
Audiological Outcomes for Adults with a
Mild Hearing Impairment

Karen Thomas

A thesis submitted in partial fulfilment
of the requirements for the Degree of

Master of Audiology

at the University of Canterbury

2014

Acknowledgements

Dr. Rebecca Kelly-Campbell, thank you. Your academic prowess is inspiring.

Dr. Donal Sinex, thank you. Your feedback was superb and extremely helpful.

Tori, Aretha, Anna, Sarah, Rach, Kamea, Jo, Sam. You are the best.

Jacque - thank you thank you and thank you. I couldn't have done this without you.

My family - thanks. I promise, this was the last big one.

Hearing Impairment

Hearing loss? Yes, loss is what we hear
who are starting to go deaf. Loss
trails a lot of weird puns in its wake, viz.
Dad's a real prism of the Left –
you'd like me to repeat that?
THE SAD SURREALISM OF THE DEAF.

It's mind of mutter at work
guessing half what the munglers are saying
and society's worse. Punch lines elude to you
as Henry Lawson and other touchy drinkers
have claimed. Asides, too, go pasture.
It's particularly nasty with a wether.

First you crane at people, face them
while you can still face them. But grudgually
you give up dinnier parties; you begin
to think about Beethoven. You Hanover
next visit here on silly Narda Fearing – I SAY
YOU CAN HAVE AN EXQUISITE EAR
AND STILL BE HARD OF HEARING.

It seems to be mainly speech, at first,
that escapes you – and that can be a rest,
the poor man's escape itch from Babel.
You can still hear a duck way upriver,
a lorry miles off on the highway. You
can still say boo to a goose and
read its curt yellow-lipped reply.
You can shout SING UP to a magpie,

but one day soon you must feel
the silent stopwatch chill your ear
in the doctor's rooms, and be wired
back into a slightly thinned world
with a faint plastic undertone to it
and, if the rumors are true, snatches
of static, music, police transmissions:
it's a BARF minor Car Fourteen prospect.

But maybe hearing aids are now perfect
and maybe it's not all that soon.
Sweet nothings in your ear are still sweet;
you've heard the human range by your age
and can follow most talk from memory;
the peace of the graveyard's well up
on that of the grave. And the world would
enjoy peace and birdsong for more moments

if you were head of government, enquiring
on an aide Why, Simpkins, do you tell me
a warrior is a ready flirt?
I might argue – and lowers keep blooming
as he swallows his larynx to shriek
our common mind-overloading sentence
I'M SORRY, SIR, IT'S A RED ALERT!

Les A. Murray (1988/98)

Abstract

A hearing impairment is one of the three leading causes of disability worldwide. It is estimated that 600 million people around the world have a hearing impairment, which affects their communication abilities, causes them to feel isolated and depressed, and impacts their economic situation. Because a decrease in the ability to hear is associated with getting older and life expectancy is increasing, the number of hearing impaired individuals is expected to increase.

Much of the current research on adults with a hearing impairment focusses on a disabling hearing impairment, which is a loss of at least 40 dB HL or worse in the better ear. The research on a mild hearing impairment is predominantly focussed on children, specifically on educational effects. The aims of this study were to identify demographic, audiometric and quality of life differences between adults with a mild hearing impairment who adopt hearing aids and those who choose not to adopt hearing aids, and to measure clinical outcomes for adults with a mild hearing impairment who adopt hearing aids.

Two groups of clients with a mild hearing impairment were compared. One group consisted of hearing aid adopters whilst the other group consisted of non-adopters. There was no significant difference between the groups in terms of demographic variables, such as age, gender or working status, or objective audiometric variables. We found a statistically significant difference between the groups in terms of subjective audiometric variables. Hearing aid adopters rated their hearing impairment worse than the non-adopters and were more inclined to change their current situation than the non-adopters. In addition, the adopters showed significant clinical improvement after wearing their hearing aids for an extended period of time.

Contents

Abstract.....	i
List of Figures.....	v
List of Tables.....	vi
Chapter One: Introduction	1
1.1 Overview.....	1
1.2 Hearing and the hearing system.....	2
1.3 Impairment Defined.....	3
1.4 The International Classification of Functioning, Disability and Health	5
1.5 Hearing impairment (HI)	8
1.5.1 Overview.....	8
1.5.2 Classification of HI.....	9
1.5.3 Prevalence of HI.....	13
1.5.4 Prevalence of MHI.....	16
1.6 Demographic Characteristics of people with an HI.....	17
1.6.1 Age.....	17
1.6.2 Gender.....	17
1.6.3 Education	18
1.6.4 Race and ethnic identity.....	19
1.6.5 Work status	19
1.7 Effect of HI on Health Related Quality of life (HRQoL)	20
1.8 Management of HI.....	21
1.8.1 Positive effects of HA adoption	22
1.8.2 Outcome measures	23
1.8.2.1 Satisfaction with Amplification in Daily Life (SADL).....	24
1.8.2.2 Hearing Handicap Inventory for the Elderly (HHIE).....	25
1.8.3 Non-Adoption of HA	26
1.8.4 Considerations in HA adoption.....	26
1.8.4.1 Self-reported HI	27
1.8.4.2 Stigma	28
1.8.4.3 Degree of HI	28
1.8.4.4 Personality/psychological factors.....	29
1.8.4.5 Cost	30
1.8.4.6 Age.....	31

1.8.4.7 Gender.....	31
1.9 HA adoption and MHI	32
1.10 Research aims questions	32
Chapter Two: Method	33
2.1 <i>A Priori</i> Power Analysis	33
2.2 Participants.....	33
2.3 Procedure	34
2.4 General Information.....	35
2.4.1 Case History Information.....	35
2.4.2 Demographic Information.....	35
2.5 Audiometric Measures	36
2.5.1 PT Audiometry.....	36
2.5.2 Speech Audiometry.....	37
2.5.2.1 Speech recognition in quiet.....	37
2.5.2.2 Speech in noise.....	37
2.6 Outcome Measures.....	39
2.6.1 HHIE	39
2.7 Statistical Methods/Data analysis	39
2.8 Ethical considerations	42
Chapter Three: Results	43
3.1 Sample characteristics.....	43
3.2 Demographic Variables	43
3.3 Audiometric variables	46
3.4 Quality of Life.....	47
3.5 Clinical Outcomes.....	48
Chapter Four: Discussion	53
4.1 Participants.....	54
4.2 Study question 1: Demographic variables	55
4.2.1 Age.....	55
4.2.2 Gender.....	56
4.2.3 Qualifications.....	57
4.2.4 Race and ethnic identity.....	57
4.2.5 Living Situation	59
4.2.6 Work Status.....	59

4.2.7 Length of hearing loss.....	60
4.3 Study question 2: Audiometric variables	61
4.3.1 Objective audiometric measures	61
4.3.2 Subjective audiometric measures.....	62
4.3.3 Prior HA use	63
4.4 Study question 3: Quality of life	64
4.4.1 HHIE (Emotional subscale)	64
4.4.2 HHIE (Social subscale).....	64
4.5 Study question 4: Clinical Outcomes.....	65
4.6 Study question 5: Satisfaction with Hearing Aids	65
4.7 Clinical Implications.....	66
4.8 Limitations and Directions for further research.....	68
4.9 Conclusion	70
References.....	72
Appendix A: MHL Study Information Sheet.....	87
Appendix B: Consent Form	89
Appendix C: Demographic Information	90

List of Figures

<i>Figure 1:</i> Representation of ICF model (WHO, 2002).....	7
<i>Figure 2:</i> HI estimates by region and classification. WHO, 2011.....	15
<i>Figure 3:</i> Age distributions between adopters and non-adopters.	43
<i>Figure 4:</i> HHIE mean values.....	48
<i>Figure 5:</i> Clinical improvement for adopters as measured by the HHIE.....	49
<i>Figure 6:</i> SADL Global Score in relation to normative range.....	50
<i>Figure 7:</i> SADL Service and Cost score in relation to normative range.	50
<i>Figure 8:</i> SADL Positive Effect score in relation to normative range.	51
<i>Figure 9:</i> SADL Negative Effect score in relation to normative range.....	51
<i>Figure 10:</i> SADL Personal Image score in relation to normative range.	52

List of Tables

<i>Table 1:</i> Degree of impairment as defined by different authors.	10
<i>Table 2:</i> Comparison of demographic variables between adopters and non-adopters.....	45
<i>Table 3:</i> Comparison of audiometric variables between HA adopters and non-adopters	47
<i>Table 4:</i> Comparison of QoL variables between HA adopters and non-adopters	47

Chapter One: Introduction

1.1 Overview

According to the World Health Organisation (WHO, 2013), a hearing impairment (HI), vision problems and mental disorders are the three leading causes of disability worldwide. Currently, 15% of people older than 15 years of age, or 600 million people, have some degree of a HI, whilst 5.4% of those have a disabling HI (WHO). This means that there are 328 million adults worldwide who, at best, are able to hear words at a distance of one metre and repeat those words correctly if they are spoken in a raised voice (WHO, 2014). In addition, 32 million children worldwide have a disabling HI (WHO, 2013). In New Zealand it is estimated that 5.9% of adults have a HI (Greville, 2005).

The stigma of having a HI often causes people to ignore their hearing problems. Embarrassment, shame, weak, feeble and ridicule are some of the terms used by hearing impaired-individuals to describe their feelings about their impairment (Hétu, 1996; Kochkin, 1993). This contributes to the fact that, on average, people wait for more than ten years after first noticing their HI before taking any action (Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007), and has implications for the general quality of life (QoL) that a person with a HI experiences.

The severity of a HI is classified on a continuum according to the degree of hearing impairment. This ranges from a mild hearing impairment (MHI) to a profound HI (Clark, 1981). People with a MHI will often have difficulty following a conversation in background noise, which can cause a breakdown in communication, embarrassment and even withdrawal. Most research on HI and hearing aids (HAs) is centred on the more severe HI range, with very little research focussing on MHI. The aims of this study were to identify demographic,

audiometric and QoL differences between adults with a MHI who adopt HAs and those who choose not to adopt HAs. In addition, the study aimed to measure clinical outcomes for adults with a MHI who adopt HAs.

1.2 Hearing and the hearing system

The act of hearing or ‘to hear’ is the ability of a hearing system to perceive and make sense of sounds. The human ear consists of three connected parts, namely the outer ear (*auris externa*), the middle ear (*auris media*), and the inner ear (*auris interna*). The outer ear consists of the only visible part of the ear, called the *pinna*, and the ear canal. The middle ear is embedded in the temporal bone and includes the tympanic membrane and an air-filled cavity that houses the three ossicular bones - the *malleus*, the *incus* and the *stapes*. One end of the *malleus*, the *manubrium*, is embedded in the tympanic membrane, whilst the *stapes* footplate is attached to the oval window. This links the middle ear to the spiral shaped *cochlea*, which is filled with fluid and found in the inner ear and which is also embedded in the temporal bone. Structures within the inner ear include the basilar membrane and the inner and outer hair cells - there are approximately 20 000 hair cells (Northern & Downs, 2002; Taylor & Mueller, 2011; Musiek & Baran, 2007). The outer ear and middle ear are often referred to as the conductive portion, whilst the inner ear and neural components are called the sensorineural part of hearing (Martin & Clark, 2000).

Inner hair cells change sound vibrations into electrical activity in the nerve fibres, and this is then transmitted to the brain via the auditory nerve. When the auditory nerve joins the vestibular nerve, it forms the vestibulocochlear, or VIIIth cranial nerve. Via several structures the encoded sounds reach the *thalamus*, and are then relayed to the cortex. The primary auditory cortex is found in the temporal lobe (Musiek & Baran, 2007).

The hearing process is as follows. Sound that reaches the outer ear in the form of sound waves or vibrations is channelled down the ear canal towards the tympanic membrane, and

causes it to vibrate. The vibrations are then transmitted to the middle ear and amplified via the ossicles. The vibrations of the *stapes* footplate move the fluid in the *cochlea*, causing the inner hair cells to convert mechanical energy to neural impulses on the auditory nerve. Different hair cells are responsible for unique frequencies, tonotopically arranged on the basilar membrane from high to low frequencies (Musiek & Baran, 2007). This is identified by the brain as ‘hearing’ (Northern & Downs, 2002; Taylor & Mueller, 2011; Martin & Clark, 2000).

The ear and its components are very small. The average length of an adult ear canal is 2.5 cm long and 0.7 cm in diameter. Owing to exposure, the ear canal is susceptible to many diseases or abnormalities, such as excessive *cerumen*, *cholesteatomas* and *exostoses*. These abnormalities can prevent soundwaves from reaching the middle ear, leading to a decrease in hearing. In the middle ear, the *stapes* is the smallest bone in the human body, with the footplate of the adult *stapes* measuring 1.14 mm on average (aWengen, Nishihara, Kurokawa, & Good, 1995). Damage to any of the ossicles could decrease the ability of the ossicles to amplify sounds and hence cause a HI. Lesions or abnormalities of the outer and middle ear cause a conductive HI – the sound is blocked before it reaches the inner ear (Skinner, 1988). In the inner ear, a cochlear or sensorineural HI is caused by hair cell damage or loss, or a disorder in the auditory nerve. The most common causes of hair cell damage are unprotected noise exposure and ageing (Taylor & Mueller, 2011; Skinner,). Damaged hair cells will not regenerate and subsequently a person will suffer from a permanent HI (Musiek & Baran, 2007).

1.3 Impairment Defined

Much has been written about finding an accurate definition of disability. Grönvik (2009) described how researchers have struggled to find “operational definitions of disability that are ‘complete’, ‘global’ or ‘stable over time’” (p. 1). He identified three different types of

definitions as used in the literature pertaining to disability: 1) functional limitation, 2) legal or administrative definitions and 3) subjective definitions. Functional limitations refer to the medical understanding of the disability in terms of changes in bodily structures; legal or administrative definitions link the identification of a disability to the right to claim a certain benefit, and subjective definitions refer to a person voluntarily labelling him or herself as disabled. Whilst there is a vast difference between these three categories, it is not always clear which definition is being referred to (Grönvik, 2009). The Convention on the Rights of Persons with Disabilities (CRPD, United Nations (UN), 2006, Article 1: Purpose section, para. 2) included the following in their definition of disabilities: “Persons ... who have long-term physical, mental, intellectual or sensory impairments which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others.”

Charles Taylor, Canadian philosopher best known for his contributions to the philosophy of social science, defined disability in terms of limitations and depreciation. In his essay, *The Politics of Recognition*, Taylor (1995) spoke about human potential, and referred to the protection of that potential, “even to people who ... are incapable of realising their potential in the normal way – handicapped people...” (p. 41). The language which is used when referring to disabilities mirrors feminist disability scholar Jenny Morris’s (1991) argument that people with disabilities have been subjected to the effects of negative language, and thus any research on, and by implication, the definition of disability, should also focus on the linguistic aspects thereof. Those with disabilities and those without disabilities view the term ‘disability’ in very different ways (Longmore, 2003). People with disabilities are frequently treated negatively, often patronized. Morris (1991, p. 63) described it as follows:

“Writers over many years ... have used ... disability ... to signify evil, badness, a state of something wrong The crucial thing about these cultural representations of

disability is that they say nothing about the lives of disabled people but everything about the attitudes of non-disabled people towards disability. The more disability is used as a metaphor for evil, or just to induce a sense of unease, the more the cultural stereotype is confirmed.”

In the 1970s, the social modellist-thinkers referred to disabilities as the “socio-structural barriers that serve to disadvantage and exclude people with impairments” and claims that “disability” was associated with “social oppression and exclusion” (Thomas, 2004, p. 23). Terzi (2004) concluded that there is a causal relation between an impairment, which is simply a deviation from normality, and disability, defined as a restriction on the abilities to perform a task. The term ‘impairment’, instead of ‘disability’, appears to be a better reflection of a person’s limitations, and, specifically in terms of a hearing impairment, it is the preferred term.

In June 2011, the World Health Organisation (WHO) released a document, The World Report on Disability, to provide, amongst others, “a comprehensive description of the importance of disability” (WHO, 2011, p. xxi). According to this report, more than one billion people worldwide, or 15% of the world’s population, suffer from some form of disability, yet “There is no agreement on definitions...” (WHO, 2011, p. xxi). According to the New Zealand Disability Strategy document, the number of people with a disability in New Zealand in 2001 was 20%, (Office for Disability Issues, 2001), which is over 30% more than the world-wide norm.

1.4 The International Classification of Functioning, Disability and Health

An impairment affects a person in a complex, multifaceted ways and as such needs a holistic, transdisciplinary approach to treatment (Laszlo & Krippner, 1998). A biopsychosocial model offers such a holistic approach, including biological, psychological, as

well as social dimensions. The impairment is therefore viewed as an interaction of the body, the mind, and the environment (Fava & Sonino, 2008).

The WHO developed the WHO Family of International Classifications (WHO-FIC) in order to “assist the development of reliable statistical systems . . . , with the aim of improving health status and health care” (Madden, Sykes & Üstün, n.d. , p. 5). Within this system, the International Classification of Functioning, Disability and Health (ICF) acts as a classification system of health and health-related fields (WHO, 2001). In contrast to the WHO’s previous classification, the International Classification of Impairments, Disabilities and Handicaps (ICIDH), the ICF does not focus on the limitations of people’s abilities as that which defines the disability. The ICF claims that the mind, body and environment cannot be separated but comprise each other in a mutual, complex way (Imrie, 2004). The ICF’s focus is on health and functioning, rather than the disability (WHO, 2001). In essence, the ICF merges two models of human functioning and impairment: a medical model with a social model (Solli & da Silva, 2012).

Diagnosis of impairment does not predict the treatment plan, which includes what services will be needed, how long treatment will take place, how much care will be needed or what the final outcomes will be. In the same vein, the presence of a disability is not a predictor for the effect that this disability will have, be it the need for benefits, ability to return to the workplace or the effect on social interaction. The ICF recognises this and supplies a framework for the shift from a purely medical model to a biopsychosocial model of human functioning and disability for, amongst others, healthcare, research and the management of disabilities (WHO, 2002).

According to the ICF model, there are three levels of human functioning: the level of the body or body parts, the level of the person, and the level of the person within an environment. This leads to the three functional levels: body functions and structures,

activities, and participation. A disability, within the ICF model, is a term that describes a decrease in functioning in one or more of these levels, thus an impairment, activity limitation (AL) or participation restriction (PR) (Bickenbach, Chatterji, Kostanjsek, & Üstün, 2003; WHO, 2011). The different structures and levels integrate in a non-linear manner as illustrated in Figure 1.

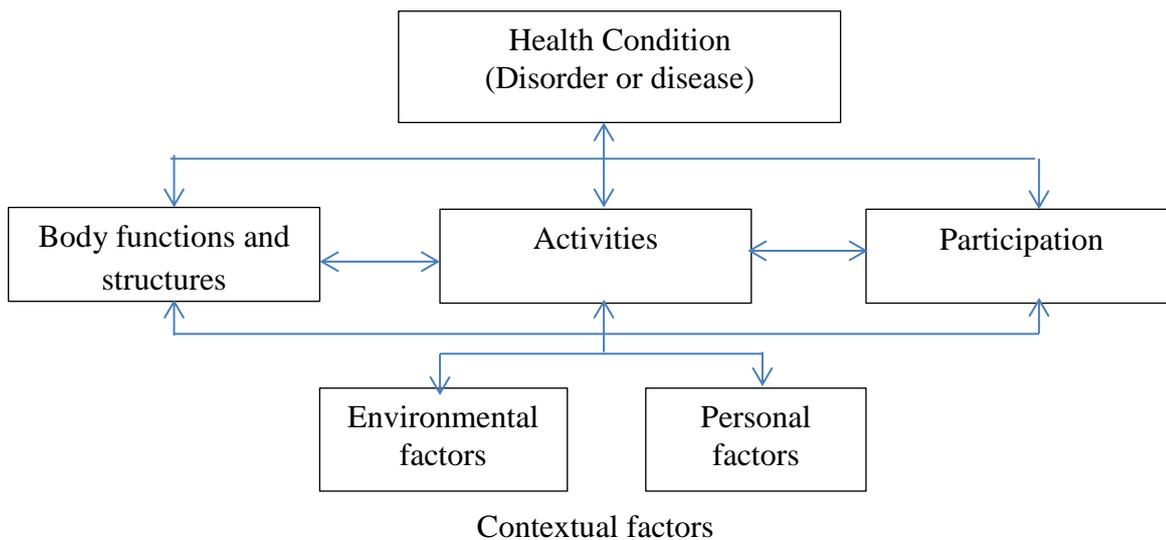


Figure 1: Representation of ICF model (WHO, 2002).

Disability and functioning thus entail the interaction between health conditions (disease, disorder and injuries) and contextual factors (environment and personal). Body functions and structures, activities and participation are contained within the Functioning and Disability level of the ICF. Body functions refer to physiological functions of body systems whilst body structures refer to organs or limbs. Impairment refers to a problem within a body function or structure. The ICF defines an activity as “the execution of a task or action” whilst participation refers to “involvement in a life situation” (WHO, 2002, p. 11). AL and PR refer to negative incidents. When a person has difficulty in executing a task, this is referred to as an AL, whilst PR occurs when a person may experience difficulties whilst involved in life

situations. The environmental factors consist of the” physical, social and attitudinal environment in which people live” (WHO, 2002, p. 11).

The contextual factors within the ICF model refer to environmental factors as well as personal factors. Environmental factors include social structures, social attitudes as well as the physical environment. Personal factors include age, race, gender and coping skills. The way in which each person experiences their reality is unique. Hence, people with a HI also experience their impairment in a unique way. The effect of a HI on quality of life (QoL) is described by the WHO within the context of the ICF (WHO, 2011). For instance, people with a HI (health condition) have an impairment (loss of hearing) within their sensory systems (functional), which could be attributed to damage in the hair cells (structure). As a result, the person cannot hear friends talk or communicate in a crowded restaurant (AL) and thus no longer goes out with friends (PR). However, because of different environmental factors, for example the attitudes of friends, or personal factors, for instance better coping skills, some people with a HI may choose to still continue going out (no PR), even though the AL (difficulty hearing others talk in a noisy background) is still present.

1.5 Hearing impairment (HI)

1.5.1 Overview

Individuals are identified as having a HI when their ability to hear specific frequencies and/or intensities is decreased owing to the absence of normal auditory capabilities (Skinner, 1988). Hearing ability can be evaluated through a variety of assessments, both behavioural (subjective) and non-behavioural (objective). The most commonly used behavioural assessment done is a pure tone (PT) audiometry with clients seated in a sound treated room. This test is performed to determine the lowest level/softest sound (in dB HL) at specific PT frequencies (in Hz) that a person can hear - typically at 250, 500, 1000, 2000, 4000 and 8000

Hz. Clinicians present PT air-conduction stimuli at various intensities to clients via earphones (Martin & Clark, 2000).

In addition, these tones can be presented through a bone-conductor, which stimulates the inner ear through the bones of the skull, essentially bypassing the ear canal and middle ear (Vento & Durrant, 2009). The results from the audiometry are then compared to results which are deemed normal (Taylor & Mueller, 2011). Once a hearing test is completed and a HI identified, the HI will be classified according to the degree of the impairment, the type of impairment as well as the configuration of the impairment (Johnson, 2012).

1.5.2 Classification of HI

After electric PT audiometers were introduced in the 1920s, Stacey Guild and Raymond Cahart developed systems by which audiograms could be classified in terms of configuration, severity and interaural asymmetry (Margolis & Saly, 2007). Audiologists prefer to use qualitative (adjective) descriptors to define and categorize the degree or severity of a HI (Clark, 1981), including normal, slight/minimal, mild, moderate, moderately severe, severe and profound. The categories are often based on a PT average which typically includes the frequencies most important for speech perception (500 Hz, 1, 2 & 4 kHz). Alternatively, a variable PT average (VPTA), which consists of the average of the worse three frequencies, would provide a “more accurate reflection of the importance of high-frequency hearing...” (Clark, 1981, p. 496).

Clark (1981) referred to a “Plethora of Hearing Loss Labels” (p. 497) and a “Vast myriad of classification systems” (p. 493) and called for some form of standardisation as well as different classification systems to be used for specific purposes. Several different classification systems are illustrated in Table 1. It is clear from the table that there is considerable variation in the classification systems, with some substantial discrepancies. What Davis (1970) classified as a slight HI is virtually the same as Goodman’s (1965)

Table 1: Degree of impairment as defined by different authors.

Degree of HI	Goodman (1965)	Davis (1970)	Rintelmann & Bess (1971)	O'Neill & Oyer (1973)	Sweitzer (1977)		Jerger & Jerger (1980)	Clark (1981)	WHO (1991)	Northern & Downs (2002)	ASHA (2005)
					Children	Adults					
Normal hearing	<26			<26			<21	-10 - 15		<16	0 - 20
Slight	16 - 25	25 - 40		27 - 40	21 - 35	27 - 40		16 - 25		16 - 25	
Mild	26 - 40	41 - 55	25 - 40		36 - 55	41 - 55	21 - 40	26 - 40	26 - 40	26 - 30	20 - 40
Moderate	41 - 55		41 - 65	41 - 55			41 - 55	41 - 55	41 - 60	30 - 50	40 - 60
Moderately severe	56 - 70				56 - 70		56 - 70	56 - 70			
Marked		56 - 70		56 - 70							
Severe	71 - 90	71 - 90	66 - 95	71 - 90	71 - 90		71 - 90	71 - 90	61 - 80	51 - 70	60 - 80
Profound	91+		96+		91+		91+	91+	81+	>70	80+
Extreme		91+		91+							

Adapted from Clark, 1981; Schlauch & Nelson, 2009

classification of a mild HI. Davis classified a MHI as between 40 – 55 dB HL, whilst Goodman (1965) described effectively the same HI as moderate. As seen in Table 1, a MHI can be anywhere between 15 – 55 dB HL and a person can, at the same time, have a slight (O'Neill & Oyer, 1973; Davis, 1970; Sweitzer, 1977, as cited in Clark 1981), mild (Goodman, 1965; Rintelmann & Bess, 1971, as cited in Clark 1981; Clark, 1981; WHO, 1991, as cited in Mathers, Smit & Concha, 2000; AHSA, 2005) or moderate HI (Northern & Downs, 2002), depending on which classification is used. These large classification variances do not make for sound scientific discourse.

Manchaiah and Freeman (2011) suggested in a letter to the editor of the International Journal of Audiology that it may be time for a change in categorizing the degree/severity of a HI. Their argument is fourfold:

- a) Similar audiological characteristics do not imply the same hearing handicap;
- b) The use of terminology such as 'mild' or 'moderate' does not reflect the client's problems;
- c) 'Normal' hearing may not describe a person's experiences with a HI; and
- d) Clients could (incorrectly) convert the dB HL to a percentage HI.

They suggested a much simpler classification system with three levels of hearing sensitivity, and a unique management option for each level: hearing sensitivity within average limits – no action needed; hearing sensitivity outside average limits – amplification through hearing aids; and very limited hearing sensitivity – cochlear implant. This could simplify and demystify counselling and decision-making for clients. However, a condensed classification system about the severity of a HI could present other challenges. People with more mild degrees of HI do not necessarily experience the same AL or PR as those with a more severe HI. In the same vein, two people with a similar MHI could also have vastly different lived experiences of their HI, since, as stated above, similar audiological

characteristics do not imply the same hearing handicap (Manchaiah & Freeman, 2011), thus different AL or PR (WHO, 2002). Whereas one person could experience a MHI as having very little impact on his or her daily life, another could find it extremely disruptive, and would benefit from intervention. Knowledge about the degree of the HI can assist the audiologist in choosing the appropriate intervention path. In addition to the degree of impairment, the site of lesion - where the HI originates from is used to classify the HI.

A HI can originate from a lesion in the conductive part of the hearing system, i.e. the outer or middle ear, or from a lesion in the cochlea and beyond, thus from the inner ear or neural pathway. Based on this, audiologists differentiate between a conductive loss and a sensorineural loss. In some cases, an individual can have a HI caused by both, in which case this is called a mixed HI. Site of lesion would determine the course of treatment, hence the inclusion of this classification category (Musiek & Baran, 2007). Not only are the degree of HI and the site of lesion important in classifying an HI, it is also important to take cognisance of the frequencies where the impairment is more prevalent.

Configuration of the HI refers to the shape or direction of the air-conduction thresholds in either ear when plotted on an audiogram. These include, for instance, downward sloping (when the loss increases progressively from the lowest to the highest frequencies), flat (when the degree of loss is similar over all the tested frequencies) or upward sloping (with a larger loss at the lower frequencies than in the higher frequencies, Johnson, 2012).

A person's HI description will thus include severity, type and configuration for each ear – for example a mild sensorineural sloping HI in the left ear or a moderate mixed flat HI in the right. If the HI is only in one ear, it is called a unilateral HI; if in both ears, it is called a bilateral HI. When the HI is the same for both ears, it is referred to as a symmetrical HI; on the other hand, if there is a distinctive difference between the degree of HI between the ears, it is identified as an asymmetrical HI. There are several different definitions used in the field

of audiology to determine whether the degree of asymmetry between the two ears warrants concern (Saliba, Martineau, & Chaqnon, 2009), but no universally “medically significant PT hearing asymmetry” (Zapala et al., 2012, p. 553). The number of adults who have a HI is increasing worldwide. The next section examines the prevalence and magnitude as well as the general trends of HI.

1.5.3 Prevalence of HI

According to the World Health Organization (WHO, 2013), a HI is one of the three most prevalent of all disabilities. Over 360 million people (5%) globally have a disabling HI - that is, a HI of more than 40dB HL in the better ear. Currently, 1.7% of all children, 7% of all adults older than 15 years and more than 30% of adults older than 65 are affected by a disabling HI. The number of male adults with a disabling HI exceeds the number of females by almost 40 million (WHO, 2013).

The world’s older population (defined as people older than 65 years) has been increasing for many centuries, but the rate of the increase has been accelerating (Kinsella & Phillips, 2005). Since it is also known that, as the elderly population increases, so will the number of adults with a HI (Bertoli et al., 2009) some estimate the number of people with a HI worldwide at 900 million in 2025 (Traynor, 2011).

Kochkin (2010) did a survey in the USA and estimated that 34.25 million Americans have a self-reported HI. This translates to more than 11.3% of the population and an increase of 8.8% over a four year period. A HI is not limited to the aged; it affects younger generations as well - at least 1.4 million children (younger than 18) in the USA have a HI (Traynor, 2011). Furthermore, Kochkin found that, within one generation, the population of adults (15 years and older) with a HI in the USA could grow by more than 30%. He estimated that by 2040 almost 50 million people in the USA alone could have a HI. This translates to almost 13% of the estimated population of 391 million (Pitkin & Myers, 2011). Reasons

given for this significant increase are the aging of the population and the increasing use of personal listening devices (Kochkin, 2010).

Similar trends are found in Europe. It is estimated that more than 10 million people in the UK, one in six or approximately 17% of the population, have some type of HI, and the estimates are that, by 2031, this figure would have climbed to 14.5 million. Whilst almost two thirds of the current hearing impaired population in the UK are of retirement age, i.e. older than 65, this means that more than three million are still of working age (Action on Hearing Loss, 2011). The majority of European countries have a HI prevalence exceeding 10% of the population, with Germany as high as 1 in 5 people.

The largest prevalence of HI worldwide is in the South Asian, Asian Pacific and sub-Saharan African regions (WHO, 2012). Tucci, Merson and Wilson (2010) estimated that almost 300 million people in developing countries have a moderate-to-profound HI, 50% of which could have been prevented. The WHO asserts that a HI is the “sixth greatest cause of the global burden of disease in the South Asia region” (National Foundation for the Deaf, NFD, n.d., para. 2), and that accounts for approximately 3% of the disability adjusted life years (DALY). The DALY is a method of quantifying the burden of disease, a “measure of ill-health which reflects functional limitation ...” (Anand & Hanson, 1997, p. 687), both in terms of “the time lived with the disability /disease as well as the time lost due to premature mortality” (Murray, 1994, p. 441). The index is weighted for different ages, genders and time periods. HI is grouped together with asthma, diabetes and musculoskeletal diseases in terms of burden of disability/disease and therefore should be a national health priority (WHO, 2012).

The ratios between different types of HI worldwide, according to regions, are illustrated in Figure 2 (WHO, 2011). It is important to keep in mind that there are large discrepancies in terms of classification when comparing the degrees of HI. The largest inconsistencies are

found between the Normal Hearing to MHI classification range. The WHO's databank, which includes 53 HI studies, details, amongst others, the prevalence of a MHI as well as a disabling HI from 31 countries. The HI range used to classify a MHI range from as high as 30 – 40 dB HL (Age group 6 – 13, Western Cape, South Africa) to as low as 16 – 30 dB HL (Selected states in the USA, age group 6 – 19; Pascolini & Smith, 2009). In essence, this means that having a HI of 20 dB HL (average over three frequencies, 0.5, 1 and 2 kHz) can be identified as having a MHI in the USA but normal hearing in South Africa (calculation method unknown). Similar anomalies are found when considering definitions for a disabling HI, where the lower limit ranges between 30 dB HL and 55 dB HL - the same person could be classified as having a disabling HI according to Vietnamese measures, and normal hearing according to hearing impairment measures in Sichuan Province, China (Pascolini & Smith, 2009).

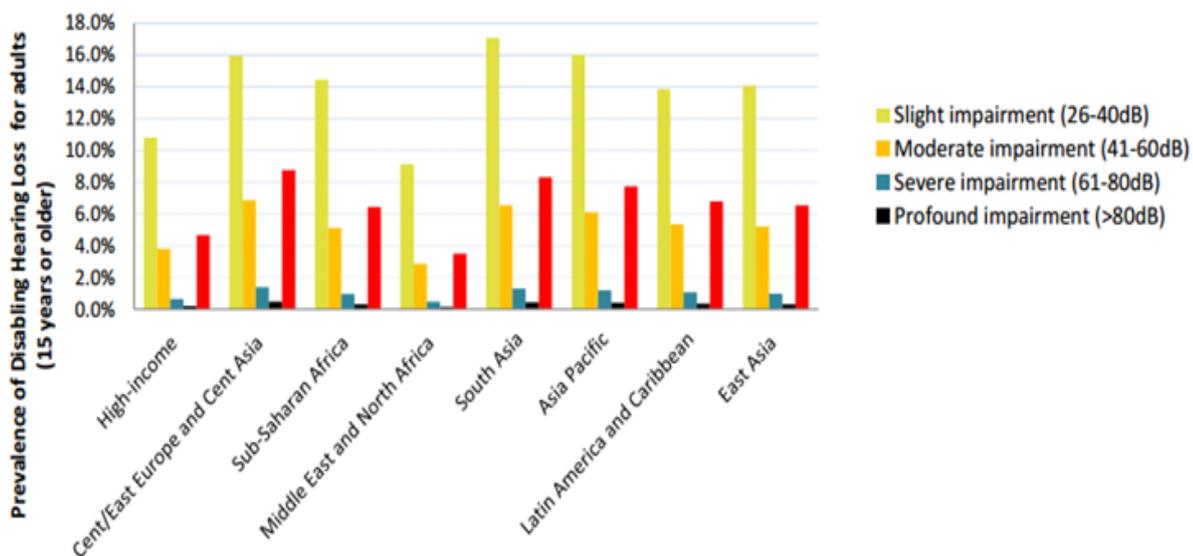


Figure 2: HI estimates by region and classification. WHO, 2011

1.5.4 Prevalence of MHI

The WHO estimates that, by far the majority of HI worldwide is mild (in terms of the Goodman scale, termed a slight impairment by the WHO). A MHI is described by this organisation as the ability “to hear and repeat words spoken in a normal voice at 1 meter”. Their recommendations are as follows: “Counselling. Hearing aids may be needed” (WHO, 2014, row 2). Yet, there has been little research focussing solely on the effect of a MHI in adults. Most research into a HI focuses on severe to a profound HI (Kochkin, 2005) and uses the HI classifications systems based on either Goodman (1965) or Jerger and Jerger (1980), where the lowest level that indicates the presence of a HI is 25 dB HL or 20 dB HL, respectively.

Digby (2012) estimated that 60% of bilateral HI in children under 19 can be classified as being mild. This is more than double the proportion of children who have a moderate HI (28%), and far exceeds the 5% severe and 3% profound HI. A large number of studies found that a MHI has a significant effect on children’s speech and language development and academic performance. Bess, Dodd-Murphy and Parker (1998) found a link between children with a MHI who were not fitted with HAs and adverse school performance, but also concluded that a MHI did not adversely affect speech/language development if the children were fitted timeously with HAs. Furthermore, Blair’s (1985) study of 24 primary school children not only supported this, but also found some evidence that the negative effect is worse for older children with an untreated MHI.

From their study on infants and children, Holstrum, Biernath, McKay and Ross (2009) proposed that infants and children with a MHI should be identified and treated as early as possible, since these children could “miss up to 50% of speech sounds” (p. 183). Holstrum et al.’s study was done in reaction to the convention that children should only be targeted if they had a moderate or worse HI - this in spite of findings that children with a MHI “can have

significant communication, academic, and behavioural difficulties” (p. 177). As early as 1978, Northern and Downs advocated that, specifically for children, having a HI should be defined at a 15 dB HL threshold, rather than 20 dB HL. This was reiterated by Clark (1981).

Figure 2 shows that more than 10% of all adults in New Zealand (classified as a High-income region) have a slight (also referred to as mild) HI. If Jerger and Jerger’s (1980) classification system were applied, where a MHI is identified as a PT-average between 20 – 40 dB HL, this proportion would, clearly, increase. However, actual New Zealand data on the prevalence on the number of people with a MHI is not available. Neither Greville (2005) nor the National Foundation for the Deaf (NFD) separate out a MHI in their reports, and hence the exact magnitude of the problem is not clear.

1.6 Demographic Characteristics of people with an HI

1.6.1 Age

It is well known that HI relates strongly to age, and as a result, there are relatively more elderly people than younger people with a HI. Helzner et al. (2005) claim that the prevalence of HI doubles for every five year increase in age, whilst Solheim (2011) found that 50% of people in their 60s, 60% in their 70s and 90% older than 80 years are affected by a HI. This is also true in New Zealand, where the prevalence of HI in people older than 65 years is approximately 3.5 times that of younger adults between 15 – 64 years old (Greville, 2005). As the general demographics in the world changes and people live longer, so will the number of older people with HI worldwide.

1.6.2 Gender

The gender distribution of HI is not clear, and seems to vary according to age. In the UK, more men than women between 40 – 80 years had a HI, whilst more women older than 80 reported HI. This could be because women’s life expectancy is higher than men’s (Baerlocher, 2007). Similar results were reported in the USA (O’Neill, 1999). On the other

hand, the WHO (2012) estimated that, of the approximately 328 million adults with a HI (older than 15 years) 56% are male and 44% are female. Data from the National Health and Nutrition Examination Survey on USA adults between 20 - 60 years (Agrawal, Paltz, & Nipoarko, 2008) suggested that the odds of having a HI were 5.5 times higher for men than for women. Helzner et al. (2005) found that males have a higher incidence of HI than females. Helzner et al.'s study was done on a sample of 2052 adults aged between 73 and 84 years old, with 46.9% of the sample male. In New Zealand, the last three census studies showed that significantly more men had HI than women. Although not conclusive, studies seem to suggest that a higher proportion of men have HI than women, and this can partly be attributed to noise induced HI (Greville, 2005; National Institute on Deafness and Other Communication Disabilities, 2008).

1.6.3 Education

In a survey done between 1990 and 1991, Ries (1994) found that people with a HI who have attained formal education (beyond secondary/ high school) are proportionally fewer than people with a HI in the general population. Whilst 19.7% of people with normal hearing had less than 12 years of education, 29.7% of those with a HI had a similar education. Fisher et al. (2011) stated that, amongst older adults who adopted HAs, both male and female adopters had more formal education than non-adopters.

In developing countries, children with a significant HI will most likely not complete primary education and hence lack work opportunities (Tucci, Merson & Wilson, 2009). The WHO (2012) found that, in general, the lower the income and literacy level of a region, the higher the incidence of a disabling HI. On the other hand, there was no correlation between education levels and HI in the sample analysed by Helzner et al. (2005). Greville (2005) found that 28% of people with a HI in New Zealand have a completed high school as their highest education, compared to 35% of the New Zealand population.

1.6.4 Race and ethnic identity

In the 1990-1991 USA National Health Survey, Ries (1994) found significant socio-demographic differences between people with and without HI. In particular, he found that White people are proportionately overrepresented amongst those with HI, and minority groups under-represented. Similar results were reported by Agrawal et al. (2008) where Black people had a 70% lower chance of having a HI than White people, and O'Neill (1999) who found that White people had more than double the chance of being hearing impaired than Black people. Helzner et al. (2005) concurred and found that a HI was the most common in White men, followed by White women, Black men and Black women. In New Zealand, 5.9% of non-Māori adults have a HI (Greville, 2005), whilst 6.1% of the Māori population have a HI (Statistics New Zealand, 2007). However, Greville found that, after adjustments were made for lower life expectancy amongst Māori, 12.1% had an HI, compared to 9.6% for non-Māori. Furthermore, the difference in the prevalence of a HI between Māori and non-Māori is more pronounced in younger age brackets than older age brackets, where the rates of a HI are approximately 3 times as high for Māori than non-Māori.

1.6.5 Work status

In general, it seems that people with a HI have poorer labour market outcomes. A report by Barker (2007) on a survey of 870 people who are deaf or hard of hearing found that 63% were employed, as opposed to 75% of the general UK population, and that 1 in 5 of those surveyed were looking for a job, compared to 1 in 20 in the general population. In Scotland, people with a severe HI were four times more likely to be unemployed than those without HI, even in a time where unemployment was virtually nil (Barker, 2007). Greville's (2005) research in NZ found that unemployment is disproportionately higher and income is disproportionately lower in the HI population than in the general population.

1.7 Effect of HI on Health Related Quality of life (HRQoL)

Quality of life (QoL) refers to a person's self-assessment of current life experience, and includes concepts such as enjoyment, freedom, purpose and independence (Boothroyd, 2007). Although defining HRQoL seems intuitive, there is no universal definition. However, there seems to be some common understanding of the domains that fall within this realm – physical, psychological, social interaction and economic/vocational (Abrams, Chisolm, & McArdle, 2012), thus within the AL and PR domains of the ICF model. HRQoL is usually determined by making use of questionnaires – either generic or disease specific (Swan, Guy & Akeroyd, 2012; Abrams et al., 2012). In 2003, Dalton and colleagues used standardised audiometric tests as well as self-reported measures (HHIE-Screening version) to determine the relationship between a HI and QoL. They found that, as the severity of the HI increased, so did difficulties in terms of communication, mental and physical abilities (Dalton, Cruickshanks, Klein, & Klein, 2003).

Communication is an essential part of daily life. Several studies have documented the effect of an untreated HI and found that it has a profoundly negative effect on communication, social interaction, cognitive functioning and psychosocial functioning (Montano & Spitzer, 2009; Dalton et al., 2003; Arlinger, 2003; Oyer & Oyer, 1979). A HI should be seen within the context of the significant other since they are as relevant as the person who has a HI (Kramer, Alessie, Dondorp, Zekveld, & Kapteyn, 2005). Often people with a HI are not self-motivated to address their HI, they are motivated by a significant other (Mahoney, Stephens & Cadge, 1996; Wilson & Stephens, 2003; Kochkin, 2012).

Having a HI means a reduced ability to hear everyday sounds, such as doorbells, telephones, sounds in nature or the traffic. In addition, people with a HI have to ask for repeats when spoken to. This is not only humiliating, but also tiring and leads to withdrawal from participating in activities where hearing is essential (Thomas & Herbst, 1980). If people

are not intellectually and culturally stimulated, they become withdrawn, passive, isolated and often depressed (Arlinger, 2003; Nobel, 2009). In addition, researchers have found a positive correlation between a HI and the risk of dementia (Lin et al., 2011; Arlinger, 2003). A HI also affects relationships, where both the person with the HI as well as their partner feel frustrated by the lack of communication (Kelly-Campbell & Parry, 2014).

It is not clear what the complete economic impact of a HI is. In 2010, Sergei Kochkin (2010) surveyed more than 40 000 households in the USA and found that an untreated HI could decrease the household income by as much as US\$ 30 000 p.a. That translated to a total loss in excess of US\$ 176 billion p. a. for families, or a \$26 billion loss in taxes for the country. According to this research, at all HI levels, an untreated HI leads to significant underachievement in the workplace, and the more severe the HI, the larger the effect on income. The likelihood of a person with an unaided HI being unemployed is significantly greater than a person with normal hearing (Action on Hearing Loss, n.d). The effect of an untreated HI can have far-reaching implications for a person's QoL and is predominantly related to the inability to communicate and the effects thereof.

1.8 Management of HI

On average, people wait more than ten years from noticing a HI to attempting aural rehabilitation (Davis et al., 2007). Aural rehabilitation is defined by Boothroyd (2007) as the “reduction of hearing-loss-induced deficits of function, activity, participation, and quality of life through a combination of sensory management, instruction, perceptual training, and counselling” (p. 63). Since it is currently not possible to restore hearing biologically, the main instrument for rehabilitation is a hearing aid (HA). Vuorialho, Karinen, and Sorri (2006) found improvements in speech reception threshold and word recognition scores after HA use, as well as an improvement in QoL, general functioning, and interpersonal relationships. Although a HA can never restore hearing to pre-loss levels, significant positive results have

been documented (Chisolm et al., 2007). Many of the benefits of HA use are determined by making use of self-reported measures, such as questionnaires.

1.8.1 Positive effects of HA adoption

From a survey of more than 2000 people with a HI and 1700 of their family members, Kochkin and Rogin (2000) concluded that HA users see improvements in their “physical, emotional, mental and social well-being “(p. 1). They found that HA users, compared to non-users, were more likely to communicate with other people, to experience more interpersonal warmth in relationships and less frustration, and to be emotionally more stable (Kochkin and Rogin, 2000). The authors also found positive relationships between HA usages and greater earning power, reduction in communication difficulties and social phobias, and improved cognitive functioning and locus of control.

Furthermore, Choi, Shim, Lee, Yoon and Joo (2011) found that, in a group of 18 participants between the ages of 60 and 80 years, their speech-related cognitive function improved significantly after wearing HAs for 6 months. Chisolm et al.’s (2007) report reviewed 16 studies on HRQoL benefits of amplification in adults, and concluded that HAs improve adults’ HRQoL by decreasing the negative psychological, social and emotional effects of an HI. HAs can improve social, emotional and communication problems caused by a HI and this improvement could be experienced within six weeks of fitting (Mulrow, Tuley, & Aguilar, 1992).

Amplification also has economic implications. In addition to the possibility of being unemployed, employees with a hearing impairment struggle to hear their clients or supervisors and are more likely to make mistakes than their colleagues with normal hearing. Kochkin (2010) found that 90% – 100% of the income differential between people with a MHI who are unaided and normal hearing people can be eliminated by wearing HAs, and 65% – 77% of the income differential for people with a severe HI.

1.8.2 Outcome measures

The audiogram and audibility index (a measure of speech information which the client can hear) are two of many aspects to consider when counselling a client on the way forward regarding audiological rehabilitation. However, these results are not the only considerations when determining whether a client is a suitable HA candidate. Demorest and Walden (1984) include non-sensory items, such as “overall emotional adjustment, and the behaviour and attitudes of friends and family...” (p. 226) as important factors to consider. Whilst one goal of amplification is to improve the client’s access to sound, audibility does not necessarily result in an improvement in communication or interaction. Whilst objective testing, i.e. the PT audiogram and speech testing, assess an impairment, these tests do not assess AL and PR; self-assessment instruments are available to assess these (Johnson, 2012).

Cox (2003) professed that self-assessment measures of benefit and outcome in real world situations are essential. She gave three reasons for this. First, there are economic reasons. Health care has become consumer-driven and consumers need to know what the benefit of HAs will be. Second, real world situations cannot be mimicked in a clinical setup and clients need to report back their HA experiences outside the clinic. Lastly, each client has a different experience of actual real-world situations and each client should rate their unique experiences. Outcome measures compel clients to reflect on areas of hearing difficulty previously ignored, which can then be used to improve their hearing situation. Furthermore, questionnaires can produce a wealth of information for audiologists. Frattali (1998) identified six areas where outcome measures can be used: clinically driven, functional, administrative, financial, social and patient defined. The procedure is standardised, results can be measured, quantified, analysed and statistically evaluated and adjustments can be made if needed (Skinner, 1988). When questionnaires are normed – that is, the results can be compared to a

reference group, this adds to the value of the outcome measures as it tells the professional what is typical and atypical for the target group (Demorest & DeHaven, 1993).

There are shortcomings with the use of self-assessment. Kelly-Campbell et al. (2012) noted the following limitations of self-reported questionnaires: (1) these types of questionnaires assume that people are aware of their own perceptions; (2) the questionnaires are only valid for the population on which it was created; and (3) self-report assumes that the client is able to understand the content and does not allow for a poor level of health literacy. Furthermore, the usefulness of self-assessment information in health depends on psychometric properties, such as reliability and validity of the questionnaire; the mode and feasibility of administration, i.e. self-completion or interview; relevance to the specific health condition and client; and the fact that subjective questioning is prone to bias (McColl et al., 2001; McDowell, 2006).

The Hearing Handicap Scale, developed in 1964, and the Hearing Measurement Scale, developed in 1970, were two of the first self-reported inventories developed as a supplement to standard audiometric measures (McDowell, 2006). Initially, self-assessment instruments for audiological purposes focussed on hearing abilities or problems, but now also include, amongst others, evaluating the benefits of HAs (Demorest & DeHaven, 1993; Cox & Alexander, 1999). Boothroyd (2007) emphasised the importance of assessing the effectiveness of an intervention by ensuring that the choice of instrument reflects the goal of the intervention. Outcome measures are effective ways of determining the effects of HAs on people's lived experiences of the HAs.

1.8.2.1 Satisfaction with Amplification in Daily Life (SADL)

The Satisfaction with Amplification in Daily Life (SADL; Cox & Alexander, 1999) is a multi-dimensional instrument consisting of 15 questions related to hearing aids. It is aimed at evaluating four different aspects of satisfaction (Positive Effect, six questions; Service and

Cost, three questions; Negative Features, three questions and Personal Image, three questions), and it also includes a Global score (<http://www.harlmemphis.org/>). Questions use a seven-category scale ranging from low (Not at all) to high (Tremendously), with a higher score indicating greater satisfaction (McLeod & Upfold, 2003). The original authors found a high Global score test-retest correlation coefficient ($r = 0.81$) as a measure of reliability of this instrument (Cox & Alexander, 1999). Hosford-Dunn and Halpern (2001) believe that the SADL could “serve as a gold standard for satisfaction outcomes and a basis for development of a predictive model of hearing aid fitting success” (p. 15). The SADL measures HA outcomes; therefore it is a useful information source for consumers.

1.8.2.2 Hearing Handicap Inventory for the Elderly (HHIE)

The HHIE (Ventry & Weinstein, 1982) was initially designed for adults aged 65 years and older. The authors describe handicap as “a multifaceted phenomenon comprised of at least three important dimensions: social/situational effects, emotional response to an HI, and sensitivity problems” (p. 129). The HHIE was designed to “assess self-perception of (a person’s) hearing handicap, identify communication problems and evaluate pre-and post-treatment” (Skinner, 1988, p. 317). It consists of twenty five questions, 13 of which measure the perceived effects of a HI on social situations, and 12 of which relate to the emotional consequences of a HI (Johnson, 2012). Patients select either yes (4 points), sometimes (2 points), or no (0 points) in response to each question, and answers are scored. Total scores range from 0 points (no hearing handicap) to 100 (maximum hearing handicap) – the higher the score, the more significant the problem (Ventry & Weinstein, 1982). The HHIE has a reliability coefficient of 0.88 – 0.95 and the two subscales have a correlation value of 0.87 (Skinner, p. 317).

1.8.3 Non-Adoption of HA

Hearing aid adoption refers to the actual purchase or acquisition of HAs. HA adopters are not necessarily HA users, since a significant proportion never actually use their HAs (Kochkin, 2005). Even though the value of amplification for people with a HI has been well researched and documented, studies consistently show that very few people who will benefit from a hearing aid, own one. (Hartley, Rochtchina, Newall, Golding, & Mitchell, 2010; Smeeth et al., 2002; Kochkin, 2012; Chao & Chen, 2008). The WHO (2006) estimate that, with proper fitting of HAs, communication can be improved in 90% of people with HAs, yet only one out of five people who would benefit from a HA, own one (National Institute on Deafness and Other Communication Disabilities, 2008). In addition, it was estimated by Chien and Lin (2012) that, between 1999 and 2006, 14.2% of Americans older than 50 years of age who had a HI wore hearing aids. However, this figure drops to fewer than 4% of individuals with a MHI over the same period. The authors estimated that 22.9 million older Americans who have a HI do not wear HA's. Similar results were found in a study of a group of USA adults, 70 years and older, of whom 63.1% had a HI (Lin, Thorpe, Gordon-Salant, & Ferrucci, 2011). The authors found that only 40% of those with a moderate HI and 3.4% with a MHI wore HAs. These findings are also echoed in the results documented by Popelka et al. (1998), Smeeth et al., Chia et al., (2007), and Gopinath et al. (2011). When considering the rate of non-adoption in New Zealand, Greville (2005) found similar trends. Twenty eight percent of adults with a HI in this country own HAs (Greville, 2005).

1.8.4 Considerations in HA adoption

Given that HAs have the potential to address many of the problems caused by an HI, it is important to understand why there is such a large number of people who recognise that they have a HI but still choose not to adopt HAs. The reasons are numerous, and include "stigmatization, insufficient awareness of hearing difficulties, underestimated handicap,

alternative coping strategies, personality, low trust in the benefit from hearing aids, cognitive and functional restrictions, costs, and false expectations” (Meister, Walger, Brehmer, Von Wedel, & Von Wedel, 2008, p. 153). Jenstad and Moon (2011) did a systematic review on the literature on HA adoption, and found seven common research themes across the literature. These are: a) self-reported HI; b) stigma; c) degree of HI; d) personality/psychological factors; e) cost; f) age; and g) gender. These themes are discussed below.

1.8.4.1 Self-reported HI

The first common research theme on HA adoption was self-reported hearing loss (Jenstad & Moon, 2011). The authors argue that, if someone does not consider their hearing poor enough to affect their QoL, they are more likely to reject HAs. However, if they experience that their HI causes PR, their attitudes towards HAs change (van den Brink, Wit, Kempen, & Heuvelen, 1996).

According to Duijvestein et al. (2003), only 57% of those diagnosed with a HI considered their hearing to be poor. This finding is supported by van den Brink et al. (1996) who found that adults with a HI who did not make use of audiological treatment perceived their HI as relatively insignificant and demonstrated a passive acceptance of HI. In addition, non-adopters state that they do not believe hearing aids are necessary (Gopinath et al., 2011; Bertoli et al., 2009; Lupsakko, Kautiainen, & Sulkava, 2005). These findings are replicated in the work of Fischer et al., whose Epidemiology of Hearing Loss Study found that for approximately 60% of non-adopting participants, the reason given mostly was “the perception that the aid was unnecessary” (2011, p. 1453). Similar results have been reported in other studies. In 1998, in a survey of adults older than 50 years, almost 70% of the hearing impaired respondents stated that “their hearing was not bad enough to need an aid or that they could get along without one” (p. 1453). People’s perception of their HI is a significantly

better predictor of HA adoption than audiological results (Palmer, Solodar, Hurley, Byrne, & Williams, 2009; Laplante-Lévesque, Hickson, & Worrall, 2012).

1.8.4.2 Stigma

Stigma was the second common theme on HA adoption identified by Jenstad and Moon (2011). The embarrassment of having a HI has led many people to simply deny the problem (Héту, Riverin, Getty, Lalande, & St-Cyr, 1989; Héту, 1996). According to these studies, because of the stigma attached to an HI, those affected would minimise the problem, be uncomfortable talking about it and rationalise why they had problems hearing in certain situations. Johnson et al. (2005) found that first-time and previous HA owners rated visibility of the device as very important in making their choice of style – cosmetics and stigma were the factors rated over comfort and technology as most important regarding overall image of HAs for both groups. Kelly-Campbell and Plexico (2012) interviewed 12 couples about their experiences living with HI. They found that older and younger adults with HI as well as their significant others cited the stigma attached to HI and to ageing as reasons for not adopting and or not wearing HAs. Whilst many authors refer to stigma with reference to HA uptake (Franks & Beckmann, 1985; Garstecki & Erler, 1998; Kochkin, 2007; Meister, et al., 2008; Wallhagen, 2010), it is not necessarily a predictor of HA uptake. On the one hand, Franks and Beckmann (1985) found that stigma is the highest concern among people surveyed. On the other hand, Meister et al. found that the expectation that HAs would have a positive effect on QoL overshadowed the expectation of HA stigma. Stigma may also be gender-dependent - it was the greatest concern for male non-adopters in Garstecki and Erler's (1998) study.

1.8.4.3 Degree of HI

For many people, it is not the degree of a HI *per se* that prompts help-seeking or hearing aid adoption (Swan & Gatehouse, 1990). Duijvestin et al. (2003) found no significant

differences between the mean PT thresholds between consulting and non-consulting adults. These findings are supported by Garstecki and Erlen (1998), who found no significant difference in audiometric thresholds between male participants with a HI who adopted hearing aids and male participants who did not. Kochkin (2012) found that one of the main reasons for adoption was the perception that the HI was getting worse – indicating that perhaps people were not adopting earlier because they felt their HI was not bad enough. Similar findings were also reported by Helvik, Wennberg, Jacobsen and Hallberg, (2008) and Humes, et al. (2003). Robertson, Kelly-Campbell and Wark (2012) compared clinical charts for 3 groups of adults who consulted for services: (a) those who purchased hearing aids and continued wearing them for at least 1 year, (b) those who purchased hearing aids but rejected them, and (c) those who did not follow the recommendation to purchase hearing aids. The groups were not significantly different in terms of degree of HI or ability to understand speech in quiet settings. However, they were significantly different in terms of their ability to understand speech in noise. It could be argued that AL and PR, as defined in the ICF model, are important factors in the decision to adopt HAs, as opposed to the HI per se.

1.8.4.4 Personality/psychological factors

Cox, Alexander and Gray (2005) used personality profiling and found that HA adopters had higher levels of internal locus of control than the general population. Locus of control measures how people perceive life events and the cause thereof. When they have a high internal locus of control, they experience more control over their lives (Laplante-Lévesque et al., 2012; Cox, et al., 2005), are more forgiving, generous and tolerant, more conventional and practical, and they are calm, confident and optimistic (Helvik, *et al.*, 2008). People with a high external locus of control believe that others or fate control their lives (Laplante-Lévesque et al.), and tend to be less inclined to adopt HAs (Allan & Kelly-Campbell, 2013).

In addition, the use of HI coping strategies was also a predictor of HA adoption. Cox et al. (2005) found that HA adopters were more pragmatic and preferred routine, needed less social support and were not prone to avoidance. People with a mild to moderately severe HI seek amplification partly because they were not able to solve their hearing problem with any other strategy (Helvik, *et al.*, 2008; Cox, et al., 2005).

Anxiety, depression and obsession were also identified as personality traits that will affect HA adoption and the perception of HA benefit (Gatehouse, 1994). Kelly, Neimeyer and Wark (2011) reported that cognitive anxiety can be one of the motivations for seeking audiological service. The authors found that an individual with a HI experiences anxiety when not being able to anticipate how, when or where in a conversation there will be a communication breakdown.

1.8.4.5 Cost

Whilst socio-economic status and income levels are not significantly related to HA adoption, research suggests that the perception of the cost of hearing aids may influence people's decision to adopt. Garstecki and Erlen (1998) found that non-adopters were more likely to express concern about the costs of hearing aids than those who adopted hearing aids. This finding is supported by Kochkin (2007) who reports that 76% of the respondents in his survey mentioned financial constraints as a barrier to hearing aid adoption. Forty-nine percent of those respondents indicated that unaffordability was the definite reason for not getting hearing aids and more than half (52%) indicated high maintenance cost as a reason for non-adoption. Finally, Fischer et al. (2011) identified cost as a reason cited by almost 60% of participants for not adopting hearing aids. Yet, the conclusion of Meister et al. (2008) was that cost is not necessarily a significant predictor of HA adoption. Laplante-Lévesque et al, (2010) found that eligibility to receive a government subsidy for a HA was not a significant uptake predictor.

Kochkin (2007) distinguishes between people who cannot afford HAs, even if they want to acquire HAs, and those who use cost as a reason not to adopt HAs, even if they can afford the HA. For the former, affordability is a concern, whilst for the latter, the perceived worth of the HA does not warrant paying the price of the HA. This is supported by Humphrey, Herbst and Faurqi (1981) who found that, even when HAs were state-funded, it did not seem to increase the number of HA adopters, supporting the notion of the perceived worth of the HAs.

1.8.4.6 Age

Although there is a positive relationship between age and a HI (Hildago et al., 2009; Helvik et al., 2008), HA uptake decreases with age (Uchida et al., 2008). In New Zealand, Greville's study found that the proportion of people with a HI who have hearing aids increases with age, and the proportion of people with a HI but without an HA decreases with age. According to Gopinath et al., (2011) older age is a significant predictor of HA ownership and/or use.

1.8.4.7 Gender.

It has been suggested that proportionally more males than females have HI, but in absolute numbers, because females generally live longer than males, females with a HI exceed males (Stephens et al. 2001; Smeeth et al. 2002; Helzner et al. 2005; Lupsakko et al. 2005). In addition, Hildago's study (2009) found that males reported the need for HAs more than females. However, according to Jacobson, Newman, Fabry, and Sandridge (2001), females are more dependent on social communication than men and seem to be more aware of their problem, hence they are more likely to acknowledge that they have a HI (Garstecki & Erler, 1998) and seek help (Jacobson et al.). It is not clear whether there are any significant differences between male and female HA use. Smeeth et al. and Bertoli et al. (2009) found that women used HAs more than men. On the other hand, research has indicated no

difference between genders in terms of HA use (Popelka et al., 1998; Lupsakko et al.; Staehelin, et al., 2011).

1.9 HA adoption and MHI

There are no definitive studies on the reason for the low uptake of HAs in MHI. The purpose of this study is to investigate whether the reasons would be similar to those found in general HA use and ownership studies – cost, and the belief by many that they do not need an HA (see Gopinath et al., 2011, Bertoli et.al. 2009; Lupsakko, Kautiainen, & Sulkava, 2005), or whether the motivation of people with a MHI to adopt HAs is significantly different. Even when a person has a mild HI, it is imperative that it is identified early and, if necessary, treated. This could reduce the amount of time that people take to come to terms with their HI, and assist in the adjustment to HAs. If people adopt HAs sooner rather than later, it is easier to adapt to them (David et al., 2007).

1.10 Research aims questions

The aims of this study were twofold. The first aim was to identify demographic, audiometric and QoL differences between adults with a MHI who adopt HAs and adults with a MHI who choose not to adopt HAs. The second aim was to measure clinical outcomes for adults with a MHI who adopt HAs.

Chapter Two: Method

This study was done in conjunction with New Zealand's largest private hearing practice group which has clinics on both the South and North Islands. The clinics on New Zealand's South Island were targeted for this prospective study. There are 25 clinics on the South Island, and all the clinics were included in this study. The research period started on 5 July 2013 and ran for a 5-month period. The research team consisted of me, as the primary researcher, a Senior Lecturer at the University of Canterbury, and a senior audiologist from the audiology clinic group. Data were collected by audiologists at different clinics throughout the South Island of New Zealand.

2.1 A Priori Power Analysis

We determined the required sample size using *a priori* power analysis. Conventional research procedure dictates a level of significance at 0.05 and statistical power of 80%. We used an effect size of 0.5. Based on this information, we required 25 participants in each group.

2.2 Participants

We used convenience sampling (also called accidental sampling, Salkind, 2010). This type of nonprobability sampling is often used because of the convenience and availability of the possible participants, as was the case in this study. In order to be included in the study, participants had to: (a) be over the age of 18, (b) have a HI acquired as an adult (c) be willing to participate by completing self-assessment questionnaires, and (d) have a PT average threshold at 0.5, 1, 2 and 4 kHz between 20 to 40 dB HL in the better hearing ear. No other inclusion criteria were stipulated. A total of 38 participants were recruited and included in the study. Of these, 13 (34%) decided to adopt HAs whilst 25, approximately 66%, decided not to adopt HAs. Although the number of adopters fell short of the 25 required, we decided to

go ahead with the study. We were mindful of the fact that the study was underpowered when we did the analysis and discussed the findings.

2.3 Procedure

All clients in the participating clinics were deemed potential study participants and were given the MHL Study History Form (Appendix A) to complete before their appointment. After clients had had their diagnostic hearing assessment, and clinicians found that they had met the inclusion criteria, they were invited to join the study and given the project information sheet. If they agreed to participate, they were then given the consent form and demographic questionnaire (Appendix B and C) to either complete in the waiting room or return at their next appointment.

During the first appointment, the hearing assessment, clinicians completed: (a) New Client Questionnaire (if this was the first time the client visited the clinic group); (b) Demographic Information form; (c) otoscopy and tympanometry; (d) PT air and bone audiometry; (e) speech in quiet testing; (f) speech in noise testing; and (g) pre-fitting HHIE. If clients did not wish to trial HAs, their participation in the study was complete. The consent forms were posted to us, as researchers, for secure storing and scanned copies of the demographic questionnaire; history form and audiogram were emailed to us.

If a client decided to trial HAs, they were offered a free trial. This is not the standard procedure for this practice. Typically, clients who, after the trial period, decide not to adopt the HAs have to pay a fitting fee. In an attempt to increase the likelihood that clients would trial hearing aids, all clients, regardless of the degree of hearing loss, were offered this option. This potentially benefited clients, who may not have otherwise trialled hearing aids. Clients were then guided and assisted, according to the clinic's protocols, to choose a hearing aid which would meet their needs best.

Appointments for fitting the hearing aid as well as follow-up appointments were made. As is dictated by the clinic's protocol, the number of follow-up appointments depends on the needs of the client, but usually there will be at least one follow-up appointment before finalisation. The HAs were finalised when the client felt confident that they were satisfied with their choice of HAs, or had decided not to adopt HAs and returned them. If clients decided to keep HAs, they were asked to complete the HHIE post-fitting questionnaire as well as the SADL questionnaire. Clients were given the option of either completing the forms in the waiting room, or taking the forms home to complete in their own time. If the latter was chosen, they were supplied with a postage-paid envelope. Finally, the MHL study hearing aid information form was completed. The hearing aid adopters therefore also completed the following forms at the finalisation appointment: (a) post-fitting HHIE; (b) SADL questionnaire; and (c) Study HA information.

2.4 General Information

2.4.1 Case History Information

During the first visit and in accordance with the clinic's protocol, the clinician took a detailed history of the client during the first visit. This included questions about the reason(s) for the clinic visit as well as hearing-health related questions. Clients were asked to rate their overall hearing ability on a scale of 1 to 10 (1 being poor and 10 being excellent). They were also asked to rate, on a similar scale, the importance of improving their hearing at that time (1 being not at all important to 10 being very important).

2.4.2 Demographic Information

In addition to the case history information sheet, clients completed a demographic information sheet. Clients were asked to estimate the length of time that they had been having difficulty with hearing. They were also asked to provide details about previous hearing aid ownership. In order to determine socio-economic status, clients were asked to comment on

their work status and their highest qualification level. The decision about adopting HAs and the type of HAs needed depends on hearing needs, therefore clients were asked about their living situation. Options included living alone, living with a partner, living in an extended family or living in a retirement home.

2.5 Audiometric Measures

Three audiometric variables were used in this study, namely PT audiometry, speech in quiet and speech in noise.

2.5.1 PT Audiometry

Clinicians performed otoscopy to determine the status of the ear canal and visualise the tympanic membrane, and tympanometry, to determine the middle ear status. After that, they completed bilateral pure-tone audiometry. Calibrated 2-channel Interacoustic AC33 or MedRx Avant audiometers with either insert ER 3-A or TDH 39 headphones were used for air conduction thresholds and Radioear Type BC 71 bone conduction vibrators for bone conduction thresholds. Instruments were calibrated in accordance to the NZAS guidelines, meeting either ANSI S3.7-1995 (R2003) or IEC 60645-1 2001 standards. Audiometric measures were obtained in sound-treated rooms meeting the ANSI standard for maximum permissible ambient noise for audiometric test rooms (ANSI S3.1-1999 (R2003), Wilber & Burkard, 2009). Air conduction thresholds were obtained at one octave intervals from 250 to 8000 Hz. Inter-octave thresholds were obtained in cases where the thresholds between adjacent octave frequencies differed by 20 dB or more. Bone conduction thresholds were obtained at 500, 1000, 2000 and/or 4000 Hz in cases where the PT thresholds at those levels were above 20 dB HL. Contralateral masking was applied where required.

The severity of the HI was determined by finding the pure tone average of the air conduction thresholds at 500, 1000, 2000 and 4000 Hz of the better ear. A lower value

indicated the better ear. If both values exceeded 40 dB HL, or were below 20 dB HL, the HI was not suitable for this study and clients were excluded.

2.5.2 Speech Audiometry

Two different speech audiometry tests were administered; the Arthur Boothroyd (AB) word list test and the QuickSIN test.

2.5.2.1 Speech recognition in quiet

The AB wordlist test is the standard test used for obtaining speech recognition in quiet in New Zealand. Clinicians used the standardised recording of a native New Zealand speaker for this test. The AB word list test consists of twelve lists of ten meaningful CVC (Consonant-Vowel-Consonant) words, presented monaurally to clients. The same earphones as for the PT testing were used and the better ear was tested first. Clients' performance is scored according to correct repetition of each phoneme. Ten points are awarded for a correct repetition of the entire word, seven points if one phoneme is incorrectly repeated, three points when two phoneme mistakes are made, and zero points if more than two phoneme errors occur. The PB Max (dB HL value where 100% or near 100% was scored) is recorded (Boothroyd, 1968).

The initial presentation level was at approximately 30 dB higher than the PT average. The AB word list test was repeated at a presentation level of between 15 – 20 dB HL lower than the PT average in order to determine the PB Half Peak Level (where the score is 50% of the PB Max). This level is considered the threshold of speech. Contralateral masking was used when necessary.

2.5.2.2 Speech in noise

Whereas a hearing loss indicates by how much a sound should be increased (in dB) to be audible, SNR-loss indicates how much the SNR should be increased for a person to understand correctly 50% of words, sentences or words in sentences. Two people with similar

PT audiograms may have very different SNR losses, resulting in completely different hearing experiences (Killion & Niquette, 2000). It is important for clinicians to know their client's SNR, for setting realistic expectations as well as for choosing the correct technology (Killion, Niquette, Gudmundsen, Revit, & Banerjee, 2004). Several tests exist to measure a client's SNR. The QuickSIN-test was used in this study.

The Speech in Noise (SIN) test was originally developed to determine the level of difficulty experienced by a listener in understanding speech in a noisy situation – i.e. SNR (Killion & Vilchur, 1993; Killion et al., 2004). The test combines a female talker of the Institute of Electrical and Electronics Engineers (IEEE) sentences (Rothausen et al., 1969) as a signal, with four-talker babble (Killion et al.). Each IEEE sentence consists of five phonetically balanced key words (Rothausen et al., 1969). Six sentences, at decreasing 5dB SNR steps, are presented to the clients. The words are scored (one point for each correct word) and the total is then subtracted from 25.5. The final answer represents the value of the client's SNR loss.

The QuickSIN test was developed as a quicker and simpler alternative to the SIN test. The QuickSIN consists of 12 sets of six sentences with one sentence presented at each adjusted signal-to-noise ratio of 25, 20, 15, 10, 5, and 0 dB (Killion et al., 2004). When only one set of six sentences is presented to a client, the predicted standard deviation is 1.9 dB with a 95% confidence interval of +/- 2.7 dB. The confidence interval as well as the standard deviation can be improved if multiple lists are presented and averaged (Etymotic Research, 2001; Killion et al.). For this study, one practice and two test lists were administered binaurally with the presentation level at 70 dB HL. The SNR loss was determined by averaging the results from the two test lists. This resulted in a confidence interval of +/- 1.4 dB. There are no standardised recordings of native New Zealand speakers for the QuickSIN, so the original Etymotic recording was used for this study.

2.6 Outcome Measures

Two outcome measures were administered, the HHIE and the SADL. The HHIE pre-test was completed by all participants, and the HHIE post-test, as well as the SADL, was completed by HA adopters.

2.6.1 HHIE

For every 'yes' clients marked they were given four points, 'sometimes' was awarded two points, and 'no' received zero points. The two subscales as well as a total score were calculated for each client by adding the points for each. Results were then entered into a Microsoft Excel spreadsheet where all the information for each client was recorded. The scores were analysed with SSPS. We (1) compared pre- scores between the groups and (2) compared pre and post total scores. The authors determined the level of clinical significance to be an 11.9 point difference between pre and post total scores.

2.6.2 SADL

SADL questions were manually scored according the scoring guide (<http://www.harlmemphis.org/>). Totals for each subscale as well as the global score were entered on the Excel spreadsheet, and analysed with SSPS. Results were compared to normative data (Cox & Alexander, 1999).

2.7 Statistical Methods/Data analysis

The study design is a cohort non-randomised/non-controlled study using non-parametric statistical analyses. Because the participants chose to adopt or not adopt HAs, associations and trends can be identified, but it is not possible to determine cause and effect relationships. Variables other than the independent variables being tested could influence the results, and taint the reliability of the results (Portney & Watkins, 2009; Shiavetti & Metz, 2006).

The overall sample size was smaller than the sample size determined by the *a priori* analysis. In addition, there was a substantial difference in the group sizes. Small and uneven sample sizes in each group lead to non-normal sampling distributions and lack of homogeneity of variance. Because the assumptions of parametric tests had been violated, we used non-parametric models to test our hypotheses. The following research hypotheses were tested using Chi Square or Mann-Whitney U tests.

Hypothesis 1: There are significant differences between hearing aid adopters and non-adopters based on demographic variables.

(a) There is a significant difference between hearing aid adopters and non-adopters based on age. Specifically, participants who adopt HAs are significantly older than participants who do not adopt HAs.

(b) There is a significant difference between hearing aid adopters and non-adopters based on gender. Specifically, significantly more males adopt HAs than females.

(c) There is a significant difference between hearing aid adopters and non-adopters based on level of qualification. Specifically, HA adopters are significantly better qualified than non-adopters.

(d) There is a significant difference between hearing aid adopters and non-adopters based on race and ethnic identity. Specifically, significantly more participants who adopt HAs are Māori than non-Māori.

(e) There is a significant difference between hearing aid adopters and non-adopters based on living situation. Specifically, significantly more participants who adopt HAs are living with somebody than participants who do not adopt HAs.

(f) There is a significant difference between hearing aid adopters and non-adopters based on work status. Specifically, significantly more participants who adopt HAs are working full-time than participants who do not adopt HAs.

(g) There is a significant difference between hearing aid adopters and non-adopters based on length of hearing loss. Specifically, HA adopters report noticing their HI for a longer period than non-adopters.

Hypothesis 2: There are no significant differences between hearing aid adopters and non-adopters based on objective audiometric variables, but significant differences between hearing aid adopters and non-adopters based on subjective audiometric variables.

(a) There is no significant difference between hearing aid adopters and non-adopters based on SNR loss.

(b) There is no significant difference between hearing aid adopters and non-adopters based on the better ear PTA.

(c) There is no significant difference between hearing aid adopters and non-adopters based on the worse ear PTA.

(d) There is a significant difference between hearing aid adopters and non-adopters based on participants' own perception of their HI. Specifically, participants who adopt HAs rate their HI significantly higher on the ten-point scale (worse) than participants who do not adopt HAs.

(e) There is a significant difference between hearing aid adopters and non-adopters based on participants' need to change their hearing situation. Specifically, participants who adopt HAs rate the importance of changing their current situation significantly higher on the ten-point scale (more important) than participants who do not adopt HAs.

(f) There is a significant difference between hearing aid adopters and non-adopters based on prior HA use. Specifically, prior HA use is a significant predictor of HA adoption.

Hypothesis 3: There are significant differences between hearing aid adopters and non-adopters based on quality of life variables.

(a) There is a significant difference between hearing aid adopters and non-adopters based on the HHIE (Emotional scale). Specifically, participants who adopt HAs score significantly higher on the HHIE (Emotional scale) than participants who do not adopt HAs.

(b) There is a significant difference between hearing aid adopters and non-adopters based on the HHIE (Social scale). Specifically, participants who adopt HAs score significantly higher on the HHIE (Social scale) than participants who do not adopt HAs.

Hypothesis 4: Participants who adopt HAs show clinically significant improvements on the HHIE (Total scale) following hearing aid fitting. Specifically, participants have a difference of 12 points or more on their pre- and post-HHIE scores.

Hypothesis 5: Participants who adopt HAs show SADL scores within or above the normative range following hearing aid fitting.

(a) Participants who adopt HAs show SADL (Global) scores within or above the normative range (4.3 – 5.6).

(b) Participants who adopt HAs show SADL (Service and Cost) scores within or above the normative range (4.0 – 5.7).

(c) Participants who adopt HAs show SADL (Positive effect) scores within or above the normative range (3.8 – 6.1).

(d) Participants who adopt HAs show SADL (Negative effect) scores within or above the normative range (2.3 – 5.0).

(e) Participants who adopt HAs show SADL personal image scores within or above the normative range (5.0 – 6.7, Cox & Alexander, 1999).

2.8 Ethical considerations

The project proposal was reviewed and approved by the University of Canterbury Human Ethics Committee on 15 June 2013. This study was not required to undergo Health and Disability Research Ethics Committee (HDEC) review.

Chapter Three: Results

3.1 Sample characteristics

In total, 38 participants took part in this study. Recognising that the use of non-parametric statistics and smaller than required sample size reduces the statistical power of the study, we gave special attention to the trends in the data.

3.2 Demographic Variables

Demographic variables for the sample are shown in Table 1. We used a 1-tailed Mann-Whitney U-test to test hypothesis 1a: there will be a significant difference between hearing aid adopters and non-adopters based on age. Chi-Square tests were used to test hypothesis 1 b-g: there will a significant difference between hearing aid adopters and non-adopters based on gender, level of qualification, race and ethnic identity, living situation, work status, and length of hearing impairment.

We hypothesised that there would be a significant difference between hearing aid adopters and non-adopters based on age. The minimum and maximum age for each group is illustrated in Figure 3.

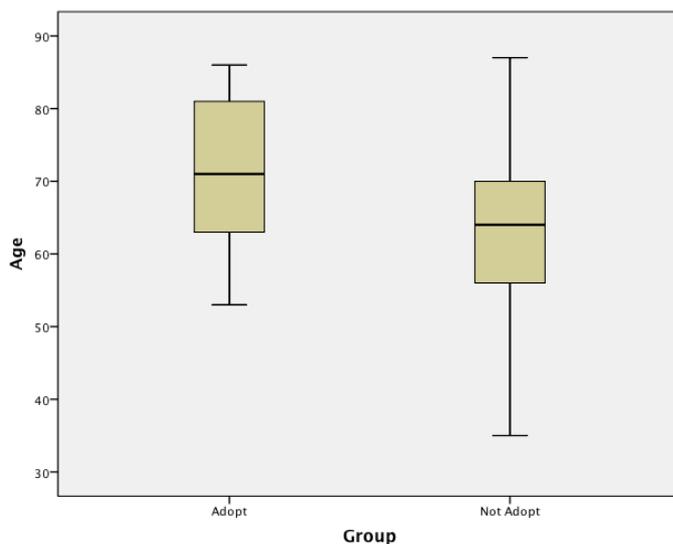


Figure 3: Age distributions between adopters and non-adopters.

Our hypothesis was rejected as no significant difference was found between the ages of the adopters and the non-adopters ($U = 104.500$, $W = 429.500$, $Z = -1.788$). However, Cohen's d effect size was $.76$, indicating a lack of power of the non-parametric test to detect the difference in age between the two groups.

Table 2: Comparison of demographic variables between adopters and non-adopters.

Variable	Group	N	χ^2	p
Gender				
Male	NA	9 (36%)	1.520	.218
	A	7 (58%)		
Female	NA	16 (64%)		
	A	6 (46%)		
Working Status				
Fulltime	NA	12	4.012	.260
	A	2		
Part-time	NA	3		
	A	2		
Retired	NA	9		
	A	8		
Not Working	NA	1		
	A	1		
Qualifications				
Primary School	NA	1	2.470	.481
	A	0		
Secondary School	NA	16		
	A	7		
Tertiary Education	NA	7		
	A	6		
Living Situation				
Alone	NA	4	1.943	.379
	A	4		
With Partner	NA	19		
	A	7		
Extended Family	NA	2		
	A	2		
Race and ethnic identity				
New Zealand European	NA	22	0.539	.764
	A	12		
Māori	NA	1		
	A	1		
Other	NA	2		
	A	0		
Length of HI				
< 6 months	NA	6	0.385	.825
	A	2		
1 – 5 years	NA	14		
	A	8		
>5 years	NA	5		
	A	3		

Note: A = adopters, NA = non-adopters, One of the NA group failed to complete the section on qualifications.

Table 2 shows the results of the Chi-Square tests when comparing the categorical demographic variables (gender, working situation, qualifications, living situation, race and ethnic identity and the perceived length of the HI) between the two groups. None of the demographic variables were significantly different between the two groups, contrary to expectations. We hypothesized that significantly more fulltime workers would adopt HAs and that significantly more participants who adopted HAs would be living with somebody than participants who live alone. However, no significant differences were found for either variable ($\chi^2 = 4.012$, $p = 0.260$ and $\chi^2 = 1.943$, $p = 0.379$ respectively).

Within the group comparisons, the demographic profiles of the hearing aid adopters and non-adopters showed very similar demographic profiles. There were no significant differences in any of the demographic profiles of the two groups.

3.3 Audiometric variables

Audiometric variables for the sample are shown in Table 3. We used a series of 1-tailed Mann-Whitney U tests to test hypotheses 2 a - e: there will be significant differences between hearing aid adopters and non-adopters based on better hearing ear PTA, worse hearing ear PTA, and SNR loss. The results showed that better hearing ear PTA, worse hearing ear PTA and SNR loss were not significantly different between the groups. However, there were significant differences between the groups based on their own ratings as well as their rating of the importance of change. We used a Chi-Square test to test hypothesis 2 f: there will be a significant difference between groups based on prior hearing aid use, which was expected to be more common among hearing aid adopters. Only one participant in the study had used HAs prior to the study. No significant difference was found in terms of prior HA use ($\chi^2 = 2.141$, $p = .143$).

Table 3: Comparison of audiometric variables between HA adopters and non-adopters

	Non-adopters N = 25				Adopters N = 13				d	U	W	Z	Exact Sig.
	Min	Max	M	SD	Min	Max	M	SD					
SNR	1	11.5	5.41	3.12	2	20.5	7.42	5.46	.45	118	394	-1.04	.312
Loss													
BEPTA	5	40	24.5	9.43	20	40	30.38	6.36	.73	103	428	-	.069
												1.834	
WEPTA	20	52.5	32.45	8.1	25	42.5	34.8	5.93	.33	130.5	455.5	-	.329
												0.987	
Own rating	4	9	7.08	1.19	3	9	5.58	1.78	1.42	71	149	-	.009
												2.626	
Change	1	10	5.58	2.92	5	10	8.33	2.19	1.06	68.5	368.5	-	.101
												2.587	

Note: SNR = signal to noise ratio, BEPTA = better ear pure tone average, WEPTA = worse ear pure tone average

3.4 Quality of Life

Quality of life variables for the sample are shown in Table 4. We used a series of 1-tailed Mann-Whitney U tests to test hypotheses 3 a-c: there will be significant differences between hearing aid adopters and non-adopters based on HHIE emotional, social and total scales.

Table 4: Comparison of QoL variables between HA adopters and non-adopters

		Min	Max	M	SD	d	Mean Rank	U	W	Z	Exact Sig.
HHIE-	A	0	32	13.38	9.640	0.737	24.58	83.5	383.5	-2.34	.020
E	NA	0	34	6.450	9.171		15.98				
HHIE-	A	2	28	14.920	7.900	0.862	25.15	76	376	-2.56	.010
S	NA	0	32	8.120	7.870		15.67				
HHIE-	A	4	60	28.310	16.469	0.822	25.31	74	374	-2.62	.008
T	NA	0	66	14.870	16.246		15.58				

Note. HHIE = Hearing Handicap Inventory for the Elderly, HHIE-E = HHIE Emotional subscale, HHIE-S = HHIE Social subscale, HHIE-T = HHIE Total score, W = Wilcoxon W

As was hypothesized, the Mann-Whitney U tests showed significant differences between groups based on the emotional subscale, social subscale, as well as total HHIE - the scores were significantly higher for the HA adopters than for the non-adopters, and is illustrated in Figure 4. For the HHIE questionnaire, a higher score is a poorer result, meaning

that HA adopters' scores were poorer and that they experienced greater social and emotional impacts of a HI than non-adopters. This finding is also supported by the literature on HA adoption.

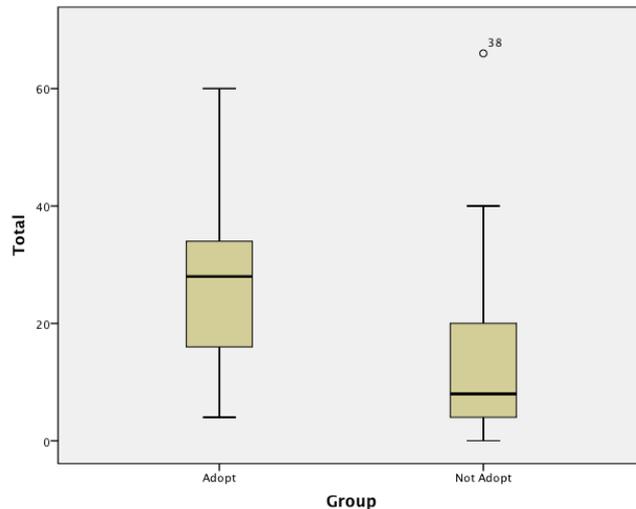


Figure 4: HHIE mean values.

3.5 Clinical Outcomes

Clinical outcomes on the HHIE and SADL are shown in Figures 5-10. We used frequency distributions to test hypotheses 4 and 5: participants will show positive clinical outcomes. Specifically, we determined the number of hearing aid adopters who met the criteria for positive clinical outcomes by examining the frequency of the differences between pre-HHIE scores and post-HHIE scores (i.e. change scores, see Figure 4) and the SADL Global score and subscale scores. The criterion for a positive clinical outcome on the HHIE was a change score of at least 11.9 points (Ventry & Weinstein, 1982). The criterion for a positive clinical outcome on the SALD was a score within or above the normative range. As can be seen from the Figures 5-10, participants tended to show some positive clinical outcome.

When we analysed each outcome individually, all participants showed positive clinical outcomes on at least one outcome measure (i.e. HHIE change score, Global SADL score or subscale). Nine participants did not meet the criteria for positive clinical outcomes

on one or more measures; 2 participants failed to meet the criteria for 3 measures; 2 participants failed to meet the criteria for 2 measures, and 5 participants failed to meet the criterion for only one outcome measure. In addition, no participant scored below the normative range on more than one of the scales of the SADL, implying that each HA adopter achieved scores within or above at least three of the subscales. These results indicate that positive outcomes were generally achieved for participants with a MHI who chose to adopt HAs.

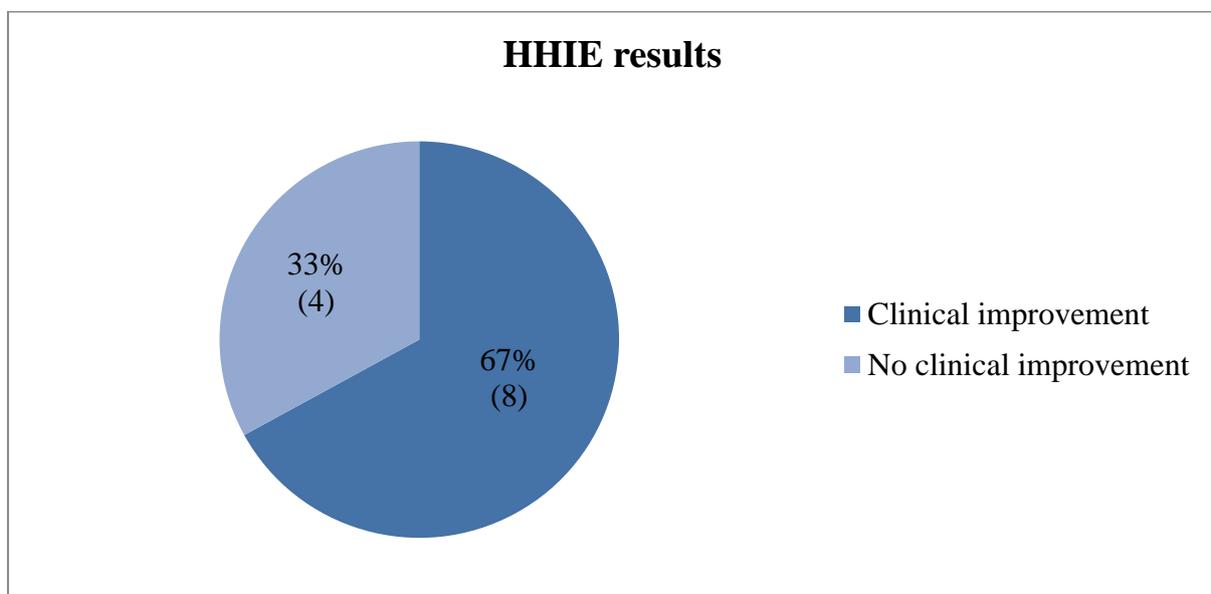


Figure 5: Clinical improvement for adopters as measured by the HHIE.

This Figure illustrates the proportion of adopters who have improved quality of life after acquiring HAs.

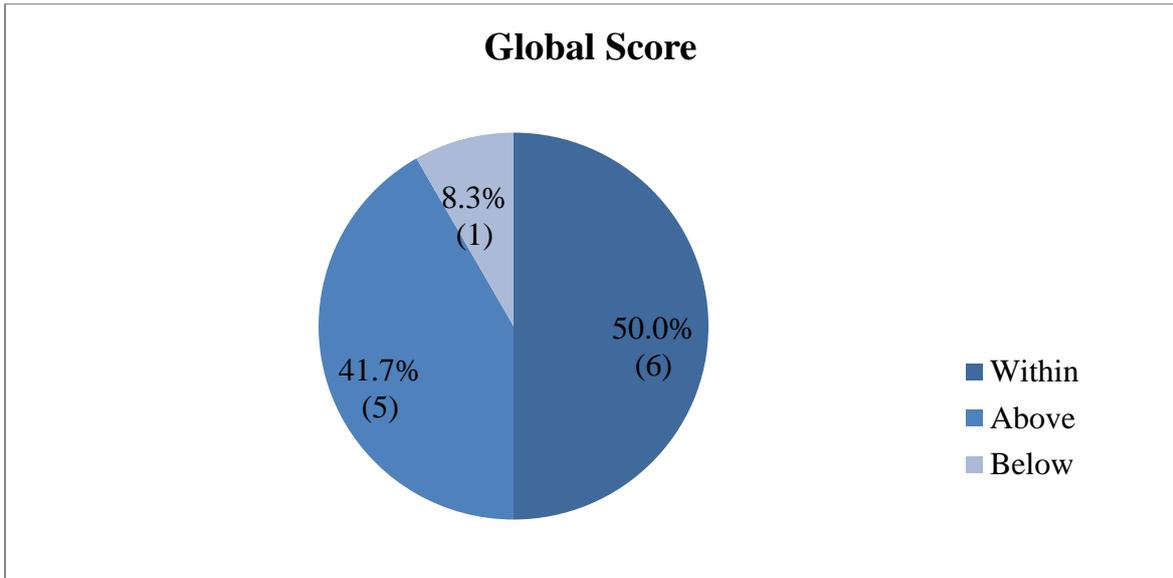


Figure 6: SADL Global Score in relation to normative range.

This Figure illustrates the proportion of adopters who scored below, within and above the normative range of 4.3 to 5.6 globally in the SADL questionnaire.

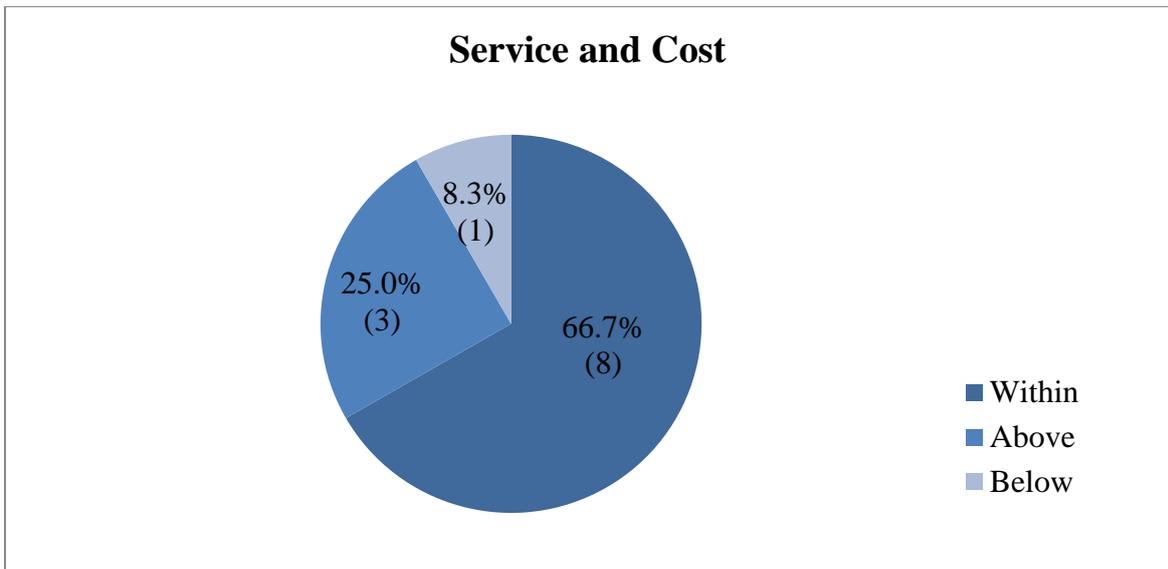


Figure 7: SADL Service and Cost score in relation to normative range.

This figure illustrates the ratio of adopters who scored below, within and above the normative range of 4.0 – 5.7 in the ‘Service and Cost’ section of the SADL questionnaire.

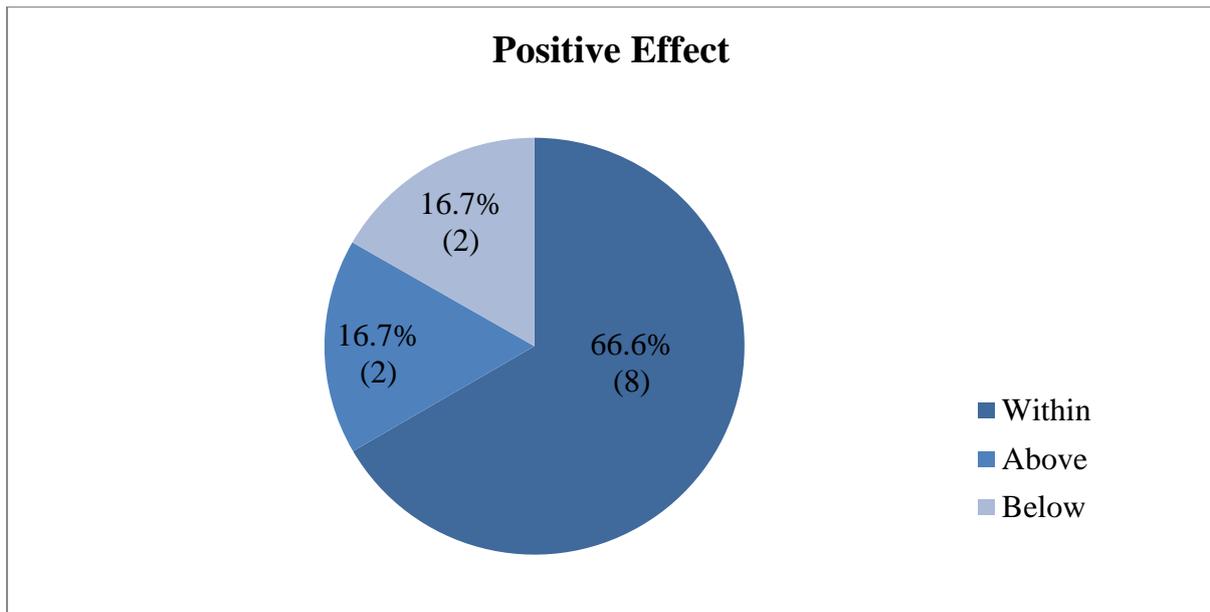


Figure 8: SADL Positive Effect score in relation to normative range.

This Figure illustrates the ratio of adopters who scored below, within and above the normative range of 3.8 – 6.1 in the ‘Positive Effect’ section of the SADL questionnaire.

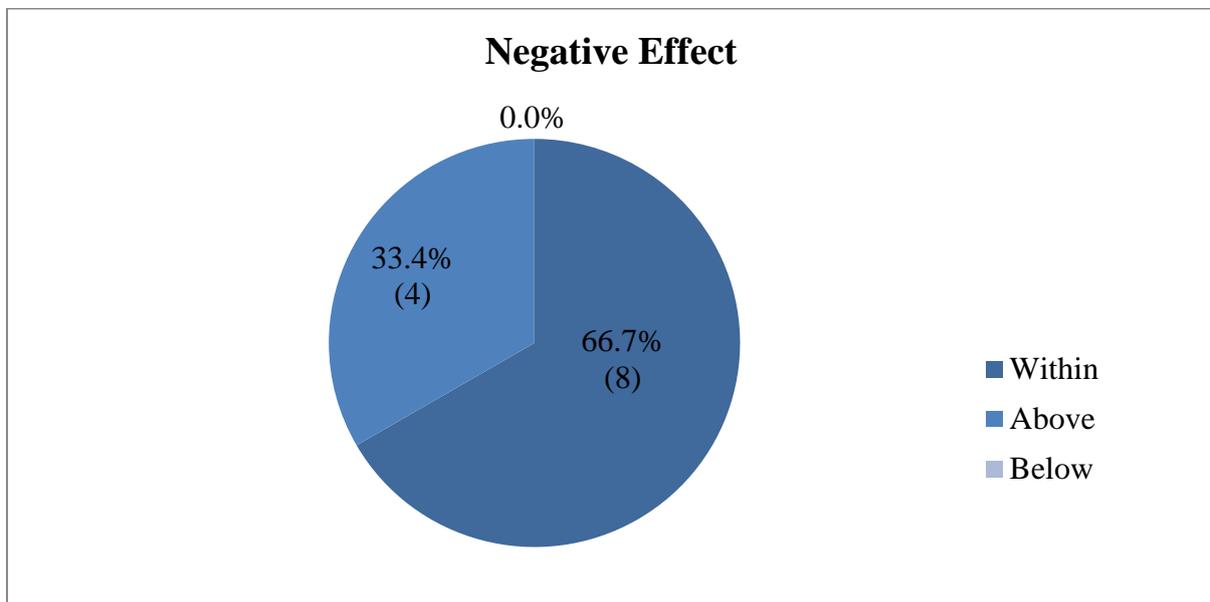


Figure 9: SADL Negative Effect score in relation to normative range.

This Figure illustrates the ratio of adopters who scored below, within and above the normative range of 2.3 – 5.0 in the ‘Negative Effect’ section of the SADL questionnaire.

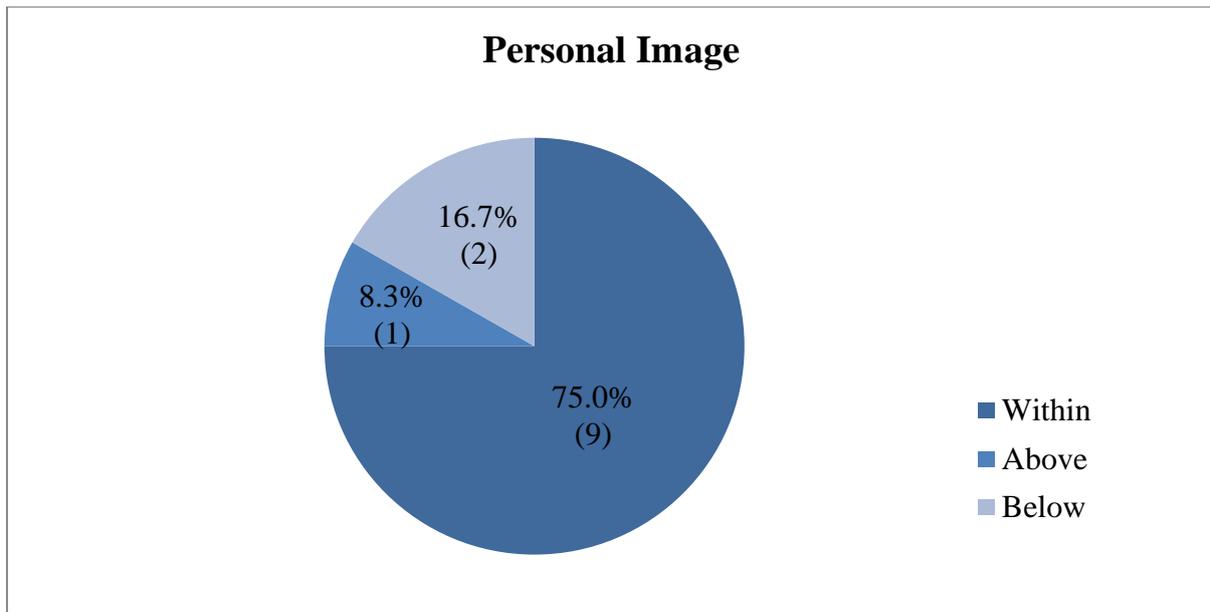


Figure 10: SADL Personal Image score in relation to normative range.

This Figure illustrates the ratio of adopters who scored below, within and above the normative range of 5.0 – 6.7 in the ‘Personal Image’ section of the SADL questionnaire.

Chapter Four: Discussion

The purpose of this study was to explore the differences between adults with a MHI who adopt HAs and those with a MHI who do not adopt HAs. Specifically, do adults with an MHL who adopt HAs differ significantly in terms of demographic and audiometric variables from adults who do not adopt HAs? Also, do adults with an MHL who adopt HAs show a significant improvement in terms of positive clinical outcomes after adopting HAs? This study was done in conjunction with a national New Zealand hearing aid clinic and ran over a five-month period. In addition to the standard information sheets and audiometric tests completed in terms of the clinics' protocol, all participants completed the pre- HHIE questionnaire as well as an additional demographic questionnaire. Furthermore, HA adopters completed the post-HHIE questionnaire and the SADL questionnaire. The following research questions were addressed:

1. Do adults with a MHI who adopted HAs differ significantly on demographic variables from adults with a MHI who do not adopt HAs?
2. Do adults with a MHI who adopt HAs differ significantly on audiometric variables from adults with a MHI who do not adopt HAs?
3. Do adults with a MHI who adopt HAs differ significantly on quality of life variables from adults with a MHI who do not adopt HAs?
4. Do adults with a MHI who adopt HAs show clinically significant improvement on the HHIE (Total) following hearing aid fitting?
5. Do adults with a MHI who adopt HAs show SADL scores within or above the normative range?

4.1 Participants

Before addressing the participants in this study, a discussion regarding the interpretation of research results is provided. Statistical significance does not necessarily mean that a study has a meaningful or practical effect; it shows the probability that the observed difference was owing to chance is acceptably small. Statistical power “describes the probability that a test will correctly identify a genuine effect” (Ellis, 2010, p. 52). According to Lipsey and Hurley (2009), there are four factors to consider when determining statistical power: sample size, alpha level, statistical test, and effect size.

The power of a test is related to the probability of making a Type II error (false negative). The larger the sample, the less likely that is to happen, and vice versa. The alpha level or alpha significance criterion (α) describes the probability of committing a Type I (false positive) error, i.e. incorrectly rejecting the null hypothesis (Ellis, 2010). The investigation is conducted within the framework of a specific statistical test, hence the test itself is a factor determining statistical power (Lipsey & Hurley, 2009). The effect size describes “the degree to which the phenomenon is present in the population” (Ellis, 2010, p. 65) and thus shows the reader how important the research findings are (Schuele & Justice, 2006).

The four parameters as discussed above are interrelated. The value of any one of the parameters can be determined from the others. For example, the statistical power can be expressed as a function of the alpha level, the sample size and the effect size. The required sample size calculated for our study in *a priori* sample size analysis with a level of significance at 0.05, statistical power of 80% and an effect size of 0.5 was 25 participants in each group and 50 in total.

Overall, 38 individuals participated in this study. Of the 38, 25 decided not to adopt HAs, which was satisfactory for this study. However, even though clients were offered a

cost-free trial period, and 25 clinics were included in this study, only 13 adults with a MHI adopted HAs in the five-month period that the study ran. This leaves the study underpowered and we have taken cognisance of this fact in our reporting.

4.2 Study question 1: Demographic variables

The first study question focussed on the hypothesis that there are significant differences between hearing aid adopters and non-adopters based on demographic variables, specifically age, gender, qualification, race and ethnic identity, work status, living situation, and perceived length of the HI. We tested the hypotheses using Chi Square or Mann-Whitney U tests.

4.2.1 Age

The prevalence of a HI increases rapidly with age, affecting approximately 50% of people in their 60s, 60% in their 70s and 90% older than 80 years of age (Solheim, 2011). One would therefore expect more older people than younger people to acquire HAs. Although there seem to be some conflicting opinions about the effect of age on HA uptake (Helvik et al., 2008; Hildago et al., 2009, Uchida et al., 2008), we hypothesised that participants who adopted HAs would be significantly older than participants who did not adopt HAs. However, there was no significant difference between the ages of the adopters and non-adopters. This is in contrast to Helvik et al (2008) and Hildago et al. (2009) who found a direct relationship between age and the possibility of HA adoption – the older the client, the larger the probability of HA uptake. This was also confirmed by Kochkin (1993) where stigma played a much more pronounced role in rejecting HAs in younger adults (35 – 44 years old) than with older adults (75 – 84 years old).

Although the results show that age is not a significant indicator of HA adoption, it is important to note that, although our study was underpowered, Cohen's effect size ($p = .76$) was larger than the minimum established *a priori* ($p = .5$), indicating a lack of power of the

non-parametric test to detect the difference in age between the two groups. Even if there is possibly a difference between the groups in terms of age, it has been obscured. Furthermore, our study examines the effect of HAs on people with only an MHI, which was not the case in other studies. For instance, Helvik et al.'s study (2008) stated that the BEPTA should be larger or equal to 25 dB HL, thus including all levels of HI. Hidalgo et al.'s (2009) participants had a screening threshold of 40 dB HL at 1 and 2 kHz in one or both ears. The differences in the audiometric characteristics could account for the rejection of this hypothesis.

4.2.2 Gender

Studies have found that men are more prone to having a HI and to own HAs than women (Stephens et al., 2001; Smeeth et al., 2002; Helzner et al., 2005). We hypothesised that there would be a difference in the gender of participants who adopted HAs, particularly that more males would adopt HAs than females. Ries (1994) found that, even in a population where the female population is older and larger than the male population, significantly more males have a HI than females. If more males have HI, one might expect more males to adopt HAs. However, it does not necessarily mean that the males use their HAs optimally. In a survey of 4979 male and 3410 female HA owners, the researchers found that females used their HAs more regularly and longer during the day (Stahelin, et al. 2011), which supports the findings of Jacobson et al. (2001) that females seem to be more aware of their problem and are more dependent on social communication than men, concluding that they are more motivated to acquire HAs than men.

We found no significant difference between the two groups in terms of gender. In contrast to our study, Helzner et al.'s study (2005) included only older adults, between 73 and 84 years of age, of whom 76% had a high frequency hearing loss (the average loss at 2, 4 and 8k Hz was greater than 40-dB HL). Smeeth et al. (2002) investigated self-reported hearing

difficulty in a group of adults older than 75 years of age. Lastly, the dominance of male HA users in Stephens et al.'s study conducted in Wales could be a consequence of the inclusion of several males who worked in noisy industries - hence noise induced HI was prevalent.

4.2.3 Qualifications

Health care literacy refers to the ability to obtain and make use of basic health information to make the appropriate health decisions – including acquiring HAs. It refers to more than the ability to read- it includes health knowledge as well. Reasons for limited health literacy include the lack of formal education (beyond secondary/ high school education, Glassman, 2013). Garstecki and Erler's study (1998) of HA use amongst older adults found that both male and female adopters had more formal education than non-adopters. This was also found by Fisher et al. (2011) in their 5-year study on determinants of HA uptake in older adults. Hence our expectations were that the adopters would be significantly better qualified than non-adopters.

Contrary to these studies, we found no significant difference in the qualification levels of the two groups. This is the opposite of what we anticipated. However, the above-mentioned studies included only older adults. In Garstecki and Erler's study, for instance, all participants were older than 65 years, whilst this study included all adults. In addition, Garstecki and Erler's study was conducted more than 15 years ago, and educational trends that were true then may not still hold today. Lastly, comparisons across countries with different education systems are problematic and could contribute to the difference in findings.

4.2.4 Race and ethnic identity

Evidence as to whether a HI is more prevalent amongst minority ethnic groups is contradictory. In the 1990-1991 USA National Health Survey, Ries (1994) found that there are significant socio-demographic differences between people with and without HI. In particular, he found that white people were proportionately overrepresented amongst those

with HI, and minority groups under-represented. Similar results were reported by O'Neill (1999) who found that white people had more than twice the possibility of being hearing impaired than black people. However, the RNID (2003) found that a HI is more prevalent amongst minority ethnic groups than other groups. New Zealand data correspond with the RNID report. Greville (2005) concludes that Māori had a higher prevalence of HI than non-Māori, especially in younger Māori (15 – 24 years). We expected to find a significant difference between hearing aid adopters and non-adopters based on race and ethnic identity; however, there was no significant difference.

In the group as a whole, 34 participants identified themselves as New Zealand Europeans (89.5%), one as a Dutch citizen, two as being from the United Kingdom and one participant was identified as Māori (2.5%). The composition of the group differs substantially from the New Zealand population, where 67.6% of the population are classified as New Zealand European whilst 14.6% are Māori. Since only one participant self-identified as Māori, it is not possible to draw a meaningful conclusion from the data in this study regarding race and ethnic identity and HI.

One could speculate what caused the imbalance in the group of respondents. First, only clinics situated on the South Island took part in the study, and only 14% of the New Zealand Māori population lives on the South Island. Second, the Māori population is relatively young with only 15% older than 50 years, and a median age of 23.4 years. Comparatively, more than 35 % of non-Māori New Zealanders are older than 50 years and the median age of this group is 37 years (Statistics New Zealand, 2012). Since a HI is more prevalent in older adults than younger adults, this could be why there is an imbalance in terms of Māori participants in this study.

4.2.5 Living Situation

The World Health Organisation (WHO, 2001) acknowledges that any disability is an interaction between the person and the overall context in which the person lives. A HI is therefore no longer seen as merely a feature of the individual, but has to be contextualised and the role of the significant other is as relevant as the role of the hearing impaired (Kramer et al., 2005). Difficulties in communicating with a partner and friends, or relatives who notice that a person has a HI are factors that could result in HA acquisition (Fisher et al., 2011). Kochkin and Rogin (2000) found that interpersonal warmth decreases as the HI gets worse, but that negativity in family relationships decreases as HA use increases.

The inability to communicate with a partner at home could contribute to a person obtaining an HA, as would encouragement from a communication partner. Previous studies show that many first-time audiology clients are not self-motivated, but were motivated by their significant other or a relative (Mahoney, Stephens & Cadge, 1996; Wilson & Stephens, 2003; Kochkin, 2012). Our expectation was that, based on living situation, significantly more participants with a MHI who adopted HAs would have been living with somebody than living alone. Our findings did not support our initial views and there was no significant difference between adopters and non-adopters in terms of their living situation. Although Kochkin's (2012) study compares people with a MHI to those with moderate-severe HI, the focus of the research is fundamentally on the latter group, which he states is representative of the typical HA adopter. It is possible that significantly more people with a more severe HI would live with a partner, which could explain the rejection of our hypothesis.

4.2.6 Work Status

We anticipated a significant difference between hearing aid adopters and non-adopters based on work status, in that significantly more participants who adopted HAs would be working full-time, as opposed to participants who did not adopt HAs. Although

Kochkin's (2010) study supports this notion, we found that there was no significant difference. This could be because of the nature of the HI studied. Kochkin specifically found that it is the severe HI category where unemployment becomes more evident as opposed to the MHI category. The UK report on the likelihood of unaided persons with a HI being unemployed (Action on Hearing Loss, n.d.) also found that the problem lies within the severe to profound HI category. A MHI might not be severe enough for a person to be concerned about making hearing-related mistakes at work. Our results could also be affected by the fact that more than half of the respondents are at or over the traditional retirement age of 65 (Cutler, 2011) and would not be in the full-time working environment.

4.2.7 Length of hearing loss

The average HA user has waited for more than ten years from first noticing the HI to acquiring an HA (Davis et al., 2007; Kochkin 2012). This led us to surmise that there would be a significant difference between hearing aid adopters and non-adopters based on length of hearing loss, and that HA adopters would have noticed their HI for a significantly longer time than non-adopters. We found that this was not the case and there was no significant difference between the two groups in terms of how long they have noticed that they had an HI.

Contrary to the norm, all but one of the participants in this study reported that they have been aware of their HI for fewer than 10 years. In our study, people with a MHI who consult audiology services do not tend to wait as long as the normal 10 or more years, and it has significant rehabilitation implications. People who seek help for their HI earlier may not have developed maladaptive strategies, such as pretending to hear when, in fact, they did not hear what was said. They could also adjust or acclimatise better or faster to their HAs.

4.3 Study question 2: Audiometric variables

Both objective and subjective measures were used in this study. Because the same HI may lead to different AL or PR for different people, it is important to assess both the objective HI as well as the person's subjective experience of the HI. The second study question considered the differences between hearing aid adopters and non-adopters based on audiometric variables. We hypothesised that the mean SNR loss of participants who adopted HAs would not be significantly higher than participants who did not adopt HAs. Furthermore, we expected no significant difference between hearing aid adopters and non-adopters based on the better ear PTA. However, we anticipated a significant difference between HA adopters and non-adopters based on participants' own perception of their HI as well as their perceived need for change. We expected participants who adopted HAs to rate their HI and their need to change their current situation significantly higher on the ten-point scale than participants who did not adopt HAs. A series of 1-tailed Mann-Whitney U tests was used to test the first five subsections of the hypothesis and a Chi-Square test to test the last subsection.

4.3.1 Objective audiometric measures

Several authors have found that the degree of HI is not the main reason why people consult with hearing specialists or decide to adopt HAs (Swan & Gatehouse, 1990; Duijvestin et al., 2003; Garstecki & Erler, 1998). According to Kochkin (2012), an important factor is the perception that the HI is worsening rather than the actual HI. We hypothesized that there would be no significant difference between HA adopters and non-adopters as measured by the mean SNR loss, the BEPTA and the WEPTA. Our findings support this hypothesis - we found that there was no significant difference on any of the objective audiometric variables between the two groups. It is possible, given the values of the effect size, that there was a difference between groups based on the BEPTA, however, our study failed to detect it.

When considering the WEPTA, it is interesting to note that only five participants (two adopters and three non-adopters) have a medically significant PT hearing asymmetry. The protocol of the clinics where the hearing tests were obtained uses the following criteria to define a medically significant PT hearing asymmetry: a difference of 10 dB between the two ears at three consecutive frequencies, 20 dB at two consecutive frequencies or 30 dB at one frequency (Personal communication, Anna Macmillan, Bay Audiology). Given that most of the participants have symmetrical HI, it is not unexpected that the mean BEPTA and WEPTA do not differ by more than 10 dB (BEPTA = 26.51, WEPTA = 33.25). However, it is interesting to note the differences in effect sizes between the BEPTA ($d = .73$) and the WEPTA ($d = .33$) and this could necessitate further investigation

The main difference between previous studies on the role of objective audiometric results on HA adoption and this study is that this study focusses solely on an MHI, whilst the other studies have included all levels of HI. In Gussekloo et al.'s study (2003) the median PT loss for the adopters was 60 dB whilst the non-adopters median PT loss was 48 dB. Both these magnitudes are above the MHL classification. Similar results are reported by Helvick et al. (2008) and Gatehouse (1994). Although this study only included MHI, it supports findings from other studies, and also extends the research findings in terms of degree of HI.

4.3.2 Subjective audiometric measures

Palmer et al.'s study (2009) confirmed that people's perception of their own hearing loss is a much stronger predictor of HA adoption than the actual audiological results. This is also echoed in other studies (Cox & Alexander, 2000; Gopinath et al., 2011; Laplante-Lévesque et al., 2012) where self-reported HIs were significant predictors of HA use. Several studies have found that, if individuals do not think that their HI is bad enough, they will not adopt HAs, but that their attitude towards HAs change as the effects of the HI start limiting or

restricting their participation in activities (van den Brink et al., 1996; Duijvenstein et al., 2003; Meister et al., 2008; Fischer et al., 2011).

One of the main reasons why people do not adopt HAs is the fact that they do not perceive their hearing as problematic (Gopinath et al., 2011). We found that non-adopters did not rate their hearing as problematic and also did not rate their need for change as highly.

We anticipated a significant difference between the two groups based on their own perception of their hearing situation. Our results are consistent with other studies in that we found that participants who adopted HAs rate their HI significantly higher on the ten-point scale. They also rated the importance of changing their current situation significantly higher than those who did not adopt HAs. It is interesting to note that the effect size for both the perception of own HI ($d = 1.42$) and need to change ($d = 1.06$) are larger than 1. These are both relatively large effect sizes, and much larger than the effect size ($d = .5$) that we defined *a priori* as being clinically important. Even in our study, with a small sample size which was underpowered, the client's own perception of their HI as well as the need to change were significantly different between HA adopters and non-adopters.

4.3.3 Prior HA use

We expected that prior HA use would be significantly related to HA adoption. A study done by Solheim (2011) tested 174 randomly selected participants older than 65 who were on a waiting list for HAs and found that subjects with an MHL have less positive expectations regarding HAs and have more problem-oriented preconceptions about HAs than those with a more severe HI. He surmises that this could be a reason why HAs are scarcely used by this group. In addition, 80% of respondents with a MHI in Gopinath et al.'s longitudinal study (2011) did not possess HAs because they simply did not need them. Since only one participant had previously worn HAs, we could not make any conclusion about this hypothesis.

4.4 Study question 3: Quality of life

The third study question considered the relationship between HA adoption and quality of life as measured by the HHIE questionnaire. Avoidance, withdrawal and social rejection are three of the many social consequences of a HI as identified by Oyer and Oyer (1979). Thomas and Herbst (1980) found that loneliness (social isolation as well as emotional isolation) were major concerns, leading to hearing impaired people withdrawing more and more from society. People who reported that they experienced a higher degree of activity limitation and participation restriction because of their HI were more likely to adopt HAs (Helvik, et al. 2008). We therefore hypothesised that adopters would score higher (worse) on the HHIE (Emotional), HHIE (Social) as well as HHIE (total) than the non-adopters. We tested our hypotheses with 1-tailed Mann-Whitney U tests and found that, in all three categories, the adopter group scored significantly higher than the non-adopter group.

4.4.1 HHIE (Emotional subscale)

The emotional subscale of the HHIE examines the relationship between hearing problems and emotional well-being of the client, with 13 of the 25 questions relating to this section. Words such as ‘embarrassed’, ‘stupid’, ‘upset’ or ‘nervous’ are used in the questions, relating to the effect that a HI has on the person’s emotional state. Previous studies have found that an increased severity in the HI would lead to an increased severity in communication difficulties, and hence a bigger emotional burden (Dalton et al, 2003). We found that adopters scored significantly higher (poorer) than non-adopters. These findings show that, even if hearing loss is mild, these effects do have emotional effects on clients, and there is a decrease in QoL.

4.4.2 HHIE (Social subscale)

In this subscale, 12 questions are focussed on situations where other people are involved and where communication could be affected. The questions are focussed on activity

limitations that the person may experience because of the HI. Issues such as a HI getting in the way of social life, people going out less often, or communicating with others less often are addressed. Many studies have found that an untreated HI has a negative effect on social interaction and communication (Montano & Spitzer, 2009; Dalton et al., 2003; Arlinger, 2003; Oyer & Oyer, 1979). Dalton et al.'s study looked at different degrees of a HI and found that increasing self-reported difficulty is associated with increased levels of an HI. Although those with a MHI were less inclined to report a hearing handicap in their study, our study found that there is a significant difference between HA adopters and non-adopters in terms of social interaction. Even a MHI does have a social impact on some people, and they tend to choose to adopt hearing aids.

4.5 Study question 4: Clinical Outcomes

The fourth study question focussed only on the adopters group. Once the clients had decided to go ahead with acquiring HAs, and after finalisation, they completed the HHIE again, and we then determined whether these participants showed clinically significant improvements on the HHIE (Total) questionnaire following hearing aid fitting. We hypothesised that participants would have a difference of 12 points or more on their pre- and post-HHIE scores (Ventry & Weinstein, 1982).

The first study done on the impact of HAs on quality of life was done at the end of the 1980s where the researchers found that HAs can improve social, emotional as well as communication problems caused by a HI and this could be experienced within six weeks of fitting (Mulrow et al., 1992). The reports from the MarkeTrak VI survey (Kochkin, 2002) found similar results.

4.6 Study question 5: Satisfaction with Hearing Aids

We hypothesised that, after being fitted with HAs and having worn these for some time, participants who adopted HAs would show SADL scores within or above the normative

range. The score that a client obtains in any self-assessment questionnaire becomes more useful when compared to the norms – that is, what is expected from a reference group. This tells the professional what is typical (acceptable) and atypical for the target group (Demorest & DeHaven, 1993). The SADL consists of 15 questions in four categories – positive effect, service and cost, negative features and personal image. Responses range from “Not at all” to “Tremendously” and are scored according to an instruction manual

Kochkin and Rogin (2000) found in their extensive investigation into the effect of HAs on the physical, emotional, mental and social well-being of nearly 4000 people, that people with a mild or severe HI reported significant improvement in specifically family relationships, self-esteem, mental health and general life after adopting HAs. Kaplan-Neeman et al. (2012) reported on a group of clients where the majority had a moderate HI, and found general improvement and benefits of using HAs. We found similar results. Most of the participants (11 or 84.61%) who adopted HAs showed SADL (Global) scores within or above the normative range (4.3 – 5.6). In addition, no participant scored below the normative range on more than one of the scales of the SADL. This means that each HA adopter achieved scores within or above at least three of the subscales, indicating that positive outcomes were generally achieved for participants with a MHI who chose to adopt HAs.

4.7 Clinical Implications

Despite a myriad of research on a HI and the effect of a HI on different aspects of QoL, a small number of studies focus specifically on MHI, re-enforcing the unfounded perception that a MHI does not warrant amplification. In some cases, this may be the case. However, as seen from the results of this study, there are clients with a MHI who gain from HAs.

Although the literature seems to suggest that there are significant differences between adopters and non-adopters in terms of demographic variables, this study did not find the same

results. In this study age, gender, qualifications, race and ethnic identity, living situation, work status and perceived length of a HI did not account for significant difference between the groups. Prior HA use was also not significantly different between the two groups.

According to the results from this study, demographic variables are not generally different between HA adopters and non-adopters. However, one should consider the fact that age was underpowered in this study and that, given the effect size, this needs further investigation.

It seems to be instinctive to suggest that people with a worse HI would be more prone to HA adoption than those with an MHI. Yet, this study found no differences in degree of a HI between adopters and non-adopters for those with an MHI. Again, the large effect size for the BEPTA needs to be considered when interpreting the results.

The audiometric results are but one of many aspects to consider when discussing rehabilitative programmes with hearing impaired clients. In this study, there was no significant difference between the adopters and non-adopters in terms of their SNR loss, BEPTA or WEPTA. This emphasises the fact that two people with exactly the same audiological information could experience hearing in completely different ways. However, clients' subjective opinions about their HIs as well as their own need to make a change about their hearing situation was significantly different between the two groups. It is unlikely that people with a documented HI will acquire an HA if they themselves do not perceive themselves to have an HI. On the other hand, a person who experiences difficulty in hearing situations will be more prone to acquire an HA, regardless of the audiological results. It is therefore imperative to ascertain the perceptions that the clients have of their hearing and to determine how important their hearing is to their lived experiences.

QoL is a unique, personal perception of the way that a client feels about his/her personal situation in terms of health and non-health variables, and can only be determined by the person's subjective opinion. QoL, relating to an HI, includes the ability to socialise and

communicate effortlessly, without emotional stress that accompanies the inability to hear well. In comparison with the non-adopters, the HA adopters in this study scored significantly worse in terms of QoL. A MHI has a significantly negative effect on the QoL of those who deem it necessary to adopt HAs.

One other factor to consider, after the HA has been fitted and a client has worn it for at least four weeks, is how the client rates his or her QoL? After being fitted with HAs, the adopters indicated that there were positive clinical outcomes in the subjective assessment of their QoL. HAs can have a significant positive contribution to improved daily living for people with MHI.

The last matter investigated in this study was whether clients were satisfied with their HAs. Now, more than ever, client satisfaction is a critical consideration in any business, in terms of best business practise evaluation as well as a method of quality control. Anecdotally, clinics have often been criticised for prescribing HAs when they were not necessary and ethical aspects have been questioned. Client satisfaction needs to be documented in order to determine whether the clients have gained from the HA fitting.

Although objective information is essential when assessing a person's hearing status, the assessment cannot be complete without asking for the subjective opinion of the client. Essentially, in terms of the audiogram, the non-adopters and the adopters had very similar HI. If only this information was taken into account, then all the participants would gain equally from HAs. However, hearing ability is not determined by hearing thresholds only. People's perception of their hearing and their motivation to do something about their hearing situation is as important.

4.8 Limitations and Directions for further research

It was clear from the outset of this research that the sample size, specifically that of the non-adopters, was smaller than what was necessary according to the *a priori* calculations.

This led to non-parametric testing being used, which further reduces the statistical power of this study. Even though the initial time frame of the data collection was extended twice and a substantial number of clinics were involved and the usual payment upfront-policy was waived for the duration of the study, only 13 HA adopters were recruited. Given that this is a Master's thesis with the accompanying time constraints, we decided to go ahead with the study, knowing that there were going to be limitations caused by the sample size.

Data were collected by multiple clinicians in several clinics in a clinical environment, as opposed to a research environment. While this is good in terms of sampling a clinical population, it could have led to problems with data collection. All clinicians may not have collected the data in the same way. Linked to this, data were collected on the South Island only and from only one clinic-group. Not all eligible participants were necessarily recruited, which implies a lack of access to the true population. We are thus not able to generalise our findings to the general population of New Zealand.

A third limitation is the absence of a standardised questionnaire. The questionnaire used to collect information about self-perceived communication ability and importance was not standardised. There have been no studies supporting its psychometric properties, so the stability/reliability and the validity cannot be assumed to be appropriate.

Lastly, only the HHIE was used, even though many of the clients were younger than 65 years. Since the development of the HHI for adults (HHIA), it has been customary to use the HHIE for older clients and the HHIA for younger clients.

As was seen repeatedly in this document, the majority of research published on HA adoption has been in relation to the more severe classifications of HI, and on older clients. Furthermore, the existing research regarding a MHI mainly involves children - with the aim of intervening in terms of their educational plan. Based on the findings in this study, several areas for further research have been identified.

First, we found in our sample a positive outcome for people with a MHI who decide to adopt HAs. However, we are not able to generalise the results of this study to the general population. Only one set of audiology clinics was used to collect data and these clinics were only found on the South island of New Zealand. Apart from our sample being too small, it did not follow a normal distribution. Therefore, we cannot assume that the results can be applied to the general population of adults with an MHI. It would be beneficial to expand the study to allow for more usable generalisations to be generated. A study that encompasses both the North and South Islands would be beneficial as it would then be more representative of the total New Zealand population.

Secondly, clients with a MHI in this study did not wait ten years or more before seeking help. This could have implications for rehabilitation and rehabilitation decisions. Fewer maladaptive strategies or faster HA acclimatisation could be found if people with a MHI were fitted with HAs.

Lastly, as a rule, the general population does not expect younger adults to have a HI and also to wear HAs. Clearly more research is needed in terms of adults, and also specifically younger adults, with MHI, their particular rehabilitation paths and needs.

4.9 Conclusion

A substantial number of people worldwide have an untreated HI - by far the majority are classified as an MHI. The results from this study indicate that positive outcomes were generally achieved for participants with a MHI who chose to adopt HAs, and they have improved in many areas that comprise quality of life. Although there are some clients with a MHI who do not need HAs, there are also clients with a MHI who show positive clinical outcomes when fitted with HAs and clinicians need to take cognisance of this. It is certainly unethical to fit a person with an HA that is superior to their needs. However, it is also not

acceptable to dismiss a person with a MHI on the grounds that the HI is not substantial enough to warrant an HA.

In addition, even though subjective measures are time consuming, the vast amount of information gained from these measures is invaluable for the clinician and it is imperative to spend that time to obtain subjective measures – both in assessment and in outcome. It certainly makes for a much more comprehensive understanding of the client's hearing experience, and allows the clinician to make a much more informed decision on the rehabilitation path. If clinicians do what is best for the client, they have a more satisfied client with an improved QoL which, in the final analysis, is what the aim of any audiological intervention should be.

References

- Abrams, H. B., Chisolm, T. H., & McArdle, R. (2012). Health-related quality of life and hearing aids: A tutorial. *Trends in Amplification*, 9(3), 99 - 109.
- Action on Hearing Loss. (2011). *Facts and figures on hearing loss and tinnitus*. Retrieved from <http://www.actiononhearingloss.org.uk/your-hearing/about-deafness-and-hearing-loss/statistics.aspx>
- Agrawal, Y., Platz, E. A., & Niparko, J. K. (2008). Prevalence of hearing loss and differences by demographic characteristics among US adults: data from the National Health and Nutrition Examination Survey, 1999-2004. *Arch Intern Med.* , 168(14), 1522 - 1530.
- Allan, L. & Kelly-Campbell, R.J. (2013). Origins and pawns scales: A pilot study assessing perception of control in adults with hearing problems. *Commun Disord Deaf Stud Hearing Aids*, 1(1), 1 – 8, doi: 10.4172/jcdsha.1000102
- Anand, S., & Hanson, K. (1997). Disability-adjusted life years: a critical review. *Journal of Health Economics*, 16, 685 - 702.
- Arlinger, S. (2003). Negative consequences of uncorrected hearing loss - a review. *International Journal of Audiology*, 42(2), 17 - 20.
- ASHA. (2005). Type, degree, and configuration of hearing loss. *Audiology Information Series, ASHA's consumer newsletter*.
- aWengen, D. F., Nishihara, S., Kurokawa, J., & Good, R. L. (1995). Measurements of the stapes superstructure. *The Annals of Otolaryngology, Rhinology and Laryngology*, 104(4Pt1), 311 - 316.
- Baerlocher, M.O. (2007) Differences in healthy life expectancy among men and women. *Canadian Medical Association Journal*, 177(10), 1174.

- Barker, M. (2006). Opportunity blocked: The employment experiences of deaf and hard of hearing people, *RIND*. Retrieved from http://www.ssiacymru.org.uk/resource/a_s_Opportunity_20Blocked.pdf
- Bertoli, S., Staehelin, K., Zemp, E., Schindler, C., Bodmer, D., & Probst, R. (2009). Survey on hearing aid use and satisfaction in Switzerland and their determinants. *International Journal of Audiology*, 48(4), 183 - 195.
- Bess, F., Dodd-Murphy, J., & Parker, R. (1998). Children with minimal sensorineural hearing loss: Prevalence, educational performance, and functional status. *Ear & Hearing*, 19(5), 339 – 354.
- Bickenbach, J.E., Chatterji, S., Kostanjsek, N. & Üstün, T.B. (2003). Ageing, disability and the WHO's International Classification of Functioning, Disability and Health (ICF). *The Geneva Papers on Risk and Insurance*, 28 (2), 294 – 303.
- Blair, J.C. (1985). The effects of mild sensorineural hearing loss on academic performance of young school-age children. *Volta Review*, 87, 87 – 93.
- Boothroyd, A. (1968). Developments in speech audiometry. *Sound*, 2(1), 3 - 10.
- Boothroyd, A. (2007). Adult Aural Rehabilitation: What is it and does it work?'. *Trends in Amplification*, 11(2), 63 - 71.
- Chao, T.-K., & Chen, T. H.-H. (2008). Cost-effectiveness of hearing aids in the hearing-impaired elderly: A probabilistic approach. *Otology & Neurotology*, 29, 776 - 783.
- Chia, E. M., Wang, J. J., Rochtchina, E., Cumming, R. R., Newall, P., & Mitchell, P. (2007). Hearing impairment and health-related quality of life: the Blue Mountains hearing study. *Ear & Hearing*, 28(2), 187 - 195.
- Chien, W., & Lin, F. R. (2012). Prevalence of hearing aid use among older adults in the United States. *Arch Intern Med*, 172(3), 292- 293.

- Choi, A. Y., Shim, H. J., Lee, S. H., Yoon, S. W., & Joo, E.-J. (2011). Is cognitive function in adults with hearing impairment improved by the use of hearing aids? *Clinical and Experimental Otorhinolaryngology*, 4(2), 72 - 76.
- Clark, J. G. (1981). Uses and abuses of hearing loss classification. *ASHA*, 23(7), 493 - 500.
- Cox, R.M. (2003). Assessment of subjective outcome of hearing aid fitting: getting the client's point of view. *International Journal of Audiology*, 42, S90 - S96.
- Cox, R.M., & Alexander, G. C. (2000). Expectations about hearing aids and their relationship to fitting outcome. *Journal of American Academy of Audiology*, 11, 368– 382.
- Cox, R. M., & Alexander, G. C. (1999). Measuring satisfaction with amplification in daily life: The SADL Scale. *Ear & Hearing*, 20(4), 306 - 320.
- Cox, R. M., Alexander, G. C., & Gray, G.A. (2005). Who wants a hearing aid? Personality profiles of hearing aid seekers. *Ear and Hearing*, 25(1), 12 – 26.
- Cutler, N. E. (2011). Working in Retirement: The Longevity Perplexities Continue. *Journal of Financial Service Professionals*, July, 19 - 22.
- Dalton, D. S., Cruickshanks, K. J., Klein, B. E. K., & Klein, R. (2003). The impact of hearing loss on quality of life in older adults. *The Gerontologist*, 43(5), 661 - 668.
- Davis, A., Smith, P., Ferguson, M., Stephens, D., & Gianopoulos, I. (2007). Acceptability, benefit and costs of early screening for hearing disability: A study of potential screening tests and models. *Health Technology Assessment*, 11(42), 1 - 294.
- Davis, H. (1970). Hearing handicap, standards for hearing, and medicolegal rules. in H. Davis and S. R. Silverman (Eds.), *Hearing and Deafness* (3rd ed.). New York: Rinehart and Winston.
- Demorest, M. E., & DeHaven, G. P. (1993). Psychometric adequacy of self-assessment scales. *Seminars in Hearing*, 14(4), 314 - 324.

- Demorest, M. E., & Walden, B. E. (1984). Psychometric principles in the selection, interpretation, and evaluation of communication self-assessment inventories. *Journal of Speech and Hearing Disorders*, 49, 226 - 240.
- Digby, J. (2012). *Deafness Notification Report 2011* (pp. 10-42). Auckland: New Zealand Audiological Society.
- Duijvestijn, J. A., Anteunis, L.J., Hoek, C.J., van de Brink, R.H., Chenau M.N., & Manni, J.J. (2003). Help-seeking behaviour of hearing-impaired persons aged > 55 years; effect of complaints, significant others and hearing image. *Acta Otolaryngology*, 123(7), 846 - 850.
- Ellis, P.D. (2010). *The Essential Guide to Effect Sizes*. Cambridge University Press: Cambridge.
- Fava, G. A., & Sonino, N. (2008). The biopsychosocial model thirty years later. *Psychotherapy and Psychosomatics*, 77, 1 - 2.
- Fisher, M.E., Cruickshanks, K.J., Wiley, T.L., Klein, B.E., Klein, R., & Tweed, T.S. (2011). Determinants of hearing aid acquisition in older adults. *American Journal of Public Health*, 101(8), 1449 – 1455.
- Franks, J. R., & Beckman, N. J. (1985). Rejection of hearing aids: Attitudes of a geriatric sample. *Ear & Hearing*, 6(3), 161 - 166.
- Frattali, C. (1998). *Measuring outcomes in speech-language pathology*. New York : Thieme,
- Garstecki, D. C., & Erler, S. F. (1998). Hearing loss, control, and demographic factors influencing hearing aid use among older adults. *Journal of Speech Language & Hearing Research*, 41(3), 527 - 537.
- Gatehouse, S. (1994) Components and determinants of hearing aid benefit. *Ear & Hear*, 15(1):30-49.

- Glassman, P. (2013). *Health Literacy*. Retrieved from <http://nnlm.gov/outreach/consumer/hlthlit.html>
- Goodman, A. (1965). Reference zero levels for pure-tone audiometer. *ASHA*, 7, 262 - 263.
- Gopinath, B., Schneider, J., Hartley, D., Teber, E., McMahon, C. M., Leeder, S. R., & Mitchell, P. (2011). Incidence and predictors of hearing aid use and ownership among older adults with hearing loss. *Annals of Epidemiology*, 21(7), 497 - 506.
- Greville, A. (2005). Hearing impaired and deaf people in New Zealand: an update on population numbers and characteristics. Retrieved from <http://www.oticon.org.nz/pdf/HearingimpaireddeafpeopleNZMar05a.pdf>
- Grönvik, L. (2009). Defining disability: effects of disability concepts on research outcomes. *International Journal of Social Research Methodology*, 12(1), 1 -18.
- Gusseklou, J., De Bont, L., Von Faber, M., Eekhof, J., De Laat, J., Hulshof, J.,... Westendorp, R. G. (2003). Auditory rehabilitation of older people from the general population--the Leiden 85-plus study. *The British Journal of General Practice*, 53(492), 536-540
- Helvik, A.-S., Wennberg, S., Jacobsen, G., & Hallberg, L. R.-M. (2008). Why do some individuals with objectively verified hearing loss reject hearing aids? *Audiological Medicine*, 6, 141 - 148.
- Helzner, E. P., Cauley, J. A., Pratt, S. R., Wisniewski, S. R., Zmuda, J. M., Talbott, E. O., . . . Newman, A. B. (2005). Race and sex differences in age-related hearing loss: the Health, aging and body composition study. *Journal of the American Geriatrics Society*, 53(12), 2119 - 2127.
- Héту, R., Riverin, L., Getty, L., Lalande, N.M. & St-Cyr, C. (1989). The reluctance to acknowledge hearing difficulties among hearing-impaired workers. *British Journal of Audiology*, 24, 265 – 276.

- Hétu, R. (1996). The stigma attached to hearing impairment. *Scand Audiol*, 35 Suppl 43, 12 – 24.
- Humes, L. E., Wilson, D. L., & Humes, A. C. (2003). Examination of differences between successful and unsuccessful elderly hearing aid candidates matched for age, hearing loss and gender. *International Journal of Audiology*, 42, 432 – 441
- Holstrum, W.J., Biernath, K., McKay, S. & Ross, D.S. (2009). Mild and unilateral hearing loss: Implications for early intervention. *Infants and Young Children*, 2(3), 177 – 187.
- Hosford-Dunn, H., & Halpern, J. (2001) Clinical application of the SADL scale in private practice II: predictive validity of fitting variables. Satisfaction with Amplification in Daily Life. *Journal of American Academy of Audiology*, 12(1), 15 - 36.
- Imrie, R. (2004). Demystifying disability: a review of the *International Classification of Functioning, Disability and Health*. *Sociology of Health & Illness*, 26(3), 287 – 305.
- Jacobson, G. P., Newman, C. W., Fabry, D. A., & Sandridge, S. A. (2001). Development of the three-clinic Hearing Aid Selection Profile (HASP). *Journal of American Academy of Audiology*, 12(3), 128 - 141.
- Jerger, J., & Jerger, S. (1980). Measurement of hearing in adults. In M. M. Paparella & D. A. Shumrick (Eds.), *Otolaryngology*. Philadelphia: W.B. Saunders.
- Jenstad, L., & Moon, J. (2011). Systematic review of barriers and facilitators to hearing aid uptake in older adults. *Audiology research*, 1(1(S)), e25. Retrieved from <http://audiologyresearch.org/index.php/audio/article/view/audiore.2011.e25/html> doi:10.4081/audiore.2001.e25.
- Johnson, C. E. (2012). *Introduction to Auditory Rehabilitation*. Boston: Pearson.
- Kaplan-Neeman, R., Muchnik, C., Hildesheimer, M. & Henkin, Y. (2012). Hearing aid satisfaction and use in the advanced digital era. *The Laryngoscope*, 22(9), 2029 – 2036.

- Kelly-Campbell, R.J., Atcherson, S.R., Zimmerman, K.R., & Zraick, R.I. (2012). Readability of audiologic self-report assessment tools. *Journal of the Academy of Rehabilitative Audiology*, 45, 1-11.
- Kelly-Campbell, R.J., & Parry, D.C. Relationship between cognitive anxiety level and client variables at initial consultation for adults with hearing impairment. *Journal of Communication Disorders* (2014), <http://dx.doi.org/10.1016/j.jcomdis.2014.01.005>
- Kelly-Campbell, R.J., & Plexico, L. (2012). Couples' experiences of living with hearing impairment. *Asia-Pacific Journal of Speech, Language, and Hearing*, 15 (2), 145-160.
- Killion, M. C., & Niquette, P. A. (2000). The audiogram and SNR loss. *The Hearing Journal*, 53(3), 46 - 53.
- Killion, M. C., Niquette, P. A., Gudmundsen, G. I., Revit, L. J., & Banerjee, S. (2004). Development of a quick speech-in-noise test for measuring signal-to-noise ratio loss in normal-hearing and hearing-impaired listeners. *The Journal of the Acoustical Society of America*, 116(4), 2395 - 2405.
- Killion, M. C., & Vilchur, E. (1993). Kessler was right-partly: But SIN test shows some aids improve hearing in noise. *Hearing Journal*, 46, 31 - 35.
- Kinsella, K. & Phillips, D.R. (2005). Global aging: The challenge of success. *Population Bulletin*, 60(1), 4 – 7.
- Kochkin, S. (1993). MarkeTrak III: why 20 million in US don't use hearing aids for their hearing loss. *Hearing Journal*, 46, 20-27
- Kochkin, S. (2007). Wireless technology in hearing care. *The Hearing Journal*, 60(11), 28 – 31
- Kochkin, S. (2010). MarkeTrak VIII: Consumer satisfaction with hearing aids is slowly increasing. *The Hearing Journal*, 63(1), 12-25.

- Kochkin, S. (2012). MarkeTrak VIII: The key influencing factors in hearing aid purchase intent. *Hearing Review* 19(3), 12-25.
- Kochkin, S., & Rogin, C. M. (2000). Quantifying the obvious: The impact of hearing instruments on quality of life. *The Hearing Review*, 7(1), 6 - 34.
- Kramer, S. E., Alessie, G. H. M., Dondorp, A. W., Zekveld, A. A., & Kapteyn, T. S. (2005). A home education program for older adults with hearing impairment and their significant others: A randomized trial evaluating short- and long-term effects. *International Journal of Audiology*, 44, 255 - 264.
- Laplante-Lévesque, A., Hickson, L., & Worrall, L. (2012). What makes adults with hearing impairment take up hearing aids or communication programs and achieve successful outcomes? *Ear & Hearing*, 33(1), 79-93.
- Laszlo, A., & Krippner, S. (1998). Systems Theories: Their Origins, Foundations, and Development. In J.S. Jordan (Ed.), *Systems Theories and A Priori Aspects of Perception*. Amsterdam: Elsevier.
- Lin, F. R., Thorpe, R., Gordon-Salant, S., & Ferrucci, L. (2011). Hearing loss prevalence and risk factors among older adults in the United States. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 66A(5), 582 - 590.
- Lipsey, M.W., & Hurley, S. M. (2009). Design Sensitivity: Statistical Power for Applied Experimental Research. In L. Bickman & D.R. Rob (Eds.), *The SAGE Handbook of Applied Social Research Methods*. (2nd ed.). Thousand Oaks, California: SAGE publications
- Longmore, P. K. (2003). *Why I Burned My Book and Other Essays on Disability*. Philadelphia: Temple University Press.

- Lupsakko, T. A., Kautiainen, H. J., & Sulkava, R. (2005). The non-use of hearing aids in people aged 75 years and over in the city of Kuopio in Finland. *Eur Arch Otorhinolaryngol*, 262, 165–169.
- Madden, R., Sykes, C., & Üstün, T.B. (n.d.). World Health Organization family of international classifications: definition, scope and purpose. Retrieved from <http://www.who.int/classifications/en/FamilyDocument2007.pdf>
- Mahoney, C. F. O., Stephens, S. D. G., & Cadge, B. A. (1996). Who prompts patients to consult about hearing loss? *British Journal of Audiology*, 30, 153 - 158.
- Manchaiah, V. K. C., & Freeman, B. (2011). Audiogram: Is there a need for change in the approach to categorize the degree/severity of hearing loss? *International Journal of Audiology*, 50, 638 - 640.
- Margolis, R. H., & Saly, G. L. (2007). Toward a standard description of hearing loss. *International Journal of Audiology*, 46, 746 - 758.
- Mathers, C., Smith, A., & Concha, M. (2000). Global burden of disease. Retrieved from http://www.who.int/healthinfo/statistics/bod_hearingloss.pdf
- Martin, F. N., & Clark, J. R. (2000). *Introduction to Audiology* (7th Ed.). Needham Heights: Allyn & Bacon.
- McColl, E. Jacoby, A., Thomas, L., Soutter, J., Bamford, C. Steen, N., ... Bond, J. (2001). Design and use of questionnaires: a review of best practice applicable to survey of health service staff and patients. *Health Technology Assessment*, 5(31).
- McDowell, I. (2006). *Measuring Health: A guide to rating scales and questionnaires*. Oxford University Press: New York.
- McLeod, B. & Upfold, L. (2003). The effect of passing time on self-reported satisfaction with hearing aid amplification. *The Australian and New Zealand Journal of Audiology*, 25 (1), 28 – 35.

- Meister, H., Walger, M., Brehmer, D., Von Wedel, U.-C., & Von Wedel, H. (2008). The relationship between pre-fitting expectations and willingness to use hearing aids. *International Journal of Audiology*, 47, 153 - 159.
- Montano, J. J., & Spitzer, J. B. (Eds.). (2009). *Adult audiologic rehabilitation*. Portland: Plural Publishing.
- Morris, J. (1991). *Pride against Prejudice: Transforming Attitudes to Disability*. London: The Women's Press.
- Mulrow, C., Tuley, M., & Aguilar, C. (1992). Sustained benefits of hearing aids. *Journal of Speech and Hearing Research*, 35, 1402 - 1405.
- Murray, C. J. L. (1994). Quantifying the burden of disease: the technical basis for disability-adjusted life years. *WHO Bulletin*, 72, 428 - 445.
- Murray, L.A. (1988/89). Hearing Impairment. *Prairie Schooner*, 63(4), 89- 90.
- Musiek, F.E., & Baran, J.A. (2007). *The Auditory System Anatomy, Physiology, and Clinical Correlates*. Boston: Pearson
- National Foundation for the Deaf. (n.d.). *New Zealand and Australia. Hearing Loss Statistics*. Retrieved from http://www.nfd.org.nz/site_resources/library/OrganisationFiles/Research/Hearing_Stats_NZ_Oz.pdf
- National Institute on Deafness and Other Communication Disorders. (2008). *Statistics about hearing, balance, ear infections, and deafness*. Retrieved from <http://www.nidcd.nih.gov/health/statistics/pages/hearing.aspx>.
- Northern, J. L., & Downs, M. P. (2002). *Hearing in Children* (5th ed.). Baltimore: Lippincott Williams & Williams.
- O'Neill, J.J. & Oyer, H.J. (1973). Aural rehabilitation. In J.Jerger (Ed.), *Modern Developments in Audiology* (2nd Ed.). New York: Academic Press.

- O'Neill, G. (1999). Hearing loss: A growing problem that affects quality of life. *National Academy on an Aging Society, December*, 1 - 6.
- Office for Disability Issues (2001). *New Zealand Disability Strategy Document*. Retrieved from <http://www.odi.govt.nz/resources/publications/new-zealand-disability-strategy.html>.
- Oyer, H., & Oyer, E. (1979). Social consequences of hearing loss for the elderly. *Allied Health and Behavioural Sciences*, 2(2), 123 - 138.
- Palmer, C., Solodar, H. S., Hurley, W. R., Byrne, D. C., & Williams, K. O. (2009). Self-perception of hearing ability as a strong predictor of hearing aid purchase. *Journal of American Academy of Audiology*, 20(6), 341 - 347.
- Pascolini, D. & Smith, A. (2008). Hearing Impairment in 2008: a compilation of available epidemiological studies. *International Journal of Audiology*, 48, 473 – 485.
- Pitkin, J., & Myers, D. (2011). Projections of the U.S. Population, 2010-2040 by immigrant generation and foreign-born duration in the U.S. *Population Dynamics Research Group: School of Policy, Planning, and Development at the University of Southern California*.
- Popelka, M. M., Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E., & Klein, R. (1998). Low prevalence of hearing aid use among older adults with hearing loss: the Epidemiology of Hearing Loss Study. *Journal of American Geriatric Society*, 46, 1075 - 1078.
- Portney, L. G., & Watkins, M. P. (2009). *Foundations of clinical research: Applications to practice* (3 ed.). New Jersey: Prentice Hall.
- Ries, P. W. (1994). Prevalence and characteristics of persons with hearing trouble: United States, 1990-91. *National Centre of Health Statistics, Vital Health Stat*, 10(188), 1 - 82.

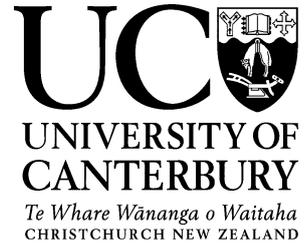
- Rothauser, E.H., Chapman, W.D., Guttman, N., Hecker, M.H.L., Nordby, K.S., Silbiger, H.R. ... Weinstock, M. (1969). IEEE recommended practice for speech quality measurements. *IEEE Transactions on Audio and Electroacoustics*, 17(3), 225 - 246.
- Saliba, I., Martineau, G., & Chaqnon, M. (2009). Asymmetric hearing loss: rule 3,000 for screening vestibular schwannoma. *Otol Neurotol*, 30(4), 515 - 521.
- Salkind, N. (2010). Convenience Sampling. Encyclopedia of Research Design. SAGE Publications, Inc. In N. J. Salkind (Ed.), *Encyclopedia of Research Design* (pp. 255). Thousand Oaks, CA: SAGE Publications, Inc.
- Schlauch, R.S. & Nelson, P. (2009). Puretone Evaluation. In J. Katz (Ed.), *Handbook of Clinical Audiology* (6th Ed.). Baltimore: Lippincott Williams & Wilkins.
- Schuele, C.M. & Justice, L.M. (2006). The importance of effect sizes in the interpretation or research. *The Asha Leader*,
<http://www.asha.org/Publications/leader/2006/060815/f060815d/>
- Skinner, M. W. (1988). *Hearing Aid Evaluation*. New Jersey: Prentice Hall.
- Smeeth, L., Fletcher, A. E., Ng, E. S., Stirling, S., Nunes, M., Breeze, E., . . . Tulloch, A. (2002). Reduced hearing, ownership, and use of hearing aids in elderly people in the UK--the MRC Trial of the assessment and management of older people in the community: a cross-sectional survey. *Lancet*, 359(9316), 1466 - 1470.
- Solheim, J. (2011). Preconceptions and expectations of older adults about getting hearing aids. *Journal of Multidisciplinary Healthcare*, 14, 1 - 8.
- Solli, H.M. & da Silva, A.B. (2012). The holistic claims of the biopsychosocial conception of WHO's International Classification of Functioning, Disability, And Health (ICF): A conceptual analysis on the basis of a pluralistic – holistic ontology and multidimensional view of the human being. *Journal of Medicine and Philosophy*, 27, 277 – 294.

- Stahelin, K., Bertoli, S., Probst, R., Schindler, C., Dratva, J. & Stutz, E.Z. (2011). Gender and hearing aids: Patterns of use and determinants of nonregular use. *Ear Hear*, 32, e26–e37
- Statistics New Zealand. (2007). *2006 Disability survey*. Retrieved from http://www.stats.govt.nz/browse_for_stats/health/disabilities/disabilitysurvey2006_hopt06.aspx
- Statistics New Zealand. (2012). *Projected population tables*. Retrieved from http://www.stats.govt.nz/tools_and_services/nzdotstat/population-projections-tables.aspx
- Swan, I. R., & Gatehouse, S. (1990). Factors influencing consultation for management of hearing disability. *British Journal of Audiology*, 24(3), 155-160
- Swan, I. R. C., Guy, F. H., & Akeroyd, M. A. (2012). Health-related quality of life before and after management in adults referred to otolaryngology: a prospective national study. *Clinical Otolaryngology* 37, 35 - 43.
- Taylor, B. & Mueller, H.G. (2011). *Fitting and Dispensing Hearing Aids*. Abington: Plural Publishing
- Taylor, C. (1995). Politics of Recognition. In A. Gutmann (Ed.), *Multiculturalism*. Princeton: Princeton University Press.
- Terzi, L. (2004). The Social Model of Disability: A Philosophical Critique. *Journal of Applied Philosophy*, 21(2), 141 - 157.
- Thomas, C. (2004). Disability and Impairment. In J. Swain, S. French, C. Barnes & C. Thomas (Eds.), *Disabling Barriers, Enabling Environments* (2nd Ed.). London: Sage.
- Thomas, A. & Herbst, K.G. (1980). Social and psychological implications of acquired deafness for adults of employment age. *British Journal of Audiology*, 14(3), 76-85.
- Traynor, B. (2011). The incidence of hearing loss around the world. *Hearing Health &*

- Techonology Matters*, (6 April). Retrieved from <http://hearinghealthmatters.org/hearinginternational/2011/incidence-of-hearing-loss-around-the-world/>
- Tucci, D., Merson, M. H., & Wilson, B. S. (2009). A summary of the literature on global hearing impairment: current status and priorities for action. *Otology & Neurotology*, 31(1).
- United Nations. (2006). *Convention on the Rights of Persons with Disabilities*. Retrieved from <http://www.un.org/disabilities/convention/conventionfull.shtml>
- University of Memphis (1999). *Satisfaction with Amplification in Daily Life*. Retrieved from <http://www.harlmemphis.org/>
- University of Memphis (2003). *Satisfaction with Amplification in Daily Life Scoring*. Retrieved from <http://www.harlmemphis.org/>
- van den Brink, R.H., Wit, H.P., Kempen, G.I., & Heuvelen, M.J. (1996). Attitude and help-seeking for hearing impairment. *British Journal of Audiology*, 30(5), 313 – 324.
- Vento, B.A. & Durrant, J. D. (2009). Assessing bone conduction thresholds in clinical practice. In J. Katz (Ed.), *Handbook of Clinical Audiology* (6th Ed.). Baltimore: Lippincott Williams & Wilkins.
- Ventry, I. M., & Weinstein, B. E. (1982). The hearing handicap inventory for the elderly: a new tool. *Ear and Hearing*, 3(3), 128 - 134.
- Vuorialho, A., Karinen,P, & Sorri, M. (2006). Counselling of hearing aid users is highly cost-effective. *European Archives of Oto-Rhino-Larangology*, 263(11), 988 – 995.
- Wilber, L. A., & Burkard, R. (2009). Calibration: Puretone, speech and noise signals. In J. Katz (Ed.), *Handbook of Clinical Audiology* (6th Ed.). Baltimore : Lippincott Williams & Wilkins.
- World Health Organization. (2001). *International classification of functioning, disability and health (ICF)*. Retrieved from <http://www.who.int/classifications/icf/en/>

- World Health Organization. (2002). *Towards a common language for Functioning, Disability and Health (ICF)*. Retrieved from <http://www.who.int/classification/icf>
- World Health Organization. (2011). *World report on disability*. Retrieved from http://whqlibdoc.who.int/publications/2011/9789240685215_eng.pdf
- World Health Organization. (2012). *WHO global estimates on prevalence of hearing loss*. Retrieved from http://www.who.int/pbd/deafness/WHO_GE_HL.pdf
- World Health Organization. (2013). *10 Facts on the state of global health*. Retrieved from http://www.who.int/features/factfiles/global_burden/facts/en/index7.html
- World Health Organization. (2014). *Grades of hearing impairment*. Retrieved from http://www.who.int/pbd/deafness/hearing_impairment_grades/en/
- Wilson, C., & Stephens, D. (2003). Reasons for referral and attitudes toward hearing aids: do they affect outcomes. *Clinical Otolaryngology & Allied Sciences*, 28, 81- 84.
- Zapala, D., Criter, R. E., Bogle, J. M., Lundy, L. B., Cevette, M. J., et al., (2012). Pure-tone hearing asymmetry: A logistic approach modelling age, sex, and noise exposure history. *Journal of the American Academy of Audiology*, 23(7), 553 - 570.

Appendix A: MHL Study Information Sheet



University of Canterbury
Department of Communication Disorders
Private Bag 4800
Christchurch 8140
New Zealand

STUDY INFORMATION

You are invited to participate as a participant in the research project entitled “Audiological Outcomes for Adults with Mild Hearing Impairment”.

The aim of this project is to better understand how adults with mild hearing impairment who live in New Zealand who adopt hearing aids experience hearing aid outcomes. Previous research has focused on people with a moderate hearing impairment and worse. However, having a mild hearing impairment can lead to a significant decrease in communication ability, and therefore other negative effects on the lived experiences of people. Information from this research project may help improve clinical practice and engagement in New Zealand.

Your involvement in this project will include: (1) filling in an information sheet about yourself, and (2) filling in standardised questionnaires about your experiences in terms of wearing hearing aids.

You have the right to withdraw from the project at any time, including withdrawal of any information you have provided. Your involvement (or withdrawal) in this project will not affect your ability to seek and receive services at the hearing aid clinic where your hearing is tested.

You will be asked about your experience wearing and using a hearing aid and the risk of participating in this study includes the possibility of feelings of distress as you complete the standardised questionnaires. A list of available support services is provided at the end of this document.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation. The consent form will be kept in a locked cabinet in a locked room in the Department of Communication Disorders on the University of Canterbury campus in Christchurch, New Zealand. The questionnaires that you complete as well as your audiological information will only be viewed by the researchers as well as your audiologist. Electronic data (without your identifying information) will be kept on password-protected computers that are stored in a locked room in the Department of Communication Disorders on the University of Canterbury campus in Christchurch, New Zealand.

This project is being carried out as a requirement of the Master of Audiology degree at the University of Canterbury by Karen Thomas under the supervision of Dr. Rebecca Kelly-Campbell, who can be

contacted on +64 (3) 364-8327. They will be pleased to discuss any concerns you may have about participation in the project.

The project and been reviewed *and approved* by the University of Canterbury Human Ethics Committee. The Human Ethics Committee can be contacted at University of Canterbury, Okeover House, Christchurch and on 03-364-2987.

Available support services:

LifeLine

09 5222999 (within Auckland) 0800 543 345 (outside Auckland) <http://www.lifeline.org.nz/>

New Zealand Association of Counsellors http://nzac.org.nz/nzac_counsellor_search.cfm

07 834 0220 (National Office)

Appendix B: Consent Form

Researchers: Karen Thomas, Rebecca Kelly-Campbell

Contact address:

University of Canterbury
Department of Communication Disorders
Private Bag 4800
Christchurch 8140
New Zealand

Date:

Consent Form

“Audiological Outcomes for Adults with Mild Hearing Impairment”

I have read and understood the description of the above-named project. On this basis, I agree to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided.

I note that the project has been reviewed *and approved* by the University of Canterbury Human Ethics Committee.

Name: (please print): _____

Signature: _____

Date: _____

Appendix C: Demographic Information

Mild Hearing Loss Study – Demographic Information



1. How long have you had difficulty with your hearing for? e.g. 3yrs, 10yrs.....

2. Have you ever owned a hearing aid? If 'Yes' go to Qu 3, if 'No' go to Qu 6.

Yes) No)

3. If Yes, do you currently wear at least one hearing aid?

Yes) No)

4. How long have you worn your hearing aids(s) for? Eg, 2yrs.....

5. How often do you wear your hearing aid(s)? eg. Every day, once a month.....

6. What is your current work status?

Retired) Employed Full-Time)

Employed Part-Time) Not working outside the home)

6. What is your current Living Situation?

Live alone) Retirement home)

Live with partner) Other:_____)

Live with extended family:)

of people in household ____

7. What is your highest Qualification level?

Primary School) Tertiary Education)

Secondary School) Other:_____)

8. Which ethnic group do you belong to

New Zealand European) Tongan)

Māori) Niuean)

Samoan) Chinese)

Cook Island Māori) Indian)

Other such as Dutch, Japanese, Tokelauan. Please state:
