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RESEARCH

**Quality of Life handicap measured in patients with profound unilateral or bilateral deafness**

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**Abstract**

**Background** Current literature related to the impact of hearing impairment on quality of life (QOL) is focused on patients with mild to moderate hearing loss. Little is known about the quantitative effect of severe hearing losses. The aim of this study was to measure the impact that single sided deafness and bilateral profound deafness has on the QOL of an individual.

**Methods** QOL was measured by the Hearing Handicap Inventory for Adults (HHIA) in ninety-six subjects with either single sided complete deafness or bilateral profound hearing loss treated with a cochlear implant, with HHIA performed for assessment of cochlear implant candidacy.

**Results** Seventy one percent of the study cohort indicated that hearing loss had a significant impact on QOL, but the impact was less in the group with unilateral deafness. The difference was identified for both social and emotional domains of the HHIA ( $t = 4.64, p < 0.005$ ) and ( $t = 4.08, p < 0.005$ ), respectively.

**Conclusions** The findings confirms that severe hearing loss has significant effects on QOL. The lesser impact in unilateral deafness is likely to be attributable to the remaining function in the contralateral ear.

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**Introduction**

Hearing impairment is the third most common chronic disease in the world. Hearing impairment is associated not only with listening difficulties but with large social and economic costs.<sup>1,2</sup> It is estimated that over 5% of the world's population lives with a disabling hearing loss and with an ageing population, the prevalence of individuals developing a hearing loss is expected to grow.<sup>3</sup> Past epidemiological studies estimate that the prevalence of hearing loss increases from 21% in individuals aged between 48 to 60 years to 90% in individuals aged over 80 years.<sup>4,5</sup> Hearing loss affects 58% of older Australians between the age of 61 and 70 years and 74% of those older than 71 years of age.<sup>6</sup> Recent large population studies have also shown that hearing loss is an independent predictor of cognitive

decline and dementia.<sup>7-10</sup> On average, older adults with hearing loss developed cognitive impairment 3.2 years sooner and had a 24% higher risk of incident cognitive impairment than those with normal hearing.<sup>10</sup>

The primary effect of hearing loss is impaired communication. With limited access to all speech sounds, individuals living with a hearing loss will have reduced speech intelligibility. As a result, the hearing-impaired individual will often require the speaker to communicate at a louder than normal volume or they will rely heavily on lip reading for them to understand the conversation.<sup>11</sup> The reduced communication ability of a hearing impaired individual is exacerbated in complex environments, such as in the presence of background noise, and this can often have a severe

impact on the quality of life (QOL) of a hearing impaired individual.<sup>12</sup> The QOL of a hearing impaired individual can be affected several aspects such as their emotional, cognitive, behavioural, occupation and social functions.<sup>13,14</sup> Several studies investigating the psychological distress associated with a hearing impairment identified that individuals with a hearing loss are more prone to developing anxiety, depression, phobic anxiety and aggressive behaviours – all of which contributed to a decreased QOL for those living with a hearing impairment.<sup>15-17</sup> It is widely accepted that hearing loss provokes social isolation, frustration and more dependence on support services for completion of daily activities<sup>13,14</sup> which adds to the cost associated with hearing loss and its treatment. The Hearing Care Industry Association (HCIA) estimated that, in Australia in 2017, the economic costs associated with hearing loss reached AU\$33.3 billion, including AU\$17.4 attributed to financing the wellbeing costs of individuals who have a hearing impairment.<sup>18</sup>

Assessment of an individual's hearing loss is quantified by the use of pure tone audiometry and the hearing loss itself is classified at different levels. Whilst pure tone audiometry does successfully capture the nature and severity of an individual's hearing loss, it fails to capture how the hearing impairment is affecting the quality of life (QOL). The level of hearing loss as per the pure tone audiometry does not reflect the level of handicap of the individual. One study has suggested that individuals living with a hearing loss can report the same impaired QOL outcomes even if they have differing hearing loss levels.<sup>19</sup>

A profound sensorineural hearing loss in one ear (single-sided deafness) or bilaterally is often rehabilitated using a cochlear implant, the gold standard treatment for hearing loss where conventional hearing aids cannot provide sufficient amplification.

Bilaterally deaf people have a high level of handicap that impairs their ability to communicate and function socially. On the other hand, people with single-sided deafness have access to one good ear and might consequently appear relatively unimpaired in quiet environments. Lack of two functioning ears has been shown to hinder an individual's ability to hear stereophonically and to understand speech in a noisy environment.<sup>20</sup> The social costs of single-sided deafness are associated with increased stress in trying to identify the optimal spatial positioning to understand and participate in a conversation.<sup>21</sup> Consequently, single-sided deafness individuals can feel socially isolated. It therefore appears that quality of life must be reduced.

Self-reported questionnaires are often used to assess the impact that a hearing impairment is having on an individual's QOL. Self-reported questionnaires are a quick and inexpensive method to assess the QOL that a hearing impairment is bringing to an individual.<sup>22</sup> These include the Hearing Handicap Inventory for Adults (HHIA), amongst others. The HHIA amended the Hearing Handicap Inventory for the Elderly by changing three questions to focus more on how the hearing loss impacts one's occupation, in order to apply more to persons less than 65 years old.<sup>23</sup> It is a 25-item questionnaire that evaluates the emotional (for example "Does a hearing problem cause you to feel depressed?") and social (for example "Does a hearing problem cause you to use the phone less than you would like?") problems adults with a hearing loss face,<sup>24</sup> and its validity has been demonstrated.<sup>23,25</sup>

Studies using the HHIA have focused on individuals who present with modest hearing loss likely to benefit from conventional hearing aids.<sup>26-28</sup> There is limited information about how QOL is affected in individuals with single-sided or bilateral profound hearing loss. The aim of this retrospective study is two-fold. First, we investigated the level of handicap reported by patients with profound hearing loss in one or both ears. Second, we compared both the single sided deaf and bilateral profound hearing loss patients. We wished to formally demonstrate what may appear obvious: that individuals with a profound bilateral hearing loss have a higher level of handicap compared to individuals with unilateral deafness.

## Methods

This study took place in a tertiary hospital in Western Australia. This study was designed and conducted in accordance with the Helsinki Declaration. Ethical approval for this study was obtained from South Metropolitan Health Ethics Committee (Approval Code: 2099).

### Subjects

Two hundred and sixty-eight adult patients (131 females, 137 males) who had profound hearing loss in one ear or bilaterally and had been referred for cochlear implant assessment were recruited for this study. The following inclusion criteria were used:

- Adult over 18 years and younger than 65 years
- Considered suitable to receive a cochlear implant to treat their profound hearing loss
- Have completed HHIA in full
- Provided written consent

Subjects were excluded from the study based on the following exclusion criteria:

- Younger than 18 years
- Older than 65 years
- Incomplete HHIA questionnaire
- No written informed consent

#### Hearing Handicap Inventory for Adults

The HHIA was completed once only at the time of the assessment for cochlear implantation suitability. The HHIA consists of 12 questions on the social impact and 13 on the emotional impact. All questions can be completed within a few minutes by the hearing-impaired individual.<sup>1</sup> The respondent is instructed to answer either 'yes', 'sometimes' or 'no' to each item, which is then assigned a score of 4, 2 and 0 respectively. The maximum total score is 100, with the maximum score for social and emotional subsections being 48 and 52 respectively. A score ranging from 0 to 16% indicates no handicap, 17% to 42% indicates a mild to moderate handicap and any scores above 43% indicates a significant handicap.<sup>25</sup>

#### Statistical Analysis

Given the uneven distribution of the data, emotional and social HHIA scores were transformed with Yeo Johnson transformation and log transformation respectively. The Yeo Johnson transformation was chosen as there was a score of zero in the data set. Two sample t-test of equal variance was used to identify if there was a significant difference between groups. All statistical analysis and graph production were conducted using Microsoft Excel 2010.

## Results

### Subjects

268 adult patients were considered suitable to receive a cochlear implant, from which 156 adult patients were selected based on the criteria above. Sixty persons older than age 65 years were excluded. Thus 96 individuals ((mean (SD) age = 49.4 (13.6) years, 47 males, 49 females) participated.

### HHIA Scores

The group average score in the emotional scale was  $29.7 \pm 14.1$  and in the social scale was  $29.3 \pm 13.4$ . This represents a handicap level compared to the maximum possible of 57% and 61% for emotional and social domains of the HHIA. These values are classified as being significant by HHIA standards. The subgroup with a bilateral profound hearing loss showed an average score in the emotional and social sub-scales of  $35.1 \pm 13.3$  and  $36.1 \pm 11.8$  respectively. This represents a handicap level of 61% and 69% for the two domains, and classified a significant handicap by HHIA standards. The corresponding scores for those with single-sided deafness were  $24.0 \pm 12.9$  and  $22.3 \pm$

11.4, a handicap level of 46% for the two domains of the HHIA. Figure 1 shows the percentage of patients for both single-sided deafness and bilateral profound hearing loss individuals in each sub-level of self-reported handicap. A majority (70.8%) of individuals with a profound hearing loss indicated via the HHIA questionnaire that their hearing loss was having a significant impact on their QOL. Mild to moderate handicap was reported by 22.9%, and 6.3% reporting no handicap. The difference between severe and mild to moderate handicaps was significant ( $p < 0.005$ ).

Figure 2A and 2B show the impact of each HHIA wellbeing domain in the two patient groups. For both domains, the impact on QOL was significantly less in patients with unilateral deafness (Social subset,  $P < 0.005$ ; Emotional subset,  $p = 0.02$ ).

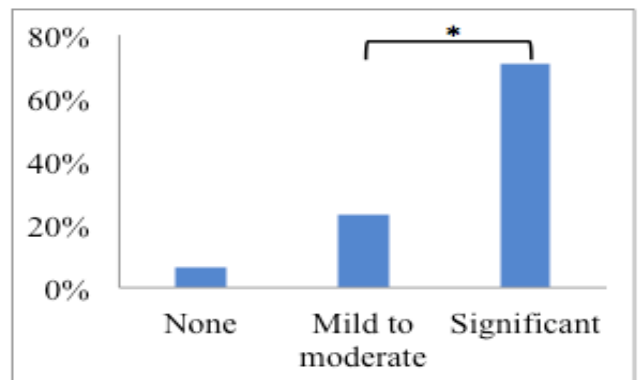
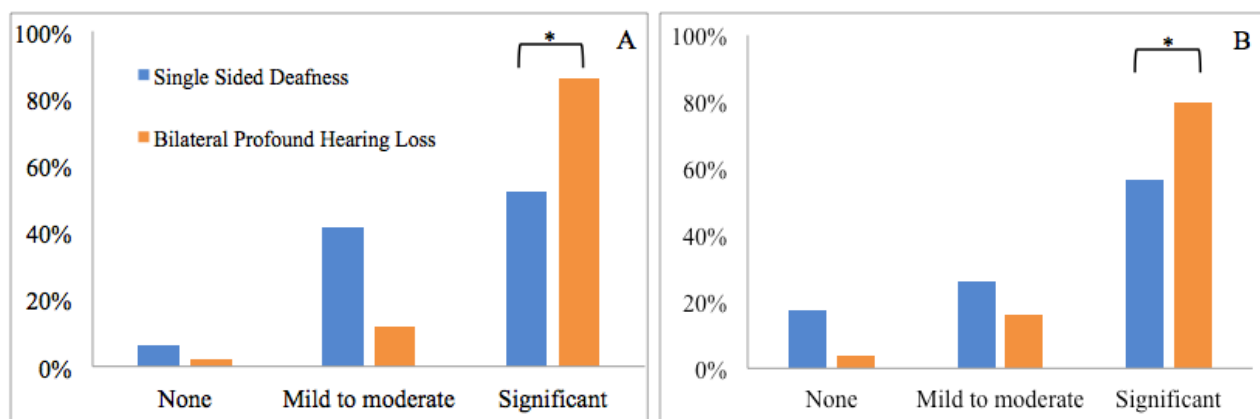


Fig. 1. Percentage of subjects with a profound hearing loss who identify as having no, mild to moderate or significant decrease in QOL. \*,  $p < 0.005$ .

## Discussion

In this study we evaluated the impact that single sided deafness and bilateral profound deafness has on the QOL of individuals who are candidates for a cochlear implant. All participants completed the HHIA prior to receiving a cochlear implant, in order to gauge the impact that their hearing loss was having on their QOL. The effect of the subsequent cochlear implant on QOL was not measured. The currently-available literature is limited to individuals whose hearing loss is not sufficiently severe for cochlear implantation and are therefore suitable for a hearing aid.<sup>26,27</sup> Furthermore, no study has compared differences in HHIA scores between single sided deafness and bilateral profound deafness.

Of all the bilaterally profoundly deaf subjects assessed in the current study, 86% indicated that the hearing loss has a significant impact on their QOL. This finding is higher than the impact (75%) reported by Parthasarathy



Figs 2A and 2B. Percentage of single-sided deaf and bilaterally deaf individuals who identify as having no, mild to moderate or significant decrease in QOL. 2A: Social impact of hearing loss on both cohorts; 2B: Emotional impact of hearing loss in both cohorts (shading as for 2A). \*,  $P < 0.005$ .

and Mathai.<sup>29,30</sup> As might be expected, the impact on QOL was largely attributed to impaired ability to exchange information, increased sense of isolation and greater dependence on others for completion of basic tasks.<sup>4</sup> To the best of our knowledge, the HHIA has not been used to compare individuals with single sided or bilateral deafness. However, our data is in line with previous studies using different self-reported questionnaires in patients with less severe unilateral hearing loss.<sup>30,31</sup>

In this study, patients with bilateral profound hearing loss had a higher level of handicap compared to single sided deaf individuals. This finding is logically attributable to the ability of the single sided deaf individual to rely on the functionality of their normal hearing ear in environments which do not require the need for binaural processing (for example, in quite environment).<sup>32,33</sup> This finding is in line with a similar report carried out in children.<sup>34</sup> Individuals with a bilateral profound hearing loss struggle to understand speech irrespective of the type of environment; quiet or noisy, as both ears possess a hearing loss.<sup>33</sup> As such, the poor functional performance of both single sided deafness and bilateral hearing loss individuals explains why in the present study we saw both cohorts indicate that their hearing loss is having a detrimental effect on their QOL. However, the ability of single sided deaf individuals to rely on the functionality of their normal hearing ear explains why they report a lesser impact on QOL than individuals with a bilateral profound hearing loss.

### Conclusion

This study identified that individuals with profound hearing loss in one or in both ears (single sided deafness and bilateral profound deafness) report a high level of social and emotional disadvantage. Those with bilateral

hearing loss had a relatively higher level of handicap when compared to those with single sided deafness. These findings suggest that while successful interventions for hearing impaired individuals in each category will have positive social, emotional and economic impacts, potential gains for people with profound bilateral hearing loss will be greater.

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*\*Editor's note: Kannada is a Dravidian language spoken predominantly by the people of Karnataka in SW India.*