

# Hearing Review™

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Issue 25 - 2012

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### Abbreviations used in this issue

HA = hearing aid  
HL = hearing loss

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## Welcome to the twenty-fifth issue of Hearing Review.

Two of the studies that we have covered in this issue have analysed data on hearing loss from the Baltimore Longitudinal Study of Aging, the longest running study of human ageing in the US. Findings from one of these studies demonstrates that older adults with hearing loss appear more likely to develop dementia and their risk increases as hearing loss becomes more severe. The other study shows that there is a clinically significant association between hearing loss and cognitive function. Does hearing loss lead to dementia/reduced cognition, or vice versa? Or is there a shared cause between hearing loss cognitive decline? More research is needed.

I hope you find the papers in this issue useful in your practice and I welcome your comments and feedback.

Kind regards,

Valerie Looi

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## Reactions to the diagnosis of a progressive hearing loss in adults

**Authors:** Light KJ, Looi V

**Summary:** This paper describes the emotional reactions experienced by 27 adults who had been newly-diagnosed with hearing loss (HL). Commonly reported emotions included a sense of loss, sadness, and resignation, as well as relief. The study researchers also evaluated audiological counselling services. These were rated positively by the patients and did not seem to significantly influence the individual's decision on whether to purchase hearing aids or not.

**Comment:** This NZ study evaluated both a patient's reaction to being diagnosed with a HL as well as the subsequent audiological counselling provided. It involved adults who were newly-diagnosed with a HL, and involved the completion of 2 questionnaires, the first of which was completed within 24hrs of the diagnosis, along with an interview. The questionnaires and interview items are provided in the paper. There was no correlation between gender or age & emotional response, although those with a greater level of HL were more likely to experience disbelief & hopelessness than those with lesser HL. Ratings of the audiologists were generally positive, although some participants felt that more time was required for explaining the hearing tests results & the implications, and providing more opportunity for questions. Interestingly, more than half of the participants reported that they were not told about how to communicate better or cope with their HL, and non-hearing aid (HA) alternatives were not discussed with any participant.

One recommendation arising from the study was to provide patients with information prior to i) their hearing test, explaining the basics of HL, its implications and the options of treatment & management, and ii) the hearing aid fitting appointment to inform them about this process and set realistic expectations.

*J Acad Rehabil Audiol. 2011;44:53-84.*

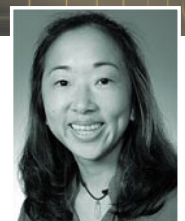
## Hearing Review™

### Independent commentary by Dr Valerie Looi.

Valerie is an Adjunct Fellow with the Department of Communication Disorders at the University of Canterbury. Her primary areas of research are in the field of cochlear implants, along with the music perception of those with a hearing impairment. She is particularly interested in developing a music training programme for cochlear implant users.

For full bio [CLICK HERE](#).

Research Review publications are intended for NZ Medical Professionals.



## Hearing loss and incident dementia

**Authors:** Lin FR et al

**Summary:** These researchers sought to determine if HL is associated with incident all-cause dementia and Alzheimer's disease, by following a cohort of 639 individuals aged 36–90 years enrolled in the Baltimore Longitudinal Study of Aging who had audiometric testing and who were dementia-free in 1990–1994. During a median 11.9-year follow-up, HL was independently associated with incident all-cause dementia in adjusted analyses.

**Comment:** In some very interesting statistics on dementia, its prevalence is expected to double every 20 years; by 2050, more than 100 million people (1/85 people) worldwide will be affected. Any intervention for dementia that could delay its onset by 1 year would result in >10% decrease in the prevalence of dementia in 2050.

This study looked specifically at 58 adults with HL (from 639 adults involved in the Baltimore Longitudinal Study on Aging) who had diagnosed dementia. Of the initial group of 639 adults: 43% of participants had a HL of at least 25dB in the better hearing ear, and the relative risk of dementia associated with HL was 2.32; the attributable risk of dementia associated with HL in this subcohort was 36.4%. Independent of age, those who later developed dementia experienced an average PTA loss of 0.52 dB/year, compared with 0.27 dB/year in those who didn't develop dementia. When the model for statistical analysis was adjusted for sex, age, race, education, diabetes, smoking and hypertension, every 10dB of HL increased the risk of dementia 1.27 times after a loss of 25dB (mild HL). Hearing aid use did not reduce the risk of dementia, suggesting that prevention is paramount. Compared with normal hearing, those with a mild HL had a 1.89 times increased risk of dementia; for a moderate loss this risk was 3.00 times, and for a severe loss, it was 4.94 times.

**Reference:** *Arch Neurol.* 2011;68(2):214-20.

<http://archneur.jamanetwork.com/article.aspx?articleid=802291>

## Hearing loss and cognition in the Baltimore Longitudinal Study of Aging

**Authors:** Lin FR et al

**Summary:** Data were analysed from participants in the Baltimore Longitudinal Study of Aging without mild cognitive impairment or dementia who underwent audiometric and cognitive testing in 1990–1994.

**Comment:** In a related study to the one above, this paper looked at cognition & cognitive processing for 347 adults, aged 55yrs or older without dementia, using a standardised neurocognitive test battery. Scores in 8/10 tests declined with increased levels of HL, and this was particularly evident for measures of memory & executive function. When adjusted for sex, age, race, education, diabetes, smoking & hypertension, HL was more strongly associated with tests of memory and executive function than with tests of psychomotor/processing speech & verbal function. 25dB HL was equivalent to an age difference of 6.8 years on tests of executive function. Hearing aid use was not associated with scores on any of the cognitive tests.

The reason for the association between HL & dementia is unknown, but could include: i) the effect of HL on cognitive reserve and loading. When auditory perception is difficult (e.g. HL), more cognitive resources are allocated to auditory perceptual processing, to the detriment of other cognitive processes such as working memory. That is, if HL increases cognitive loading for auditory tasks, a smaller pool of resources are available for other cognitive tasks. ii) HL and communication difficulties increase social isolation and reduce social engagement. There is physiological evidence of neurobiological pathways linking loneliness with physiological pathology. Further, epidemiological & neuroanatomical studies have shown significant associations between social isolation & dementia. Individuals who remain engaged in leisure activities have shown a reduced risk of dementia, which may be related to lower  $\beta$ -amyloid levels when more socially stimulated.

**Reference:** *Neuropsychology.* 2011;25(6):763-70.

<http://psycnet.apa.org/journals/neu/25/6/763/>

## Hearing threshold levels at age 70 years (65–74 years) in the unscreened older adult population of the United States, 1959–1962 and 1999–2006

**Authors:** Hoffman H et al

**Summary:** This US study reports a lower prevalence of hearing impairment in older adults (aged 65–74 years) in 1999–2006 compared with 1959–1962.

**Comment:** At present, age-related HL reference data for international standards such as those by the ISO and ANSI have been based on data collected in the US between 1959–1962, with no exclusion of subjects in that sample who had a history of otological or noise exposure, nor has there been any gender division. The data in this study was collected in the US from the National Health & Nutrition Examination Survey, between 1999 and 2006, and included 472 subjects aged 65–69, and 252 subjects aged 70–74.

Overall, hearing thresholds are better in the more recent survey, although male thresholds are 19.3 dBHL worse than females (median of 3, 4 & 6kHz). The prevalence of HL (PTA of 0.5, 1, 2 & 4kHz) was 58.9% for males, 39.4% for females, and 48.1% combined. There was a 25% improvement for both sexes in the prevalence of HL, compared to the 1959–62 data. Reasons for the better thresholds may include: less occupational noise exposure, lower rates of smoking, better control of conditions such as diabetes and cardiovascular risk, and greater awareness of HL in the general public.

**Reference:** *Ear Hear.* 2012;33(3):437-40.

<http://tinyurl.com/8vfgvs8>



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## Societal costs of hearing disorders: a systematic and critical review of literature

**Authors:** Hjalte F et al

**Summary:** These researchers systematically reviewed the published literature on societal costs due to HL. According to the evidence, HL impacts the social welfare system more than the medical care system.

**Comment:** This very interesting paper reviews studies between 1995–2012 that report the societal costs of HL, as opposed to cost-effectiveness or cost-utility studies (i.e. studies evaluating the cost-benefit of interventions for hearing loss). The studies evaluated included both those that considered direct (e.g. resource use) and indirect (e.g. productivity losses, lower quality of work, increased mortality) costs.

In one paper from 2000 by Mohr & colleagues looking at the lifetime societal cost of severe to profound HL in the US, they estimated this to be USD\$410,000 during the lifetime for 1 person; this is comparable to the lifetime cost of schizophrenia, and twice the cost of stroke. Another similar study from 2004 by Honeycutt and colleagues estimated the lifetime cost to be USD\$468,000 per person. In both studies, most of the costs were attributed to productivity losses. In a paediatric study from the UK, comparing the societal costs for normal hearing vs. hearing impaired children aged 7–9 years in the preceding year of life, costs were USD\$8227 for a NH child vs. USD\$27,729 for a child with a HL – i.e. greater than 3 times the NH costs. In a study from Australia, the financial cost of HL was estimated to be USD\$10.5 billion, or 1.4% of the GDP for 1 year (2005). Further, when converted to a quality of life measure (using a disability-adjusted life years measure – DALYs), 95,005 DALYs were estimated lost in 2005. In terms of disability equivalence, a mild HL was comparable to mild asthma, a moderate HL to chronic pain from a slipped disc, and a severe HL to having chronic pneumonia.

**Reference:** *Int J Audiol.* 2012;51(9):655–62.

<http://informahealthcare.com/doi/abs/10.3109/14992027.2012.690077>

## Implantation of the semicircular canals with preservation of hearing and rotational sensitivity: a vestibular neurostimulator suitable for clinical research

**Authors:** Rubinstein JT et al

**Summary:** These researchers describe the successful implantation of a stimulating electrode array in the semicircular canals without damaging rotational sensitivity or hearing in rhesus macaques. This device shows promise for the amelioration of abnormal vestibular function.

**Comment:** This research discusses the development of a vestibular implant and its successful use in an experiment with rhesus monkeys; the data from this has enabled the centre to begin clinical trials of the device in human subjects. Current therapy for vestibular dysfunction consists of either ablative therapies or vestibular rehabilitation. However, except for superior semicircular canal dehiscence and vestibular rehabilitation, there has been little change in drug or surgical therapies for vestibular dysfunction in the last 25 years. The vestibular implant is based on the principles of a cochlear implant, electrically stimulating the vestibular labyrinth to provide missing vestibular information using a trifurcating array of 9 electrodes – i.e. 3 electrode pads on each of 3x 2.5mm arrays. The trial showed that with precise electrode placement near the ampullae of the semicircular canals, robust activation of eye movement could be recorded. Importantly, hearing was largely preserved for 6/7 monkeys. Like the cochlear nerve, an ECAP could be recorded from the vestibular nerve, and recorded using standard clinical cochlear implant software. Details and images of the implant, surgery, stimulating pulses, recording software and hearing preservation is provided in the paper. It is hoped that the implant will provide relief from vertigo attacks associated with Ménière's disease, with the long-term goal being to restore balance function through electrical stimulation.

**Reference:** *Otol Neurotol.* 2012;33(5):789–96.

<http://tinyurl.com/9lnqms8>

## What makes adults with hearing impairment take up hearing aids or communication programs and achieve successful outcomes?

**Authors:** Laplante-Lévesque A et al

**Summary:** This Australian study investigated the predictors of uptake and of successful outcomes of hearing aids and communication programs in 153 middle-aged and older adults with hearing impairment seeking help for the first time. Seven intervention uptake predictors were identified: (1) application for subsidised hearing services (participants more likely to obtain hearing aids and less likely to complete no intervention); (2) higher socioeconomic status (no intervention less likely); (3) greater communication self-efficacy (hearing aids less likely); (4) greater contemplation stage of change (no intervention less likely); (5) greater hearing disability perceived by others and self (communication programs less likely); (6) greater perceived communication program effectiveness (communication programs more likely); and (7) greater perceived suitability of individual communication program (hearing aids less likely and communication programs more likely). Six predictors of successful intervention outcomes were identified: (1) higher socioeconomic status; (2) greater initial self-reported hearing disability; (3) lower precontemplation stage of change; (4) greater action stage of change; (5) lower chance locus of control; and (6) greater hearing disability perceived by others and self.

**Comment:** This study was a follow-up from a previous study conducted by these authors looking at intervention decision making in adults with hearing impairment, where they were offered the following options: hearing aids, group & individual communication programs, and no intervention. However, when they followed-up on these participants' decisions, they found that the uptake was quite poor, and not all participants pursued the intervention they had decided on. Therefore, this study was to determine predictors of uptake and successful outcomes for adults seeking audiological help for the first time. The seven variables listed above accurately predicted more than 70% of the adults' intervention uptake, with the second set of 6 variables accounting for 10–52% of the variance in intervention outcomes at 3 months post-intervention completion. When compared to their previous research, though, there were differences in the predictor variables for intervention decisions vs. intervention uptake (e.g. level of hearing loss predicted the intervention decision, but not intervention uptake), with these outlined in the paper. One other issue the authors discuss is the need for clinics to expand the range of intervention options offered (i.e. not just hearing aids), as a significant proportion of these participants opted for the non-hearing aid option.

**Reference:** *Ear Hear.* 2012;33(1):79–93.

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## Audiologist-driven versus patient-driven fine tuning of hearing instruments

**Authors:** Boymans M, Dreschler WA

**Summary:** These researchers compared two methods of fine tuning the initial settings of HAs: An audiologist-driven approach – using real ear measurements and a patient-driven fine-tuning approach – using feedback from real-life situations. A total of 73 participants were included.

**Comment:** In fitting HAs, the starting point, or ‘first-fit’ using the manufacturer’s fitting rules is usually well defined, however, the fine-tuning process after the user has trialed the HA(s) for a period of time is often more arbitrary with a variety of approaches available. This study compared a more subjective patient-driven (PD) approach (Amplifit® audiovideo clips) to an objective audiologist-driven (AD) one (NAL-NL1 prescription). Whereas the former would be more likely to tailor the fitting to listening comfort for listening conditions relevant to the individual, the latter focuses on general speech intelligibility. Hence, one may predict that PD settings may result in higher scores on comfort and quality ratings. However, the study only found weak evidence to support this; loudness comfort ratings were higher for the PD approach, but sound quality ratings were higher for the AD settings. Additionally, speech intelligibility scores were significantly better for the AD settings, as were the objective speech perception test scores. Hence the authors caution that a PD-only approach may lead to suboptimal speech perception. However, given that loudness comfort is important to user acceptance, a mixed procedure that first uses the objective prescription and later the Amplifit (or another PD approach) may be an option to consider.

**Reference:** *Trends Amplif.* 2012;16(1):49-58.

<http://intl-tia.sagepub.com/content/16/1/49>

## Clinical measures of hearing aid directivity: assumption, accuracy, and reliability

**Authors:** Wu YH, Bentler RA

**Summary:** The directivity of the directional microphones of two behind-the-ear HAs was measured with 4 clinical measures: the front-to-back ratio (FBR) and front-to-side ratio (FSR) performed in the test chamber of a HA analyser and in sound field; with the Directivity Index (DI) measured in an anechoic chamber; and with the Hearing in Noise Test (HINT), to measure the perceptual directional benefit in each directivity-degraded condition among 10 hearing-impaired adults in a sound field with diffuse noise. The aim of the study was to determine whether directivity, when measured in a clinical setting, changes monotonically when compared with measurements made using the DI and perceptual directional benefit. The findings support the use of the FSR by clinicians to monitor HA directivity, informed with a 30% change in directivity recommended as the referral threshold signifying defective directional systems.

**Comment:** One feature of HAs that needs verification and monitoring is the directionality of the microphone system. Directionality may decline over time, and have a deleterious effect on performance. In a dual-microphone system, the 2 omnidirectional microphones must have precisely matched amplitude and phase characteristics; if the output of either microphone shifts, the directivity would be decreased. This “drift” typically occurs after long-term use, and is usually frequency-dependent; average drift is approximately 0.25dB after 1 year of use. Most HAs do have an automatic compensation algorithm for this drift. However, the algorithm doesn’t allow for mismatch caused by dirt and moisture accumulation. Clogged ports result in frequency-dependent changes in amplitude and phase, and have a greater impact on directivity and performance of speech in noise.

The ‘gold standard’ for measuring microphone directivity is the Directivity Index, which describes the attenuation capabilities in a soundfield of diffuse noise; it’s correlated with perceptual directional benefit. However, as it requires an anechoic chamber and specialised equipment, it’s not used in a clinical setting.

This study compares two different clinically-feasible measures for assessing directionality of HA microphones, how to perform these checks, reports on their respective reliabilities, and recommends a 30% change in directivity as a referral threshold for clinicians to determine defective directionality systems.

**Reference:** *Ear Hear.* 2012;33(1):44-56.

<http://tinyurl.com/8tvr9hg>

## Bilateral bone-anchored hearing aids for bilateral permanent conductive hearing loss: a systematic review

**Authors:** Janssen RM et al

**Summary:** These researchers systematically reviewed the data from 11 observational studies that described the outcomes of bilateral versus unilateral bone-anchored hearing aids (BAHAs) for bilateral permanent conductive hearing loss.

**Comment:** Based on the principles of dental implants where osseointegration occurs between titanium implants and bone, a BAHA comprises a titanium screw with a percutaneous abutment to which a sound processor/bone conductor is attached. It can compensate for any amount of air-bone gap, and has been shown to provide significant benefits for patients with bilateral conductive hearing losses, those unable to wear air conduction HAs (e.g. atresia), and single-sided deafness. Mixed losses can also benefit from a BAHA, although there is a limit to which the sensory component can be adequately fitted. Fitting of bilateral BAHAs is debated, given the additional cost, additional surgery, and the fact that both cochleae are stimulated with a single bone conduction transducer. However, there is evidence that binaural benefits can be obtained via bone conduction and that 2 bone conduction transducers may allow patients to detect interaural timing and intensity cues.

This publication summarises the reported advantages of bilateral BAHA implants for a wide variety of candidates (adults and children), including improved hearing sensitivity, speech perception in quiet and in noise, localisation and lateralisation, sound quality and quality of life. The one exception was for speech perception in noise when the noise was directed to the unaided ear (in the unilateral condition); in this case, bilateral BAHAs offered no benefit, or made things worse when compared to unilateral stimulation. Some of the candidacy considerations include: age, aetiology of hearing loss, binaural hearing experience; and bilateral symmetry. Although this study found considerable support for the clinical benefits of bilateral direct bone conduction, it highlighted the need for more studies of cost-effectiveness.

**Reference:** *Otolaryngol Head Neck Surg.* 2012 Jun 19. [Epub ahead of print]

<http://oto.sagepub.com/content/early/2012/06/18/0194599812451569.abstract>

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