND CI

Nr participant	How did the implantation affect your tinnitus?
1	It has improved it, although initially it was moderately bad. Perhaps from the trauma of the operation.
32	Worse after the op but gradually back to where it was before
7	Initially very little tinnitus so improvement from before
26	Not much change
8	Immediately after operation was very loud and intrusive. It must have settle down somewhat-less noticeable when wearing processor and hearing aid.

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14	It was worse
10	No change
2	It got worse
41	It moved to the left ear
11	Severe tinnitus following the second implant in the right ear. Gradually subsided after 3 months. Now only occasionally if I become stressed or very tired.
42	It did not at all
49	Helped subdue tinnitus

Nr participant	How does the implant affect your tinnitus now in everyday life?
1	I hardly notice tinnitus now, except when I am tired
32	I try too adapt, just carry on
7	I do have tinnitus, from the time to time, more often recently
26	Not much
8	I don't think there is much difference in the tinnitus now, before or after implant. Less noticeable wearing processor and aid. I have learnt to block out the sound and don't notice it too much when my mind is occupied with everyday life.
14	This noise is a killer
10	No change, but better hearing better masking
2	Sometimes it affects me in the day but mostly at night times
41	As sound being heard, I notice it
11	Very little, generally a night after a stressful day brings it on.
42	It does not. Tinnitus level are occasionally raised
49	Helped subdue tinnitus

QUESTION 3:

Nr participant	Which ear is affected by tinnitus?
1	Head
32	Both ears
7	Right ear
26	Both
8	It would be hard to pinpoint. Possibly the right side
14	Both and head
10	Both but mainly left
2	Both
41	Left mainly
11	Right ear
42	Right ear but really meaningful in this case
49	Both

QUESTION 4:

Nr participant	What kind of tinnitus treatment did you already receive?
1	-----
32	None
7	None
26	None
8	I have not received treatment for tinnitus
14	None
10	TRT
2	Treatment with my auditory implant clinic of ways to deal with my tinnitus
41	None really other than "one of those things" and suggestions for managing.
11	None. Audio scientist explained that tinnitus prior to implantation didn't go away. But tinnitus after implantation usually gradually subsided. This is what happened to me.
42	None
49	None

QUESTION 5:

Nr participant	What is your first reaction when your tinnitus gets worse?
1	It just makes me notice it more but I ignore it and carry on.
32	Get going and do something as interesting as possible, keep occupied.
7	Sit quietly as it is very distracting and loud.
26	Sometimes I cannot stand the noise.
8	Frustrating.
14	There we go again, oh god, please stop it.
10	Depression.
2	Hope it will go away soon but never does.
41	How worse will it get? It is a bit of uncertainty that makes this non pronounced. Also it is in the head so non stressful.
11	Cannot sleep and get increasingly worried that it is going to continue. Usually comes on gradually, becomes very intrusive and then subsides over 1 to 3 Hrs.
42	Annoyance.
49	Ignore it!!

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QUESTION 6:

Nr participant	When (in which situation or what time of the day) is your tinnitus the worst ?
1	Perhaps when I have been in a very noisy environment and then move to a quiet one. At night when I remove my implant.
32	Last thing in the evening when I take the processor off and first thing in the morning.
7	Unable to say. Varied times.
26	Time of day varies. Worst time is when I am in a noisy environment such as traffic.
8	In bed, in the quiet.
14	Any time of the day and night.
10	When tired or stressed.
2	Night times in bed when I have to take off my cochlear implant and hearing aid.
41	-----
11	At night when not wearing my processor.
42	When particularly stressed: usually evenings.
49	If I am ill or tense, mornings and evenings.

QUESTION 7: ARE THERE ANY FACTORS THAT APPEAR TO CHANGE THE LOUDNESS OF TINNITUS?

Nr participant	Are there any factors that worsen your tinnitus?
1	Loud noises, auditory testing makes the tinnitus the worst.
32	Not really, some foods or wine.
7	Unable to say.
26	All loud noises.
8	Stress, taking aspirin.
14	No.
10	Lack of sleep.
2	Night time, when I remove my implant.
41	-----
11	Yes, tiredness and stress.
42	Stress
49	Tension or if I am ill.

QUESTION 8:

Nr participant	Are there any factors that alleviate your tinnitus?
1	Quiet.
32	No.
7	Sitting quietly. Sometimes I remove implant.
26	When it is quiet and I am on my own.
8	Playing music.

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14	No it just goes on!
10	Masking with music.
2	Different sounds.
41	-----
11	Wearing the processor helps but hearing difficult.
42	None.
49	Sleep.

QUESTION 9:

Nr participant	When you are in stressful situation, how do you perceive your tinnitus?
1	I don't notice it particularly.
32	A nuisance.
7	Worse.
26	Try to go when is quiet.
8	Try not to think about it.
14	Makes me more stressful.
10	As a [*****] nuisance.
2	I don't.
41	-----
11	This usually follows a stressful day when it makes me in the early hours or the mornings.
42	Varies- but this is a rarely a sudden onset.
49	Concentrate on job in hand.

QUESTION 10:

Nr participant	Have you ever been depressed because of your tinnitus?
1	No.
32	Honesty – no.
7	No.
26	Sometimes.
8	Not really.
14	The wooing noise makes the depress.
10	Yes.
2	Yes.
41	-----
11	For short periods, yes.
42	No.
49	No.

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QUESTION 11:

Nr participant	Did you ever have thoughts about committing suicide?
1	No.
32	No.
7	No!
26	No.
8	No.
14	No no no.
10	No.
2	No.
41	-----
11	No never.
42	No.
49	No!

QUESTION 12:

Nr participant	How can you describe your current tinnitus?
1	High pitched whistles and buzzes. Very mild.
32	Mostly high pitches. Annoying from time to time.
7	Buzzing. Someday I do not have any problems but some days quite severe and noises very loud, sound changes when I have tinnitus.
26	Bearable, like a humming sound.
8	Hissing, kettle sound, quite high sound.
14	A killer, hell on earth, spin dryer on full with train coming in dryer, thunder, wooing.
10	Like a repetitive tune
2	Buzzing in both ears, sea waves, raining.
41	Intrusive. Body sound, clicking, running of blood, joint movement in neck.
11	No problem today. Occurs occasionally at night if I have become stressed. First started shortly after my second implant in the right ear. Very severe, prevents sleep.
42	Moderate.
49	Moderate.

QUESTION 13:

Nr participant	Do you have any other problems such as headache, facial pain or vertigo?
1	I have headaches- sometimes a piercing pain of my tinnitus. Onset is sudden and high pitched. Vertigo, not particularly but my balance is poor.
32	I do suffer from headaches. Vertigo – form time to time, slightly.
7	Headaches when tinnitus recedes.
26	No.
8	Migraines. Ear pain occasionally. Vertigo – sometimes.

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14	No. Vertigo – used to but I am off balance a lot. Walk like a drunk.
10	Neck ache. Vertigo – I have in the past, I feel less steady on my feet than I used to.
2	Headache. Vertigo – sometimes.
41	Clicking in ear as movement and vertigo.
11	No, vertigo a little.
42	No.
49	No.

QUESTION 14:

Nr participant	Does and how tinnitus affects your sleep?
1	No.
32	Only at odd times.
7	Not at all.
26	Yes, getting to sleep and keep me waking up.
8	Not really. Try to divert thoughts.
14	Before going to bed I drink hot milky drinks, Camomile tea, use Lavender oil, over rule point.
10	BADLY!! I use sleeping pills.
2	Always affect my sleep.
41	Noises. Sudden changes of tinnitus.
11	Yes, occasionally if I become stressed.
42	No.
49	No.

QUESTION: 15:

Nr participant	Does tinnitus affect your work?
1	No.
32	No.
7	Yes, as sound changes: I don't always hear when spoken to.
26	Sometimes when it is noisy.
8	Not really. A lot of noise in hairdressing. Hairdryers, radio and talking.
14	No, but when the wooing noise starts it does.
10	Always through the lack of sleep.
2	Sometimes.
41	Yes. Anxiety and lack of concentration.
11	No.
42	Not too much.
49	No.

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QUESTION 16:

Nr participant	Does tinnitus have any influence on your life (social interaction) and activities?
1	No.
32	Not really.
7	No.
26	Cannot engage in conversation with other people.
8	Not really.
14	I don't have much of social life now. But with all noise around I know I will suffer from it.
10	Doesn't occur as I am tired.
2	Yes, I avoid them.
41	---
11	No.
42	No.
49	It influences my activities but not social life.

QUESTION 17:

Nr participant	What do you do to stop hearing tinnitus?
1	Sing a song in my head or just think of other things and ignore it.
32	Get outside gardening or start cooking.
7	Trying to keep calm until it fades.
26	Do puzzles and quite things to try to calm down it but I still can hear it.
8	Divert my thoughts.
14	Nothing really I can do. It isn't easy to ignore this devil noise.
10	Take a sleeping tablet at night, listen to the music? TV otherwise.
2	Not sure.
41	-----
11	Try to concentrate my mind on something or problem.
42	Use the CI – it makes (mostly) for me.
49	Ignore it.

QUESTION 18:

Nr participant	Are you able to stop thinking about tinnitus?
1	Yes.
32	Yes.
7	Not when I have it.
26	No.
8	Try to.
14	I don't think about it.
10	Yes.
2	No.

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41	At times.
11	Very difficult at the time, but don't usually think about it.
42	Yes.
49	Yes.

QUESTION 19:

Nr participant	What do you think and feel about tinnitus?
1	I don't very often. Before my implant I used to quite like it as it felt as though at least I could hear something.
32	I know for me it could be worse, so I just try to get on with it.
7	Unpleasant!
26	I cannot yet round about being deaf but can hear noises all the time.
8	Annoying.
14	It is just devil.
10	It is a *****nuisance.
2	Not sure.
41	---
11	I wondered whether I should have agreed to have the second implant. But feel the benefit is worth the tinnitus discomfort.
42	It is annoying but there are worse noises to hear. I have much more frustrating but related to my "musical ear syndrome" effect diagnosed as tinnitus.
49	Acceptance.

QUESTION 20:

Nr participant	Does tinnitus affect your mood and your view of the future?
1	No.
32	No.
7	No.
26	Sometimes.
8	Not really.
14	My mood – yes.
10	No. But it reflects how tired I am which does affect.....
2	Yes.
41	Yes, it can do at times.
11	Not often.
42	No.
49	Sometimes.

Appendix 15a: Responses to Open Questions – the control group

There were nineteen questions to answer, most of which were Open Questions, enabling us to understand the full scope of issues that affected the participants. Some questions required a full description and some only a short statement in response. All participants decided to respond to the Open Questions, which gave us a complete picture of tinnitus sufferers and cochlear implant users in parallel.

Category: Tinnitus

There were eleven questions that directly asked about tinnitus. There were also questions exploring tinnitus as a factor that interferes with everyday social activities.

In answer to the question “*Which ear is affected by tinnitus?*”, six out of twelve respondents claimed that tinnitus occurs in both ears. One participant located his tinnitus in his head. Two participants pinpointed their right ears as the source of their tinnitus, while three respondents indicated their left ears:

“It would be hard to pinpoint. Possibly the right side.”

“Right ear but really meaningful in this case.”

We tried to establish if there was a relationship between the location of tinnitus and side on which the patient was implanted. In this case, the responses varied a lot and it was not possible to find an association. In the control group, two participants received cochlear implants in each ear: one had received the two implants sequentially and the other had both implants simultaneously. The participant who was operated on sequentially had tinnitus in the right ear; the one who was implanted simultaneously complained about tinnitus in both ears. In neither of these cases, did tinnitus occur as a result of cochlear implantation.

While analysing the cause of deafness, which can indirectly cause tinnitus, various aetiologies were presented, such as wide vestibular aqueduct, flu, nerve deafness, noise trauma and motorcycle accident.

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The following question focuses on subjective perception of tinnitus: *“How can you describe your current tinnitus?”* The answers were very descriptive; four out of twelve participants described their tinnitus as a high-pitched whistle and buzzing sound, three participants described their tinnitus as moderate and bearable, while two respondents labelled their tinnitus in a much more negative way than others: *“A killer, hell on earth, spin dryer on full with train coming in dryer, thunder, wooing.”*
“Intrusive. Body sound, clicking, running of blood, joint movement in neck.”

The intensity of tinnitus and its psychoacoustic characterization does not influence the severity of tinnitus; however, the variety of sounds is enormous and each of the sounds can create different distress and lead to various psychological reactions. One of the respondents perceived tinnitus as intrusive, especially at night, since it prevents sleep. In his responses, two significant issues relating to tinnitus were revealed: a problem with sleeping and with stress, a major cause of increased tinnitus.

“No problem today. It occurs occasionally at night if I become stressed. It first started shortly after my second implant in the right ear. Very severe, prevents sleep.”

The following question focuses on the personal feeling and behavioural reaction towards the sudden onset of tinnitus, or when it becomes worse: *“What is your first reaction when your tinnitus gets worse?”* All participants gave similar responses, describing their anger and frustration:

“Frustrating”, “Depression”, “Annoyance”.

When their tinnitus becomes worse, three participants tried to ignore it or somehow keep themselves distracted and occupied with something else:

“Get going and do something as interesting as possible, keep occupied.”

“It just makes me notice it more but I ignore it and carry on.”

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Three respondents showed deeply wishful thinking, slight resignation and feelings of helplessness with the belief that their tinnitus will never go away and that there are not many ways to cure it completely:

“Sometimes I cannot stand the noise.”

“There we go again, oh God, please stop it.”

“Hope it will go away but, [it] never does.”

During the workshop, participants talked about their early experiences, anxiety and stress, as well as poor management from organizations that should have helped. The participants commented that if the first consultation had been positive, their attitude towards tinnitus might have been different. Respondents suggested that the gradual build-up of anxiety about tinnitus might cause more negative attitudes and psychological disturbance.

In two responses, the role of stress and anxiety were emphasized, as well as particular anxiety responses towards tinnitus:

“How worse will it go [get]?”

“Cannot sleep and get increasingly worried that it is going to continue.”

Taking into consideration the results from one of the Tinnitus Questionnaire’s subscales (emotional distress) and the HADS subscales of anxiety and depression, it becomes clear that sudden onset of tinnitus or increase in its loudness may create psychological distress. This distress may, in turn, result in specific behaviours, such as depression, feeling low or sleep disorder. In the control group, seven out of twelve participants got low scores on the anxiety scale (HADS), which suggests a mild to moderate level of anxiety. On the depression scale (HADS), four respondents scored between 0-7. According to Hallam’s score interpretation (Hallam, 2008), total emotional distress within the group ranged from 51% to 75%.

The relationship between tinnitus and the individual’s reaction towards it was examined in more detail in the next two questions, which asked about factors that alleviate or worsen tinnitus. The question *“Are there any factors that worsen your tinnitus?”* aimed

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to itemize the causes by which perception of tinnitus increases. Two participants pointed out that loud noise, or even auditory testing, makes their tinnitus worse:

“Loud noises, auditory testing makes the tinnitus the worst.”

“All loud noises.”

Three respondents claimed that tiredness or lack of sleep was a factor that may increase their perception of tinnitus:

“Yes, tiredness ...”

“Lack of sleep.”

One participant emphasized that, when the CI processor has to be removed at night, tinnitus increases significantly:

“Night time, when I remove my implant.”

Three participants responded that stressful situations cause tinnitus to be less bearable:

“Stress...”

“Stress and tension.”

Besides stress, participants suggested that particular foods, or taking aspirin, may influence their tinnitus. Reactions to tinnitus usually include anxiety and tension, which in turn may provoke negative thoughts to predominate. When tinnitus becomes louder than usual and sufferers think that it will stay louder forever, some somatic problems may occur and this may result in depression or lead to extreme anxiety.

The second question that examined the perception of tinnitus was *“Are there any factors that alleviate your tinnitus?”* This question also highlights the general characteristics of tinnitus and ways of coping with its symptoms. Three respondents pinpointed quietness as a factor that helped to decrease the perception of tinnitus. One respondent even suggested that taking off the CI processor may sometimes be helpful:

“Quiet.”

“Sitting quietly, sometimes I remove [the] implant.”

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“When it is quiet and I am on my own.”

Two respondents, on the contrary, preferred to mask their tinnitus with different sounds and therefore avoided silence:

“Playing music.”

“Masking with music.”

Another three participants had not yet found any solution for rapidly increasing tinnitus:

“None.”

“No, it just goes on!”

Answers from the remaining respondents varied from sleep as a factor that alleviated tinnitus to wearing the CI processor all day.

“When (in which situation or what time of the day) is your tinnitus the worst?” The responses to this question were very different. Participants suggested various times of day and night, and were unable to identify a particular time at which their tinnitus was at its worst:

“Unable to say.”

“Time of the day varies.”

Some of the respondents pointed to noisy situations, or stress, as the most difficult factors to cope with. In addition, when participants are not well, their tinnitus may increase:

“If I am ill or tense, mornings and evenings.”

“Perhaps when I have been in a very noisy environment and then move to a quiet one. At night when I remove my implant.”

The situation that some participants described – of tinnitus rapidly increasing after they remove their CI processors – has been widely discussed in many articles. This situation may be described more accurately using one of the TQ subscales, that is, intrusiveness. In the control group, the score for intrusiveness was quite high, and for some respondents

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was even 100%. Tinnitus intrusiveness can lead to emotional distress, which, in turn, may increase levels of anxiety. This close relationship between intrusiveness and anxiety may be a primary cause of the development of a vicious circle response.

The question that naturally follows investigates the close association between stress and tinnitus: *“When you are in a stressful situation, how do you perceive your tinnitus?”* The participants’ responses show that the fluctuation of tinnitus is amplified by an independent stressful event.

“Worse.”

“This usually follows a stressful day when it wakes me in the early hours or the mornings.”

“Makes me more stressful.”

Some other participants try to divert their attention to something else, such as work, or simply tried not to think about it. One of the respondents, interestingly, did not notice whether stress influenced his/her tinnitus at any point:

“I don’t notice it particularly.”

The relationship between tinnitus and stress was introduced in both the neurophysiological and psychological models of tinnitus. The vicious circle between these two aspects may lead to severe health problems and constant mobilization of “flight or fight” reaction, which in turn can influence perception of tinnitus. The most important factor is to break this vicious circle and stop the tinnitus triggering an overwhelming physical reaction.

The purpose of the question *“What do you do to stop hearing tinnitus?”* was to find out how respondents deal with, and control, their tinnitus in everyday life: Three out of twelve participants had not found any way of relieving their tinnitus:

“Nothing really I can do. It isn’t easy to ignore this devil noise.”

“Taking a sleeping tablet at night, listening to music? TV otherwise?”

“Not sure.”

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Nine participants appeared to be able to control their tinnitus or, at least, they found a way to divert their attention in order to make their tinnitus more bearable:

“Try to concentrate my mind on something or [a] problem.”

“Do puzzles and quiet things to try to calm it down but I still can hear it.”

“Get outside gardening or start cooking.”

One aim of the Tinnitus Workshop intervention was to present some possible ways of managing tinnitus, in order to change perception of tinnitus and decrease the level of anxiety. Some distraction exercises were demonstrated, and participants themselves were able to experience how easily the brain can “switch on” to different sounds. The main concerns discussed by participants, during the intervention, were about whether tinnitus remains at a higher level and how to maintain tinnitus management.

The following question explores the issue of respondents being able to stop concentrating on their tinnitus: *“Are you able to stop thinking about tinnitus?”* Six participants responded positively; however, they highlighted how difficult it was to achieve:

“At times.”

“Very difficult at the time, but don’t usually think about it.”

The remaining participants claimed that they could not manage to “switch off” their brains and, at the same time, control their tinnitus. This could be because of the lack of information about ways of tinnitus management in the first instance.

The last two questions aimed to identify the significance of tinnitus to the individual sufferer and how it can affect everyday life. In response to the question *“What do you think and feel about tinnitus?”*, six out of twelve participants described tinnitus as a factor that makes their lives more difficult and that takes time, and a lot of energy, to reduce to an acceptable level:

“Annoying.”

“It is just [the] devil.”

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“I cannot yet [think?] about being deaf but can hear noises all the time.”

One of the two respondents who had implants in both ears doubted whether they should have had the second implant, because it increased the tinnitus in the second implanted ear.

“I wonder whether I should have agreed to have the second implant. But feel the benefit is worth the tinnitus discomfort.”

According to the literature, examples of implantation increasing or causing tinnitus are common.

A couple of respondents also displayed a degree of acceptance of tinnitus and described their own ways of dealing with it. This response could be viewed in the light of House's theory of the tinnitus personality (House, 1981), in which she suggested that certain personality features, such as optimism and internal locus of control, may predispose sufferers to utilize effective strategies to cope with tinnitus. In contrast, pessimism and external locus of control may lead to an ineffective management of tinnitus, resulting in higher levels of distress. During the workshop intervention, the significance of tinnitus to each was discussed; however, because of the structure of the intervention, the subject could not be explored more deeply.

The last question came under the category of tinnitus: *“Does tinnitus affect your mood and view of the future?”* The question was designed to find out how much tinnitus could influence the participants' view of their future and to understand their general views of life with tinnitus. It also tries to uncover if any respondents showed high levels of depression or emotional distress which, in turn, could put their lives at risk. (This question related to another in the subcategory of “Tinnitus and informative factors” (see below), which asks about tendencies to commit suicide.)

Seven out of twelve respondents confirmed that, although tinnitus is a bothersome problem, it does not significantly affect their mood or general wellbeing:

“No.”

“Not often.”

Three participants clearly stated that tinnitus is a major factor that influences their general mood and distorts their view of life:

“Yes.”

“Yes, my mood.”

Answers from the remaining participants were ambiguous.

Subcategory: Tinnitus and informative factors

This subcategory of tinnitus was developed to discover as much as possible about all aspects of how tinnitus interacts with co-existing factors, such as previous treatment, depression or social difficulties caused by the presence of tinnitus. These questions were included in this subcategory to avoid any confusion, as well as to introduce a simple way of presenting such a difficult syndrome as tinnitus. This subcategory consists of seven questions.

The first question was: *“Do you have any other problems such as headaches, facial pain or vertigo?”* It aimed to find out if there are any other somatic symptoms or ailments which could affect the severity of tinnitus.

Three respondents out of twelve did not notice any severe problems with their health that could be associated with tinnitus. Five participants complained about severe headaches and migraines:

“I have headaches - sometimes a piercing pain of my tinnitus.”

“Headaches when tinnitus recedes.”

Seven participants reported an occurrence of vertigo from time to time:

“Clicking in ear as movement and vertigo.”

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“Vertigo - used to but I am off balance a lot. Walk like a drunk.”

In the study, some questionnaires, or their subscales, describe somatic complaints as issues which may increase tinnitus perception. SF-36 (Short Form 36 Health Survey) estimates quality of life with co-existing health or mental problems. Health status and corresponding quality of life are described as a mean combination of subjectively measured health, including physical function, social function, emotional or mental state, burden of symptoms and sense of wellbeing (Jenkinson, 1996). After evaluating SF-36 results in the control group, four participants showed below-average scores in the physical health subscale. The other eight respondents achieved higher than average scores.

Similarly, one of the subscales from the TQ (Hallam, 2008) focuses on somatic complaints, such as the presence of ear or head pain and muscle pain and tension, especially in the face and neck. The results from this questionnaire showed that general somatic complaints can reach between 75% and 100%. This means that almost all respondents suffer from a different kind of somatic malady, which may influence, to some degree, their perception of tinnitus. In this group, the most common complaints were of headaches, neck ache and vertigo:

“I do suffer from headaches. Vertigo - from time to time.”

“Neck ache. Vertigo-I have [had] in the past, I feel less steady on my feet than I used to.”

The next question presented to the participants focused on sleep problems and their impact on sufferers: *“Does and how tinnitus affects your sleep?”* As described in the literature, tinnitus is very closely related to sleep difficulties. Tinnitus sufferers complain that tinnitus takes control during the night and either prevents them from falling asleep or makes it extremely difficult. According to Tyler and Baker (Tyler, 1983), insomnia was the most commonly reported problem by people with tinnitus. In Sanchez & Stephens (Sanchez, 1997), sleep difficulties were the second most commonly reported problem; a similar conclusion to that of Lindberg et al. (Lindberg et al., 1988).

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In this study, five out of twelve participants claimed that, actually, tinnitus did not disturb their sleep and, so far, they have managed it well at night:

“Not really, try to divert my thoughts.”

“Not at all.”

Two participants claimed that sleeping problems only occurred sometimes, usually after a stressful day:

“Yes, occasionally if I become stressed.”

Unfortunately, five respondents confirmed that tinnitus does hamper them from going to sleep. Furthermore, their management of tinnitus and their sleep routines have not been successful thus far:

“Yes, getting to sleep and keeps waking me up.”

“Before going to bed I drink hot milky drinks, camomile tea, use lavender oil, over rule point.”

“BADLY!! I use sleeping pills.”

On evaluating one of the TQ subscales, relating to sleep disturbance, results showed that all except four participants scored between 76% and 100%. This result suggests a severe sleep problem among this population.

The next question, which relates to the previous one, asked if tinnitus could influence one's work, concentration and similar mental activities: *“Does tinnitus affect your work?”* In the literature, Andersson and McKenna (Andersson, 2006) found out that loss of concentration appears as a consequence of tinnitus. In their research, a direct question: *“Does tinnitus affect your concentration?”* was posed, and 70% of respondents claimed that tinnitus did. Similarly, in Rossiter et al. (Rossiter, Stevens et al., 2006), some evidence suggested that tinnitus patients had problems with concentration when performing a task. The authors stated that tinnitus reduces cognitive capacity needed to perform tasks that require voluntary or conscious effort and strategic control.

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In this study, six out of twelve respondents confirmed that they did not experience any problems during work time because of tinnitus. Three participants claimed that tinnitus disturbed their concentration occasionally:

“Sometimes, when it is noisy.”

“No, but when the wooing noise starts, it does.”

The assumption that tinnitus causes poorer concentration may be linked to one of the Tinnitus Questionnaire’s subscales - intrusiveness. According to Hallam (Hallam, 2008), this particular subscale tends to focus on sensory and attentional aspects, rather than emotional aspects. The noises are perceived as loud and unrelenting, constantly intruding into one’s consciousness, and become impossible to ignore. Participants in the control group presented a high score on this intrusiveness subscale, indicating that it is a severe problem among this population.

The next question specifically asked about the impact of tinnitus on social life: *“Does tinnitus has any influence on your life (social interaction) and activities?”* This question was designed to substantiate the findings in the literature, which show that one of the cognitive and behavioural consequences of tinnitus is a gradual withdrawal from social life. In addition, safety behaviours and Automatic Negative Thoughts (NATs) occur. People who suffer from tinnitus prefer to stay at home than to go out, because they are convinced that external noise will increase their tinnitus (Andersson, 2009).

During the intervention, the limitations on participants’ social lives due to tinnitus were widely discussed. Most of the participants emphasized their lack of control over tinnitus and a fear of misunderstanding or difficulty in understanding speech in the “outside world”.

Six out of twelve participants claimed that their social life was not limited by tinnitus. The remaining respondents showed some concern about managing conversation with other people:

“Cannot engage in conversation with other people.”

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Other participants directly referred to their anxiety about going out and said that they simply gave up on any social situations:

“...but with all noise around I know I will suffer from it”.

“Yes, I avoid them.”

Interestingly, one of the participants suggested some distinction between activities, as an example of tinnitus management:

“It influences my activities but not social life.”

Other questions, included in this subcategory of tinnitus, were designed to explore the individual's personal view of tinnitus, or its depressive consequences, as experienced by sufferers. Tinnitus can be one of the factors that cause depression or anxiety disorder (Erlandsson, 1995), and in an extremely difficult situation may be one of the factors that may lead to suicide (Lewis, 1994).

The question *“Have you ever been depressed because of tinnitus?”* seeks to gauge the incidence of low moods, and any signs of depression, among respondents. Six out of twelve participants responded negatively to this question; they did not experience any side-effects such depression or lowered moods that could be caused by tinnitus:

“Honestly – no.”

Five other respondents confirmed that they felt low, or even depressed, because of tinnitus:

“The wooing noise makes me depressed.”

“Yes.”

In the depression subscale (HADS), the scores showed a mild level of depression among the respondents. The TQ subscale for emotional distress, which also can be a predictor for future development of depression, indicated a moderate level in respondents who at the time confirmed their lowered mood or despondency. For the six participants who did

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not experience any side-effects of tinnitus, the emotional distress score also did not show any significant abnormalities.

To complete analysis of responses to this question, the SF-36 mental health subscale was employed. Results obtained from this scale may also be a prognosticator of the emotional condition of the participants. In the control group, only two respondents' results were at the lower level, which may suggest a slightly lowered mood or early stages of depression.

The next question relating to the same subject was: *"Did you ever have thoughts about committing suicide?"* It aimed to evaluate psychological wellbeing among participants in the control group. In this case, all answers obtained from the respondents were negative, all of them responding *"No"* to the question.

In addition, we asked the participants about previous treatment for tinnitus: *"What kind of tinnitus treatment did you already receive?"* Ten out of twelve participants claimed that they had not received any treatment nor attended any psychological therapies. However, some of them had obtained basic information about ways of dealing with tinnitus:

"Treatment with my auditory implant clinic of ways to deal with tinnitus."

"Not really other than 'one of those things' and suggestion for managing."

"None. Audio scientist explained that tinnitus prior to implantation didn't go away. But tinnitus after implantation usually gradually subsided. This is what happened to me."

Only one participant from the control group received Tinnitus Retraining Therapy.

Category: Cochlear implants and tinnitus

There were only two questions that aimed to examine whether there was a relationship between suppression of tinnitus and the cochlear implant in the control group.

"How did the implantation affect your tinnitus?"

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Five out of twelve respondents stated there was significant improvement of tinnitus perception just after the implantation or soon after it:

“It has improved it, although initially it was moderately bad. Perhaps from the trauma of the operation.”

“Initially very little tinnitus so improvement from before.”

“Immediately after [the] operation was very loud and intrusive. It must have settled down, somewhat less noticeable when wearing processor and hearing aid.”

“Severe tinnitus following the second implant in the right ear. Gradually subsided after 3 months. Now occasionally if I become stressed or very tired.”

“Helped subdue tinnitus.”

Five respondents did not notice any significant change after cochlear implantation:

“No change.”

“Worse after the op but gradually back to where it was before.”

Unfortunately, two participants found that their tinnitus increased after the implantation:

“It got worse.”

“It was worse.”

Examples of increased tinnitus after cochlear implantation can be found widely in the literature, where 3-4% of implantation resulted in increasing or triggering tinnitus (Ito & Sakakihara, 1994).

The second question in this category asked about the impact of cochlear implants on tinnitus in everyday life: *“How does the implant affect your tinnitus now in everyday life?”*

Five out of twelve participants confirmed that cochlear implants had improved their tinnitus and, therefore, tinnitus perception had also improved:

“I hardly notice tinnitus now, except when I am tired.”

“Helped subdue tinnitus.”

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Some participants are still aware of their tinnitus; however, it has been suggested that because of improved hearing ability, tinnitus itself is sometimes sidelined from consciousness:

“No change, but better hearing better masking.”

Nevertheless, for five respondents, tinnitus perception did not change and they still suffer from tinnitus to some extent. Some participants are aware of their tinnitus, but they try not to pay attention to it:

“This noise is a killer.”

“I don’t think there is much difference in the tinnitus now, before or after implant. Less noticeable wearing processor and hearing aid. I have learnt to block out the sound and don’t notice it too much when my mind is occupied with everyday life.”

“As sound being heard, I notice it.”

“I try to adapt, just carry on.”

One week after the interventions, evaluation forms were sent out to assess the practicality of the Tinnitus Workshops. Participants were asked not to put their names on the form so they were strictly confidential, which made it possible to achieve a critical level of feedback.

Appendix 16: Evaluation Forms – the control group

The Tinnitus Workshop evaluation form was included in the study solely to assess how helpful the intervention was in reducing perception of, and stress caused by, tinnitus to each individual in the control group. Eleven out of twelve completed evaluation forms were obtained. In one evaluation form, the respondent probably overlooked the first part; however, it was still included in the general discussion.

The evaluation form included two parts: the first focused on whether the workshop was successful in helping participants to manage their tinnitus: the second part assessed the methodological quality of the workshop as an intervention. The first part of the evaluation form consisted of six questions:

1. Do you think the Tinnitus Workshop was successful in helping you to cope with tinnitus?
“No, I have no problem. I was pleased to share my experience.”
“No – interesting but not successful in helping cope with T.”
“Yes.”
“Gave useful info + strategies. Some degree of success.”
“Yes.”
“Not really – in that I do not find it difficult to cope anyway. The sharing of information was reassuring though.”
“Did not make any difference.”
“Yes.”
“Some good ideas given to cope with it.”
“Yes. Although I only have tinnitus occasionally when I am stressed and during the early hours of the mornings.”
2. Did your perception of tinnitus change after attending the Workshop?

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“Yes by learning experience of others”; “No”; “No”; “No, but it was good for thoughts”; “A little”; “No”; “No”; “No”; “Not really”; “Yes. I don’t realize so many people suffered and some could ignore even quite loud tinnitus.”

3. Did your emotional attitude towards tinnitus change after attending the workshop?
“No”; “No”; “A little”; “To some extent”; “Yes”; “No”; “No”; “Yes”; “No”; “Yes a little”.
4. Has your behaviour towards your tinnitus changed since the workshop because of the information you were given about?

a. General information	6 participants claimed that general information improved their attitude to tinnitus
b. Relaxation instruction	6 participants claimed that relaxation instruction influenced their general behaviour
c. Sleep hygiene instruction	3 participants found this information useful

Two participants found this information to be unhelpful in their management of tinnitus.

5. What was the most important thing you found out about your tinnitus or anything related to it during the workshop?
“General information and relaxation”; “Stress levels”; “Effects of sleep”.
“That I am not only one sufferer”; “It’s cause is still unknown.”
“Breathing and relaxation”; “Can’t get much of it”.
“That others also suffer and actually my perception of it and how I deal with it is the same as the officially recommended process”.
“Evidence basic of guidance on dealing with T”.
“How many people could manage their tinnitus in the positive way. I can cope next time I get attract.”

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6. From the scale 1-5 with 1 being helpful and 5 being the most helpful, please rate the following aspects of the workshop by putting a tick in the boxes below:

Workshop	1	2	3	4	5
General information about tinnitus		3 participants	1 participant	2 participants	4 participants
Relaxation information		1 participant	3 participants	4 participants	2 participants
Sleep hygiene		2 participants	1 participant	4 participants	3 participants
Distraction exercise		2 participants	4 participants	2 participants	2 participants

The second part of the Evaluation Form assessed the practical side of the Tinnitus Workshop, such as presentation, duration and opportunity to ask questions:

Workshop presentation were carried out using PowerPoint slides, how did you find the presentation?	11 positive or very positive marks were obtained*
--	---

*One participant suggested that the speaker should be nearer the screen

Was the information presented on the slides understandable?	10 positive marks were obtained, 1 negative
---	---

Did the presenters speak with clarity during the workshops?	11 positive marks were obtained*
---	----------------------------------

*One participant replied “Yes, perhaps too fast on occasion”.

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If you wanted to raise a point or ask a question, did you do so without any hesitation?

11 positive marks were obtained

If you did ask questions, was your question answered appropriately?

11 positive marks were obtained*

**“Yes, I felt very comfortable since the cause of tinnitus isn’t really known.”*

Do you think that duration of 3 hours for the workshop was appropriate?

8 positive marks were obtained*

**“2 hours long enough”.*

“Yes but no more than that, long periods of listening are quite tiring for the hearing impaired”; “Bit long, but OK”; “It could be longer with a patient experience aspect.”

Were there enough breaks?

10 positive marks were obtained, 2 negative

Do you have any suggestions on how this workshop can be improved in the future?

Only 8 participants gave feedback*

**“Take away materials?”*

“I wonder if some the concept would be meaningful to all. I enjoyed it but some may need adaptation.”

“We ran short of time - so maybe a longer session with time for a break.”

“Decaffeinated coffee +less sweet biscuits”.

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“No – I wish more casual aspects were known.”

“Only two people attended. More would have been nice. But I understand this is beyond your control.”

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Appendix 17: Open Questions script – the research group

(Taken at the time of the CBT sessions in 2011/12)

QUESTION 1: BACKGROUND DATA

Nr participant	Date of birth	Year of receiving CI	Implanted ear	Time of deafness (years)	Cause of hearing loss	Personal status
27	12.02.1968	01.1994	right	10	Meningitis	In relationship
31	08.05.1944	2008	right	12	Unknown	Married
54	16.01.1974	2010	right	Progressive from birth	Mother's pregnancy complications	Married
23	04.05.1951	02.2008	Right	2	Unknown	Married
21	04.11.1940	29.11.08	Left	40	Otosclerosis	Married
6	03.04.1936	2006	Right	66	Childhood abscesses	Married
29	02.04.1953	06.2009	Right	Progressively from birth	Congenital-cookie bite loss	Married
22	19.03.1956	1998	Left	Born deaf	Unknown, but it was because my father has malaria in 2 nd world war (low count sperm)	Single, looking after his mother.

QUESTION 2: TINNITUS AND CI

Nr participant	How did the implantation affect your tinnitus?
27	Improved it vastly as had other sound to listen to
31	It increased threefold (three times)
54	After the op tinnitus was much better with the processor on but returned when off, sometimes it is noticeable when on but clear voice seems to help. I tend to focus more on things that augment it and avoid them caffeine / alcohol / tiredness
23	Very little to start with, but as time has gone on it has got worse
21	Tinnitus stopped for a while then returned
6	Relieved it on right side only
29	Don't think it has changed a great deal. I am a little more conscious of it due to the

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	increased absence of other sounds when not wired up.
22	Have no idea how did it happen

QUESTION 3:

Nr participant	How does the implant affect your tinnitus now in everyday life?
27	Most of the time the noise I have to concentrate on means I do not pay too much attention to the tinnitus
31	This question is very technical and impossible to answer with an immediate answer
54	The implant helps me to go through life with very little annoyance from tinnitus
23	Because the implant picks up lots of sound and magnifies it, this makes the tinnitus worse.
21	Not at all
6	Gives me something else to listen to
29	Once wearing aid and processor I don't notice the problem so a lot.
22	Can't say as it always happens on different way everyday

QUESTION 4:

Nr participant	Which ear is affected by tinnitus?
27	Both
31	Both
54	Both
23	Mainly my left ear
21	Right
6	Both
29	I don't know. Sounds may seem to come from anywhere in my head.
22	It is my head more than my ears

QUESTION 5:

Nr participant	What kind of tinnitus treatment did you already receive?
27	A tablet caused something like "SEC" a very long time ago while I was still deaf. It didn't do anything.
31	The doctor prescribed Beta histine
54	None
23	None
21	None
6	Counselling, support group
29	None

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22	I was on medication by then but it didn't work at all. Can't remember what it is called but something like ...beta.
----	---

QUESTION 6:

Nr participant	What is your first reaction when your tinnitus gets worse?
27	Despair, resignation
31	Grin and love it or try to ignore it
54	Annoyance – I can knock my head sometimes
23	Anger and frustration
21	Annoyed
6	Fed up!! Makes me slow down
29	It doesn't generally as it is quite short lived and wiring for sound sees it off.
22	I went like :Oh here I go again

QUESTION 7:

Nr participant	When (in which situation or what time of the day) is your tinnitus the worst?
27	Usually evening + first thing in morning
31	When stressed or tired
54	At night, bed time, when you want peace and quiet.
23	When I am in noisy situations and when there is a lot of conversation around me.
21	Night time
6	When I am very tired and/or anxious
29	Morning before putting on aids and processor
22	Mostly in the afternoon or evening

QUESTION 8:

Nr participant	Are there any factors that worsen your tinnitus?
27	Stress and tinnitus, anger
31	When tired and stressed and I have trouble with my balance when there are unusual loud noises
54	Thinking about the sound and actually listening to it.
23	Loud noise and wind
21	No
6	Stress and noise
29	Thinking about it
22	Not really

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QUESTION 9:

Nr participant	Are there any factors that alleviate your tinnitus?
27	Not really
31	No cow milk, cut down on salt, cut down on cheese
54	No - nothing
23	When I am reading or concentrating
21	No
6	Gentle music and fresh cold air
29	Listening to something else
22	Not really but cannot eat ginger biscuit

QUESTION 10:

Nr participant	When you are in a stressful situation, how do you perceive your tinnitus?
27	A thick fog that is difficult to think through
31	An immense nuisance
54	It tends to be worse
23	It feels as if I am not in control and that the tinnitus is the winner, which I hate
21	The same
6	A threat to my health
29	Tinnitus isn't usually worse with stress
22	I try not taking any notice of it.

QUESTION 11:

Nr participant	Have you ever been depressed because of your tinnitus?
27	Yes, before my implant when I was totally deaf, it was all I could hear
31	Yes
54	I feel low about it a lot
23	Yes
21	No
6	Yes, the year I was totally deaf (2006)
29	No
22	Yes as it has affect me in a lot of way like getting tired, poor vision

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QUESTION 12:

Nr participant	Did you ever have thoughts about committing suicide?
27	Yes
31	A few times but it would be unkind to my wife, two sons, granddaughter, 4 brothers, 1 sister etc.
54	No
23	Yes, stupid I know
21	No
6	No, pushed them away. Lucky to be a positive person
29	No
22	Yes at the first few years but not too bad at the moment

QUESTION 13:

Nr participant	How can you describe your current tinnitus?
27	Very loud, sounds like pulsating static with single tone going through it sometimes
31	Awful
54	My left ear has a sound like a high jumbo jet. My right ear is the worst, it has a buzzing like a car horn being pressed constantly but the sound is deeper and a distance away.
23	Annoying and frustrating. I don't get the full benefit from my cochlear implant because of the noises.
21	Bloody loud
6	Dammed annoying
29	Repetitive and boring but not very intrusive. Gives way to distraction.
22	Difficult to say as it sound different every time

QUESTION 14:

Nr participant	Where do you hear it?
27	Head, in between ears
31	In both ears
54	In both ears
23	Mostly the left hand side of my head and left ear.
21	In my ear
6	Mainly left side but generally all over head
29	Head feels this way often
22	Worse in head, mild in ear

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QUESTION 15:

Nr participant	Do you have any other problems such as headache, facial pain, ear pain or vertigo?
27	No
31	I have always suffered with some sinus congestion which seems to affect the nose face and ears at times. In the last few years I have had a few headaches.
54	Headaches can be painful due to tinnitus but I wouldn't say it is the cause.
23	No
21	No
6	Tension headaches
29	Not really
22	Yes, have headaches every day

QUESTION 16:

Nr participant	Does and how tinnitus affects your sleep?
27	Occasionally it can be too loud to allow me to fall asleep quickly, but not often
31	Not at all
54	I have trouble getting to sleep sometimes because of it.
23	It used to but I now take sleeping tablets
21	Not at all
6	When too active or stressed/worried
29	Not really, I read a book
22	Tinnitus goes away when I lay down

QUESTION 17:

Nr participant	Does tinnitus affect your work?
27	It can cause problems in meetings, on courses where I have to concentrate on what is being said, this make it worse
31	I am retired now, but it and my lack of hearing definitely affected my career
54	Yes, it can distract and ruin the concentration.
23	I don't go out to work so no, not really
21	No
6	Has done
29	Retired as teacher due to deafness in 2000
22	Yes as it affects my balance (professional horse raider)

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QUESTION 18:

Nr participant	Does tinnitus have any influence on your social life (social interaction) and activities?
27	No
31	Yes because it reduces my sense of wellbeing and confidence and also reduces my hearing which I receive solely through my cochlear implant.
54	No, being totally deaf it doesn't make any difference. It is the only sound I hear. Being deaf does.
23	Sometimes. Frustrating when I cannot hear because of the noises in my head.
21	No
6	No
29	Not compared to the deafness itself.
22	Yes because it has made difficult to read and it is difficult with my balance problem

QUESTION 19:

Nr participant	What do you do to stop hearing tinnitus?
27	I have never managed to stop hearing it but try relaxing techniques
31	I never stop hearing it. But I try to ignore it. Driving the car helps, probably because I am calm and concentrating.
54	Nothing I can do
23	Read. Play games on my computer or Nintendo, do crosswords.
21	Nothing
6	Keep very busy
29	Listening somebody or something
22	Nothing has worked

QUESTION 20:

Nr participant	Are you able to stop thinking about tinnitus?
27	If I do something which takes my thoughts away from it, engrossed me
31	No, not really
54	For short periods when occupied.
23	Yes. Sometimes.
21	No
6	Yes
29	Yes
22	Sometimes

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QUESTION 21:

Nr participant	What do you think and feel about tinnitus?
27	Sometimes it can make my job even more difficult, which annoys me, I feel held back when that happens
31	It is really horrible and I have great sympathy with all sufferers. I wish I could help all sufferers.
54	It happens and I have to deal with it. I cannot stop it. Sometimes it annoys me and will make me angry.
23	It is a blasted nuisance
21	That's life
6	I could do without it but have worked hard to forget it.
29	I am lucky. It is not that bad. Sometimes it is more intrusive than others, but I manage it
22	I try not to think about it

QUESTION 22:

Nr participant	Does tinnitus affect your mood and your view of the future?
27	Not really, but it would be wonderful no to have it
31	Yes, because tinnitus and lack of hearing very much limits one's scope of life. Not many people sympathise or understand what it does to people.
54	It does affect my mood, my view of the future is: I hope it will stop
23	Not all the time. I have learnt to accept it and get on with life.
21	No
6	I can worry, yes!
29	No
22	Yes it has affected my mood which made me less sociable

Appendix 17a: Responses to Open Questions – the research group

There were twenty-one questions to answer, most of which were Open Questions, enabling us to understand the full scope of the issues that affected the participants. Some questions required a full description, others only a short statement. All participants decided to respond to the Open Questions, which gave us a complete picture of tinnitus sufferers and cochlear implant users in parallel.

Category: Tinnitus

There were eleven questions designed to illustrate whether or not tinnitus was a troublesome factor that resulted in limited or poor wellbeing.

In answer to the question, “*Which ear is affected by tinnitus?*”, four out of eight respondents claimed that tinnitus occurred in both ears. Two respondents pointed out the head as a place where they perceive their tinnitus and rest of the participants indicated alternately the left and right ear, stating:

“I don’t know. Sounds may seem to come from anywhere in my head.”

“It is my head more than my ears.”

Interestingly, four out of six participants who were implanted on the right side, claimed that their tinnitus occurred on both sides of the head. Only one participant from the research group developed tinnitus as a result of cochlear implantation. According to the literature, in some patients cochlear implants either fail to suppress tinnitus or tinnitus occurs as a result of implantation. A study by Pan et al. (Pan, 2009), indicated that 12% of research subjects who did not have tinnitus prior to implantation developed tinnitus as a result of the intervention. According to the authors, subjects who had suffered profound hearing loss for a shorter period of time and tended to be older were more likely to develop tinnitus as a result of CI implantation.

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When analysing the cause of deafness (which may also indirectly suggest the cause of tinnitus), various aetiologies were presented, such as meningitis, complications during the pregnancy, otosclerosis and a few unknown factors.

The following question focuses on the subjective perception of tinnitus: *“How can you describe your current tinnitus?”* All eight participants used the expression *“very loud, annoying”*. It has been suggested, in the cited literature, that the intensity and psychoacoustic characterization of tinnitus do not influence the severity of tinnitus. Therefore, the variety of sounds that can represent tinnitus is enormous and this can create different behavioural and psychological reactions:

“Very loud sounds like pulsating static with a single tone going through it sometimes.”

“My left ear has a sound like a high jumbo jet. My right ear is the worst; it has a buzzing like a car horn being pressed constantly but the sound is deeper and some distance away.”

An interesting answer was given by one of the respondents, in which he claimed that, because of his tinnitus, the benefits of his cochlear implant is limited:

“Annoying and frustrating. I don’t get the full benefit from my cochlear implant because of the noises.”

Even though there was only one response of this kind, similar views were frequently expressed during therapy. Participants complained that they simply could not hear, because the tinnitus is also heard through the cochlear implant itself. It often happens that, according to the participants, their tinnitus is either magnified by the cochlear implant, or it becomes louder without the CI processor on.

One question is focused on the individual’s feelings and behaviour as a response to sudden onset of tinnitus, or when it unexpectedly gets worse: *“What is your first reaction when your tinnitus gets worse?”* All respondents answered in a similar way, expressing frustration, anger and annoyance. Two participants responded in a way that could be interpreted either as a form of resignation or as a way of coping with it:

“Grin and love it or try to ignore it.”

“I went like: Oh here I go again.”

Participants revealed their despair about tinnitus. One of them complained that when it increases or appears suddenly, it makes him/her slow down and ruins the day. Another participant is so tired with it, that his /her reaction to tinnitus is to “*knock my head sometimes*”.

During therapy, some patients showed resignation about tinnitus and, when it increases, they just give up fighting against it. According to the participants, they developed this attitude as a result of the duration of their suffering and the lack of beneficial management of their tinnitus. This response may be associated with both the anxiety (HADS) subscale and the emotional distress (TQ) subscale. According to Hallam’s scoring interpretation (Hallam, 2008), six out of eight respondents in the research group scored higher in the emotional distress (TQ) subscale. Only one participant recorded a very low score and this was reflected in the participant’s anxiety (HADS) score.

The question “*Are there any factors that worsen your tinnitus?*” focuses on factors which may alleviate or worsen tinnitus. In response, three out of eight respondents pointed to stress as a major factor that increases tinnitus. Besides stress, participants suggested that particular foods could influence their tinnitus. Also, background noise was included as a factor and, moreover, as inhibiting their desire to socialize. The fear of noise leads to a withdrawn attitude and participants prefer to stay at home rather than go out. The anxiety about tinnitus provokes stress, which in turn makes respondents avoid any social situations.

Analysing HADS scores in the research group, before the CBT intervention, showed that in four out of eight participants anxiety levels were higher than average. One participant demonstrated a moderate level of anxiety, which suggested exceptional distress. The anxiety (HADS) subscale is defined as a combination of states – of an anxious mood, restlessness and anxious thoughts. During therapy, participants talked about their fear that

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tinnitus might get and remain more intense. Participants were worried that in a stressful situation they cannot really control their tinnitus and it feels as though the tinnitus takes over. This lack of control, especially when it gets worse, results in greater anxiety and may cause depression later on.

The second question that focuses on the unpredictability of tinnitus is: *“Are there any factors that alleviate your tinnitus?”* Answers to this question also reveal the general characteristics of the individual’s tinnitus and their coping mechanisms. Three out of eight respondents emphatically stated that nothing helps to reduce their tinnitus. Two participants mentioned diet as a factor that helps to maintain tinnitus at a tolerable level:

“No cow’s milk, cut down on salt, on cheese.”

“Not really but cannot eat ginger biscuits.”

Three respondents claimed that concentrating on something else, such as listening to music or getting fresh air, helps them to reduce tinnitus and, in general, reduce tension related to it:

“When I am reading or concentrating.”

“Listening to something else.”

With regard to the question *“When (in which situation or what time of the day) is your tinnitus the worst?”*, the most frequent response was morning and evening time, often when participants were tired and had had a difficult day:

“Usually in the evening and first thing in the morning.”

“At night, bed time, when you want peace and quiet.”

One participant mentioned that stress and anxiety result in their worst experience of tinnitus:

“When I am very tired and anxious.”

Another participant pointed out that the tinnitus increased, and was at its worst, before they switched on the CI processor in the morning. This situation, where implanted

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patients could hear their tinnitus more intensely before switching on their cochlear implants, has often been discussed in the cited literature. This question is reflected in a TQ subscale: intrusiveness of tinnitus. According to the responses before intervention, IN (intrusiveness - TQ) of tinnitus in the research group was quite high for some respondents (51-75%). High rates of intrusiveness can lead to emotional distress, which in turn can build up the level of anxiety, and a vicious circle may develop (see Chapter 2.3.2).

The question that naturally relates to the one mentioned previously examines the close relationship between stress and tinnitus: *“When you are in a stressful situation, how do you perceive your tinnitus?”* It directly pinpoints the reaction to tinnitus when amplified by an independent stressful event.

“A thick fog, that is difficult to think through.”

“An immense nuisance.”

An important point highlighted by one of the respondents is lack of control when tinnitus becomes more intense and seems overwhelming:

“It feels as if I am not in control and that the tinnitus is the winner, which I hate.”

This statement ties in with a theory about the personality of tinnitus sufferers, developed by House (House, 1981). She suggested that personality features such as optimism and internal locus of control may predispose sufferers to utilize effective strategies to cope with tinnitus. Conversely, pessimism and external locus of control may lead to ineffective coping strategies and resulting higher levels of tinnitus-related distress. It is important to emphasize that any psychological reaction to stress and/or tinnitus may vary in individuals. Above all, reaction to stress depends on the source and duration of stress and the state of the ego and its conflicts, the person's maturity and his/her powers of comprehension. Also, a vicious circle may occur.

According to Selye (Selye, 1976), constant exposure to stress can cause constant mobilization for action (“fight or flight” response), which may result in physical disorder.

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In turn, stress caused by physical disorder can lead to tension and influence perception of tinnitus:

“A threat to my health.”

In general, stress can lead to the loss of wellbeing and slowly may lead to depression. Collet et al. (Collet, 1990) used the Minnesota Multiphasic Personality Inventory (MMPI) and discovered the relationship between personality features and tinnitus disorders. She suggested that the general profile of tinnitus sufferers on the MMPI was normal; however, the higher scores on the depression scale came from male participants, while high hypochondria scores were found to be related to tinnitus duration.

The aim of a following question was to find out how tinnitus sufferers manage to control their tinnitus: *“What do you do to stop hearing tinnitus?”* Five out of eight respondents claimed that they are not able to control their tinnitus at all:

“I have never managed to stop hearing it but try relaxing techniques.”

“I never stop hearing it. But I try to ignore it. Driving the car helps, probably because I am calm and concentrating.”

“Nothing has worked.”

“Nothing I can do.”

“Nothing.”

Three participants appeared to control their tinnitus and they showed that they discovered some ways of managing it:

“Read. Play games on my computer or Nintendo, do a crossword.”

“Keep very busy.”

“Listening to somebody or something.”

Part of the therapy in this study consisted of teaching participants how to control tinnitus and find suitable ways of managing tinnitus, which may result in changing perception of tinnitus and decreasing anxiety. During the therapy sessions, issues like safety behaviours and daily tinnitus management were widely discussed. This topic also covered the

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“Thoughts and Feelings Diary” (see Appendix 13), given to participants. Participants were asked to follow the instructions and fill in the diary, an exercise designed to explore their reactions to a stressful event, including automatic thoughts and feelings about it, and the “dispute”. The dispute was a method of identifying their behaviour and attitudes to the stressful reaction, such as “What evidence do I have to support this thought?” or “Are there many alternative views I did not consider?” Some participants focused more on the way they mentally perceive tinnitus and try to accept the situation they are in:

“There is probably nothing I can do except to accept the situation.”

“Probably put too much pressure on myself but have always strived to do well in everything. Very difficult not to do this. Cannot do much about the job security + changes ahead which is difficult to think around as job as it is (without the added stress) is a great set up. I try to deal with day to day + not think ahead.”

While analysing the Thoughts and Feelings Diary, a certain pattern became apparent: all negative reactions may be caused by stressful events and not by tinnitus itself:

“Waking up knowing I have a really stressful day ahead. Tinnitus was loud immediately. It didn’t improve when processor was put on. Have slept OK night before.”

“Lunch time break with assistant, no tinnitus problem till returned to office.”

As suggested above, most cases when tinnitus becomes worse happen because a co-existing event was stressful. Participants did not really show any ability to stop focusing on their tinnitus, because it was difficult for them to separate the two threatening issues of a stressful situation and tinnitus. Also, there was a corresponding physical reaction, which made respondents feel tired, anxious or annoyed:

“Tired, little anxious.”

“Annoyed.”

“Distracted, sensitive.”

The next question was closely associated with ability to stop concentrating on tinnitus:

“Are you able to stop thinking about tinnitus?” Three out of eight participants responded

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negatively, and the remaining respondents claimed that it is possible; however, management of their tinnitus was not always successful:

“If I do something which takes my thoughts away from it, engrossed me.”

“For short periods when occupied.”

As suggested before, this may be related to poor management of tinnitus or the belief that tinnitus cannot actually be controlled:

“I just have to accept it.”

“I just accept it as a part of life but I wish that it was not.”

The last two questions in the “Tinnitus” category were designed to discover what tinnitus means to the individual and how it influences the patient’s general view of the future. In answer to the question *“What do you think and feel about tinnitus?”*, respondents stated that tinnitus makes their life more difficult and it takes a lot of time and energy to reduce tinnitus to an acceptable level:

“Sometimes it can make my job even more difficult, which annoys me. I feel held back when it happens.”

“I could do without it but have worked hard to forget it.”

During therapy, the individual’s reaction to tinnitus was explored, and it became clear that there may be a link between the psychological and physiological reaction to tinnitus and a propensity to develop a negative, “vicious-circle” response to the condition:

“It happens and I have to deal with it. I cannot stop. Sometimes it annoys me and will make me angry.”

“It is really horrible and I have great sympathy with all sufferers. I wish I could help all sufferers.”

The next question was, *“Does tinnitus affect your mood and your view of the future?”* It was designed to discover the extent to which tinnitus influences an individual’s general view of life and their future while living/coping with tinnitus. We also wanted to find out if anyone with a highly depressive disposition might put his/her life in danger. This

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question was linked to a similar question (see below) in the tinnitus subcategory that asks about tendencies to commit suicide. Half the respondents (four) to this question confirmed that tinnitus is one of the factors that influences their wellbeing:

“Yes, because tinnitus and lack of hearing very much limit one’s scope of life. Not many people sympathise or understand what it does to people.”

“Yes, it has affected my mood which made me less sociable.”

Other participants expressed less depressing views, which demonstrates that some people can cope quite well with tinnitus:

“Not really, but it would be wonderful not to have it.”

“Not all the time. I have learnt to accept it and get on with life.”

Subcategory: Tinnitus and informative factors

This subcategory was created because we wanted to explore how other factors may influence tinnitus. Questions focus mainly on the experience of tinnitus, but also how it interacts with co-existing factors such as previously received treatment, depression or social difficulties caused by tinnitus. The questions were separated to avoid any confusion and to break down this complex syndrome into comprehensible topics. There were seven questions in this subcategory.

“Do you have any other problems such as headaches, facial pain, ear pain or vertigo?”

Four out of eight respondents clearly stated that, apart from tinnitus, they do not suffer from any severe ailments. Four other participants mentioned that, as well as tinnitus, they have problems with headaches and some sinus congestion, which seems to influence the nose and ears:

“I have always suffered with some sinus congestion which seems to affect the nose, face and ears at times. In the last few years I have had a few headaches.”

“Headaches can be painful due to tinnitus but I won’t say it is the cause.”

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The results of some questionnaires or their subscales do, however, substantiate the hypothesis that somatic complaints may increase perception of tinnitus. The SF-36 questionnaire estimates quality of life with co-existing health or mental problems. Health status and corresponding quality of life are described as a mean combination of subjectively measured health, including physical function, social function, emotional or mental state, burden of symptoms and sense of wellbeing (Jenkinson, 1996). Analysis of the SF-36 results from the research group demonstrated that only one participant had lower than average scores in both physical and mental health. This particular patient suffered from many physical disorders due to implantation. One of the subscales of the Tinnitus Questionnaire (Hallam, 2008) focuses on somatic complaints. This factor indicates the presence of ear or head pain and muscle tension, especially in the face and neck. The results from this questionnaire used in our study showed that up to 75% of respondents actually suffer from differing kinds of somatic malady. In this case, the most common complaint related to headaches:

“Tension headaches.”

“Yes, I have headaches every day.”

The subsequent question aimed to find out about their sleep problems and their impact:

“Does and how tinnitus affects your sleep?” As stated before, tinnitus is strongly related to sleeping problems. Tinnitus sufferers complained that tinnitus is so predominant at night-time that it impacts their sleep. According to the literature, insomnia was the most commonly reported problem by people with tinnitus (Tyler, 1983). In Sanchez & Stephens, sleep disturbance was the second most commonly reported problem (Sanchez, 1997), and this was also borne out by Lindberg’s research (Lindberg, 1988):

“Occasionally it can be too loud to allow me to fall asleep quickly, but not often.”

However, in this study, results and Open Questions showed that, within the research group, no one actually suffers from sleep problems caused by tinnitus. Nevertheless, sleeping complaints recorded by the TQ showed that this problem is apparent in 26–50% of sufferers, which suggests there is a mild problem in the population used in this study.

“Not at all.”

“I have trouble getting to sleep sometime because of it.”

“Tinnitus goes away when I lay down.”

The next question asked if tinnitus has an effect on work, concentration and similar mental activities: *“Does tinnitus affect your work?”* Five out of eight respondents confirmed that tinnitus is a factor which may influence work, concentration and balance. Three participants stated categorically that their poor concentration is entirely due to tinnitus:

“It can cause problems in meetings, on courses where I have to concentrate on what is being said, this makes it worse.”

“Yes, it can distract and ruin the concentration.”

“Yes, it affects my balance (and it stopped me from what I was doing).”

In the literature, Andersson and McKenna (Andersson, 2006) pointed out that loss of concentration appears as one of the problems caused by tinnitus. In their research, he and his co-author asked directly “Does tinnitus affect your concentration; 70% of respondents confirmed that tinnitus affected their concentration and mental activities. Also in Rossiter et al. (Rossiter, Stevens et al., 2006), the evidence suggested that tinnitus patients had some problems with concentration when performing tasks. The authors stated that tinnitus reduces cognitive capacity needed to perform tasks that require voluntary or conscious effort and strategic control.

The impression that tinnitus causes poorer concentration may be also connected with a TQ subscale – intrusiveness. According to Hallam (Hallam, 2008), this factor assesses the respondent’s sensory or attentional evaluation of tinnitus, rather than an emotional one. The noises are perceived as loud and unrelenting, constantly intruding into one’s consciousness, inescapable and impossible to ignore. In this study, participants from the research group presented quite a high score of intrusiveness, which implies a mild problem in this population.

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Also, it is interesting how tinnitus makes the work environment stressful. One participant's "Thoughts and Feelings Diary" described a stressful event, which exacerbated their tinnitus and provoked further consequences:

"Obnoxiously rude person on phone (again) angry as I couldn't understand them and wouldn't do what they wanted. Really made the tinnitus flare up." The reaction to this was, *"Anger! Anger! Frustration! Anger, really wound up wrong."*

Three participants did not record any negative statements, since they were either retired or simply did not have any problems with concentration.

The next question asked specifically about the impact of tinnitus on social life: *"Does tinnitus have any influence on your social life (social interaction) and activities?"* One of the cognitive and behavioural consequences of tinnitus is a gradual withdrawal from social life, as well as the appearance of safety behaviours and Negative Automatic Thoughts (NATs). People who suffer from tinnitus prefer to stay at home rather than go out, because they are convinced that external noise will increase their perception of tinnitus (Andersson, 2009).

Three participants out of eight confirmed that, because of tinnitus, their social life had become limited:

"Sometimes. Frustrating when I cannot hear because of the noises in my head."

"Yes because it reduces my sense of wellbeing and confidence and also reduces my hearing which I receive solely through my cochlear implant."

The rest of the participants, on the other hand, made the point that their deafness made a huge difference to their lives. Tinnitus was viewed more as a consequence, which they had to deal with as a secondary consideration:

"Not compare to the deafness itself."

"No, being totally deaf. It doesn't make any difference. It is the sound I hear. Being deaf does [make a difference]."

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Subsequent questions included in this tinnitus subcategory were designed to discover the individual's view of tinnitus, or its depressive influence on the sufferer. Tinnitus may be one of the factors which can cause depression or anxiety disorder (Erlandsson, 1995), and in extremely difficult situations, may be one of the factors that may lead to suicide (Lewis, 1994).

The question *"Have you ever been depressed because of tinnitus?"* aimed to assess the incidence of lowered moods or depressed states among respondents. Six out of eight admitted that they had suffered, or still suffer from, lowered moods and depression:

"Yes, before my implant when I was totally deaf, it was all I could hear."

"I feel low about it a lot."

Two participants clearly stated that they have not been depressed because of tinnitus.

According to the depression (HADS) subscale used to analyse the research group's responses, the respondents appeared on a normal to moderate level. The TQ subscale for emotional distress may also be a predictor for future development of depression. This subscale showed that distress (as a factor leading to depression) was at a moderate level for respondents who confirmed they felt low. For two other participants, the emotional distress subscale scores did not show any significant deviations.

When evaluated according to the SF-36 mental health subscale, six respondents obtained above-average results, which suggests that their mental states were good. Only two participants had a lower mental health score, which may suggest a slightly lowered mood or the beginning of depression.

The next question evaluated the psychological wellbeing of the participants in the research group: *"Did you ever have thoughts about committing suicide?"* Four respondents stated that they thought about committing suicide (possibly because of tinnitus):

"Yes, stupid I know."

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“A few times but it would be unkind to my wife...”

Yes, in the first years but not too bad at the moment.”

We asked participants about the treatment they had previously received: *“What kind of tinnitus treatment did you already receive?”* Four out of eight participants, before undergoing Cognitive Behavioural Therapy, had received some kind of help from doctors or support groups:

“A tablet called something like “SEC” a very long time ago while I was still deaf.”

“I was on medication by then but it didn’t work at all. Can’t remember what it is called but something like...beta.”

“Counselling, support group.”

The rest of the participants did not receive any prior help or guidance on how to cope with tinnitus.

Category: Cochlear implants and tinnitus

There were only two questions which aimed to examine whether there was a relationship between suppression of tinnitus and the cochlear implant. The first of these was: *“How did the implantation affect your tinnitus?”*

Three out of eight respondents declared a significant improvement in their perception of tinnitus just after cochlear implantation:

“Improved it vastly as had other sound to listen to.”

“After the operation tinnitus was much better with the processor on but returned when off. Sometimes it is noticeable when on but clear voice seems to help. I tend to focus more on things that assuage it and avoid things that can increase tinnitus like; caffeine, alcohol or tiredness.”

“Relieved only on one side.”

Three participants described their tinnitus as becoming worse after implantation:

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“It increased three times.”

“Very little to start with, but as time has gone on it has got worse.”

One of the participants claimed that he had only experienced tinnitus for the first time after his cochlear implantation. A similar example can be found in the literature, where about 3-4% of implantations have been found to result in increasing or triggering tinnitus (Ito & Sakakihara, 1994):

“Have no idea how it happened.”

The remaining participants did not notice any change in their perception of tinnitus; it either stayed the same or, thanks to their enhanced hearing with the implant, the tinnitus became less noticeable:

“Tinnitus stopped for a while then returned.”

“Don’t think it has changed a great deal. I am a little more conscious of it due to the increased absence of other sounds when not wired up.”

The second question in this category asked about the impact of the cochlear implant on tinnitus in everyday life: *“How does the implant affect your tinnitus now in everyday life?”*

Three out of eight participants found the implant useful in reducing tinnitus in everyday life:

“The implant helps me to go through life with very little annoyance from tinnitus.”

“Gives me something else to listen to.”

Two respondents did not notice any change in their tinnitus, even after a long period of adapting to the implant:

“Not at all.”

“Most of the time the noise I have to concentrate on means I do not pay too much attention to the tinnitus.”

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The remaining three respondents did not find the implant useful in helping to cope with tinnitus:

“Because the implant picks up lots of sound and magnifies it, this makes the tinnitus worse.”

Appendix 18: Thoughts and Feelings Diary – the research group

When you notice some distress associated with your tinnitus, fill in Column A (Event). Then complete column C (Feelings). Then try to work out the thoughts (Column B) which might be leading to the feelings you identified. Finally, try to develop some effective challenges to those thoughts which are unhelpful (Column D).

A: Event	B: Thoughts	C: Feelings	D: Dispute
Who was I with? What was I doing? Where was I? When was it? Was my tinnitus louder? Did my tinnitus interfere with what I was doing?	What was going through my mind just before I started to feel this way? What does it say about me? What does this mean about me? My life? My future? What am I afraid might happen? What is the worst thing that could happen if it is true? What does this mean about how the other person feels or thinks about me? What does this mean about the other person or people in general? What images or memories do I have in this situation?	Depressed, anxious, angry, guilty, ashamed, sad, hurt, embarrassed, excited, scared, frightened, irritated, insecure, panicky, frustrated, nervous, disgusted, cheerful, happy, disappointed, enraged, humiliated	What evidence do I have to support this thought? What evidence is there against this thought? Are there any alternatives views I haven't considered? How would someone else view these situations? What is the effect of thinking that way? If someone else had this thought, how, what would I say to help them to dispute it? Does this thought help or hinder me in getting what I want? Am I concentrating on my weakness and forgetting my strengths? Am I expecting myself to be perfect? Am I overestimating the chances of a disaster? Am I using a double standard - how would I view someone else in this situation? Am I fretting about the ways things ought to be rather than dealing with them as they come? What can I do to test out the truth of these thoughts?

Participant 31

- A. Event
Very loud hissing in my left ear today + some humming in the right ear.
- B. Thought
It is just louder today. No particular reason
- C. Feeling
I just take it as normal
- D. Dispute
I just have to accept it

- A. Event
Very loud tinnitus today as was yesterday also. Hissing in left ear and medium humming in right ear.
- B. Thought
There is no reason for it being louder today, it just is.
- C. Feeling
Will have to put up with it as it is obviously not going away
- D. Dispute
I just accept it as part of life but I wish that it was not

- A. Event
Mild tinnitus. Hissing in left ear, humming and train whistle in right ear
- B. Thought
I don't know. But it is nice and sunny but cold weather, so that is cheerier.
- C. Feeling
It is quite nice to be having a mild tinnitus day
- D. Dispute
I don't think that I am thinking about unhelpful thoughts

- A. Event
My tinnitus is very loud today. Hissing in the left ear and humming + whistle in the right ear
- B. Thought
Don't know what is causing it but hopefully it won't be as bad tomorrow.

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- C. Feeling
Very annoying but I just have to put up with it
- D. Dispute
No deputies, just shopping. The tinnitus was there before we left home.
- A. Event
Tinnitus as usual today. Hissing and humming. It is not interfering just annoying.
- B. Thought
I wish that I could hear my wife and other loved ones, just like I used to but I realise that I must face up to reality.
- C. Feeling
Mostly cheerful
- D. Dispute
There is probably nothing I can do except accept the situation

- A. Event
Had a tooth extracted yesterday. Have got slight hissing in left ear and medium humming +hissing in right ear. Tinnitus is not interfering, just annoying.
- B. Thought
Just positive thoughts.
- C. Feeling
Cheerful and happy
- D. Dispute

Participant 29

- A. Event
Waking up at night. Unable to read as P. is asleep. Don't want to get up – it is cold.
- B. Thought
Nothing previously - not a response to a thought or thoughts
- C. Feeling
Frustration, boredom
- D. Dispute
Consideration of others in conflict with what I know will dispel the tinnitus

- A. Event
Having visitors in the house at night – unable to watch TV if P is asleep and I am awake.

- B. Thought
Waking issue again
- C. Feeling
Again frustration and boredom
- D. Dispute
Assert self or consider others. Also it is cold out of bed.

Participant 27

- A. Event
Waking up knowing I have a really stressful day ahead. Tinnitus was loud immediately. Didn't improve when processor was put on. Has slept OK night before.
 - B. Thought
Thinking about day ahead. Worried. May not hear crucial elements during day, leading to not receiving full information or making mistakes at a later date.
 - C. Feeling
Irritated, stressed, tired, resentment, annoyed
 - D. Dispute
Probably put too much pressure on myself but have always strived to do well in everything. Very difficult not to do this. Cannot do much about the job security + changes ahead which is difficult to think around as job as it is (without the added stress) is a great set up. I try to deal with day to day + not think ahead.
-
- A. Event
Obnoxiously rude person on phone (again) angry as I couldn't understand them + wouldn't do what they wanted. Really made the tinnitus flare up.
 - B. Thought
What is it with people on the phone that they just do not listen. If I spoke to them or treated them the way they did me I would have an official complaint against me which would go on for months.
 - C. Feeling
Anger! Anger! Frustration, anger, really wound up wronged.
 - D. Dispute
No answer to the anger apart from talk to my boss (my mate) who understands totally. I don't blame myself for this but wish people would think of the effect their actions have.
-
- A. Event
Trying very hard to understand softly spoken man face to face, who I have told 3 times about my hearing + who continues to turn head away.

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B. Thought

What is wrong with people? If someone told me they had a problem + I could do something to assist /help out I would ! There are some very selfish, thoughtless people around. He is not a stranger (meet at dog training every week) + he is not shy.

C. Feeling

Frustration, GRRRR, disbelief anyone can be so thick + insensitive

D. Dispute

Don't talk to him again – simple

Participant 54

A. Event

Lunch time break with assistant, no tinnitus problem till returned to office

B. Thought

I won't be drinking alcohol at lunch – use C/V to help

C. Feeling

Distracted, sensitive

D. Dispute

Discussion that alcohol causes tinnitus

A. Event

Jo (sister) stamp in coffee shop - sister made a bit of scene about getting stamp on card

B. Thought

Just let it be. It is just a stamp. Why be so irritated about it. Keep calm and talk through

C. Feeling

Annoyed, embarrassed a bit, cheap want to dismiss myself from it.

D. Dispute

I don't think I would have reacted that way. Talk about it after was loud. I would probably forget about it. But I know if I was very annoyed I would do the same.

A. Event

Assistant eating at desk after one hour plus lunch

B. Thought

He should have eaten in an hour. Now he wastes time when should be working, tinnitus noticed after – dismissed.

C. Feeling

Angry

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D. Dispute

I had to choose if to say something. I didn't. Maybe he had some things to do not eat. I do it all the time. Is it worth the agro?

A. Event

Umits' friends for dinner, all talking Turkish. Sit in silence

B. Thought

Why am I here – why do these people not speak English, tired after hard day

C. Feeling

Angry, annoyed, bored. No tinnitus but then when sleep

D. Dispute

It is hard for them- could have made more effort- this is their house. 5 to 1 ratio

A. Event

Ex-girlfriend is back in UK. Sisters friend also want to go. Umits not happy

B. Thought

*I don't really care to go or not. I would like to but not if Umit is going to be unhappy.
Thought turn to tinnitus as I am bored*

D. Feeling

Annoyed, not trusted – dismissive

E. Dispute

How would I feel if it was reverse. I don't feel as bad I don't think

A. Event

Worried for new house cost-sleeping tinnitus noticeable

B. Thought

What would happen if my jobs goes, how will we cope? Can I get another one-thinking about tinnitus and how it is not so bad but constantly there now.

C. Feeling

Tired/little anxious

D. Dispute

We will find a way I can get a job I am skilled in my trade- worry less, deal with things when they happen rather than worry about nothing.

Appendix 19: Evaluation Forms – the research group

The Evaluation Forms were sent to the participants one week after the Cognitive Behavioural Therapy sessions ended. The aim was exactly the same as in the control group, where individuals were asked to assess how helpful the Tinnitus Workshop intervention was in decreasing distress caused by tinnitus. The research group's Evaluation Form differed slightly from that of the control group: it included only five questions and focused on CBT as a procedure that could ease tinnitus perception, influence behaviour and in turn improve the patient's cognition. The section of the form, in which participants assess the methodological quality of an intervention was not included, because any such issues had been resolved during the process. Seven filled-in Evaluation Forms were received out of eight.

Question: Do you think the Cognitive Behavioural Therapy was successful in helping you to cope with tinnitus?

“Yes”; “Partly”; “Yes, very useful”.

“It answered a few questions, and caused some life changes which seem to help a little.”

“Yes because it helped to remind me that other people suffer with tinnitus, not just me.”

“The sessions were interesting but I was pretty good at coping beforehand.”

“No.”

Question: Did your perception or understanding of tinnitus change after attending the therapy?

“No”; “Yes”; “Yes”.

“A little – I learnt I have a mild case.”

“Not really, because I have known for many years, that it is linked to the brain and being deafened”; “I learnt a few things about tinnitus”; “No.”

Question: Did your emotional attitude towards tinnitus change after the therapy?

“Yes”; “Partly”; “Yes”; “Not really, but I was never challenged before therapy.”

“No, but I am working on it”; “Not really – I was OK with it before.”

Appendices

“No.”

Question: What was the most important thing you found out about your tinnitus or anything related to it during the therapy?

“That it was important for me to control my tinnitus and to find a way to relax.”

“Own attitude to tinnitus is very important”; “Understood it better”.

“Caffeine + chocolate play a part – headaches not caused by sleep disturbance due to tinnitus.”

“I received no new information but was reminded of a lot things which I already knew.”

“I am lucky to be easily distracted from it”; “Grin and bear it.”

Question: Do you have any suggestion on how these sessions can be improved in the future?

“No. The sessions were very informative and it was good to meet other who were trying to cope with tinnitus.”

“This should be happened sooner instead 12 years of waiting for this sort of help as it was be better for anyone to understand it as soon as possible so they can cope better with their life.”

“I liked them as they were.”

“Yes, hold the sessions in a room with good acoustics. I just hope that more knowledge will become available in the future and hopefully will help other people.”

“Perhaps a larger group than 3.”

“No.”

Appendices

Appendix 20: Photographs from the CBT sessions

