

The relationship between hearing loss self-management and hearing aid benefit and satisfaction

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CONFLICT OF INTEREST STATEMENT

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ABSTRACT

Purpose: Hearing loss self-management refers to the knowledge and skills people use to manage the effects of hearing loss on all aspects of their daily life. The purpose of this study was to investigate the relationship between self-reported hearing loss self-management and hearing aid benefit and satisfaction.

Method: Thirty-seven adults with hearing loss, all of whom were current users of bilateral hearing aids, participated in this observational study. The participants completed self-report inventories probing their hearing loss self-management and hearing aid benefit and satisfaction. Correlation analysis was used to investigate the relationship between individual domains of hearing loss self-management and hearing aid benefit and satisfaction.

Results: Participants who reported better self-management of the effects of their hearing loss on their emotional wellbeing and social participation were more likely to report less aided listening difficulty in noisy and reverberant environments and greater satisfaction with the effect of their hearing aids on their self-image. Participants who reported better self-management in the areas of adhering to treatment, participating in shared decision-making, accessing services and resources, attending appointments, and monitoring for changes in their hearing and functional status were more likely to report greater satisfaction with the sound quality and performance of their hearing aids.

Conclusions: Study findings highlight the potential for using information about a patient's hearing loss self-management in different domains as part of clinical decision-making and management planning.

INTRODUCTION

Permanent hearing loss is a chronic condition that exerts significant effects on an individual's communicative functioning, psychosocial wellbeing, and health-related quality of life (Bainbridge & Wallhagen, 2014; Chia et al., 2007; Kramer, Kapteyn, Kuik, & Deeg, 2002).

The multidimensional experience of a chronic condition can be described using the International Classification of Functioning, Disability and Health (ICF), a biopsychosocial model of health and disability (World Health Organization, 2001). According to the ICF, health is experienced at three interrelated levels of functioning: body functions and structures, activities, and participation. Disability refers to dysfunctioning at one or more of these levels, for which the corresponding terms *impairments*, *activity limitations*, and *participation restrictions* are used (World Health Organization, 2001). In the context of hearing loss, for example, a loss of cochlear outer hair cells (impairment of structure) can cause a reduction in spectral and temporal resolution (impairment of function). These impairments may lead to difficulty hearing on the telephone (activity limitation) and thus restrict a person's ability to work in jobs that require frequent telephone use (participation restriction) (Audiology Australia, 2014; Danermark, Granberg, Kramer, Selb, & Möller, 2013). Environmental factors (e.g. family support, employment policies, societal attitudes) and personal factors (e.g. age, level of education, coping style) can serve as barriers or facilitators to functioning at any or all of these levels (World Health Organization, 2001). For the example described above, the person's friends and family may choose to communicate with her via text messaging or email instead of the telephone (environmental facilitator), whereas the person's employer may require her to answer telephone calls in a noisy open-plan office (environmental barrier). The person may be sufficiently self-confident to request accommodations in the workplace to enable her to optimally perform her duties (personal facilitator), or she may do nothing

because she believes she has no control over how the requirements of her job must be fulfilled (personal barrier). In summary, the ICF framework conceptualizes functioning and disability as arising from an interaction between a person's health state and the contextual factors that are present in the person's life (World Health Organization, 2001).

The ability to self-manage a chronic condition can be considered one of the personal factors that influences a person's experience of that condition. Self-management refers to the knowledge and skills that are used to manage the effects of a chronic condition on all aspects of daily life (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002; Convery, Hickson, Keidser, & Meyer, under review; Lorig & Holman, 2003). Self-management domains encompass not only the ongoing use and management of prescribed interventions, but also involves maintaining physical and emotional wellbeing; monitoring for and responding to changes in condition severity and functional status; seeking out information, resources, and support; and taking an active role in clinical decision-making (Battersby & Lawn, 2009; Clark et al., 1991). A recent study has suggested that there is considerable overlap in the domains of self-management that have been identified for chronic conditions such as diabetes, arthritis, and mental illness and those that are relevant for hearing loss. Convery et al. (2018) assessed hearing loss self-management in a group of 62 older adults using the Partners in Health scale and the Cue and Response interview, a complementary pair of validated tools that assess self-management holistically (Battersby, Ask, Reece, Markwick, & Collins, 2003) and which have been modified for use with adults with hearing loss (Convery, Keidser, Hickson, & Meyer, 2016; Convery, Meyer, Keidser, & Hickson, 2017). A comparison of the factor structure of the original and modified assessment tools revealed a number of common self-management domains, including knowing about one's condition, knowing about treatment options and management strategies, and managing the social and

emotional effects of the condition on everyday life. While there were specific aspects of self-management that appeared less relevant to hearing loss than to other chronic conditions, such as maintaining healthy dietary and exercise habits, the findings suggest that chronic condition self-management likely has broad conceptual applicability to adult hearing rehabilitation.

Self-management may be considered clinically useful to the extent that it can be linked with treatment outcomes. The implementation of programs to foster self-management skills has been shown in many studies to yield better patient outcomes, including improvements in physical disease measures such as glycemic control and blood pressure (Chodosh et al., 2005; Norris, Engelgau, & Narayan, 2001); improved self-efficacy for managing the day-to-day demands of a chronic condition (Brody et al., 1999; Lorig et al., 2001; R. H. Osborne, Wilson, Lorig, & McColl, 2007); less self-reported health distress (Brody et al., 1999; Harvey et al., 2008; R. H. Osborne et al., 2007); greater feelings of empowerment, hopefulness, and motivation (Harvey et al., 2008; Lawn et al., 2007); and better self-reported general health (Harvey et al., 2008; Ory et al., 2013). However, the vast majority of self-management research has been conducted in primary care settings with patients who have diabetes, arthritis, asthma, mental illness, and chronic respiratory and cardiovascular diseases. Despite the fact that hearing loss is an acknowledged chronic condition (World Health Organization, 2002), the relationship between self-management and patient outcomes in the context of adult hearing rehabilitation has not been well-established.

Hearing aids are the most common form of rehabilitation provided to adults with hearing loss. In ICF terms, hearing aids address impairments of body function by increasing audibility and restoring at least partial access to acoustic cues (Hickson & Scarinci, 2007; Meyer, Grenness, Scarinci, & Hickson, 2016). Commonly used measures of hearing aid

performance, such as speech discrimination and sound localization testing, also evaluate hearing aid outcomes at the impairment level of the ICF (Granberg, Dahlström, Möller, Kähäri, & Danermark, 2014; Granberg, Möller, Skagerstrand, Möller, & Danermark, 2014). Previous research has established that for patients with mild to moderately severe hearing loss, the use of hearing aids can also lead to a reduction in activity limitations and participation restrictions, with greater social participation, improved psychological wellbeing, better interpersonal relationships, and reduced anxiety and depression as reported outcomes (Chisolm et al., 2007; McArdle, Chisolm, Abrams, Wilson, & Doyle, 2005; Vuorialho, Karinen, & Sorri, 2006). Further, it is the activity limitations and participation restrictions arising from hearing loss, rather than an awareness of impaired body functions, that are among the primary motivators for adults to seek help for their hearing loss (Carson, 2005; Duijvestijn et al., 2003; Meyer, Hickson, Lovelock, Lampert, & Khan, 2014) and to take up hearing aids (Helvik, Wennberg, Jacobsen, & Hallberg, 2008; Knudsen, Öberg, Nielsen, Naylor, & Kramer, 2010; Laplante-Lévesque, Hickson, & Worrall, 2010). Together, these findings underscore the importance of selecting outcome measures that not only assess the impact of hearing aids on impairments of body function, but also their effect on activity limitations and participation restrictions.

Benefit and satisfaction are two frequently measured outcome domains that can be categorized within the activities and participation levels of the ICF (Granberg, Dahlström, et al., 2014; Granberg, Möller, et al., 2014). Hearing aid benefit is a subjective construct that reflects a person's perception of hearing aid performance in different listening situations (Humes, 2003; Turner, Humes, Bentler, & Cox, 1996). Hearing aid satisfaction has been defined as an emotional response that arises from a comparison between the expectations and the experience of using hearing aids (Wong, Hickson, & McPherson, 2009). Although closely

related to benefit, satisfaction is thought to be informed not only by hearing aid performance, but also by the hearing aid's physical appearance; its cost; the frequency and nature of problems encountered while using the hearing aid, such as loudness discomfort and acoustic feedback; the quality of the professional service through which the hearing aid was obtained; and the extent of residual communication difficulty (Cox & Alexander, 1999; Wong, Hickson, & McPherson, 2003; Wong et al., 2009). The aim of this study was therefore to investigate, in a group of experienced bilateral hearing aid users, the relationship between self-reported hearing loss self-management (a personal factor) and hearing aid benefit and satisfaction (activities and participation outcomes).

METHODS

Participants

Sample size determination was based on the hypothesis that hearing loss self-management would be an important parameter to assess clinically if it explained, at a minimum, 20% of the variance in self-reported hearing aid benefit and satisfaction (Lenth, 2001). For correlation analysis, 36 participants were required to detect an R^2 of 0.2 (a correlation coefficient of 0.45) with 80% power at an alpha level of 0.05. Thirty-seven participants took part in the study, all of whom were recruited from a database of research volunteers maintained by the National Acoustic Laboratories (Sydney, Australia). The inclusion criteria were: (1) aged between 50 and 85 years; (2) a four-frequency pure-tone average (PTA4; average of pure-tone hearing thresholds at 0.5, 1, 2, and 4 kHz) between 25 and 65 dB HL in both ears; and (3) user of bilateral hearing aids for ≥ 1 year. The exclusion criteria were: (1) presence of active ear disease; (2) non-English speaking; and (3) additional disabilities

diagnosed by a physician (e.g. dementia) that would preclude participation in the present research study.

An overview of participant data is shown in Table 1. Of the 37 participants, 25 were male and 12 were female. Participants ranged in age from 52 to 83 years, with a mean age of 74 years (SD = 8.3). The mean PTA4 across the participant group was 49 dB HL (SD = 9.9).

Participants had worn bilateral hearing aids for an average of 12 years (SD = 7.8). All participants wore behind-the-ear hearing aids. All participants reported that they wore their hearing aids ≥ 4 hours per day; 24 participants reported that they wore their hearing aids for ≥ 8 hours per day.

Materials

Hearing loss self-management

Hearing loss self-management was assessed with modified versions of the Partners in Health scale and the Cue and Response interview (Battersby et al., 2003; Convery et al., 2017; Smith, Harvey, Lawn, Harris, & Battersby, 2017), which were adapted with permission for audiology use. Both tools are part of the Flinders Chronic Condition Management Program™, a semi-structured assessment, planning, and motivational process for adults with chronic conditions (Battersby, 2005). Audiology versions of the Partners in Health scale and the Cue and Response interview were developed because the vocabulary used in the original tools was more medical in nature (e.g. symptoms, medication) than would typically apply in an audiology context (Convery et al., 2016). The audiology versions of the Partners in Health scale and the Cue and Response interview are shown in Table 2.

The audiology version of the Partners in Health scale is a 10-item questionnaire in which participants are asked to rate the extent to which they feel they self-manage their hearing loss on a scale of 0 (*very little/never/not very well*) to 8 (*a lot/always/very well*). Higher ratings reflect better perceived self-management. Following the completion of the Partners in Health scale, the Cue and Response interview is administered by the clinician. Open-ended questions are used to explore the participant's understanding and knowledge of each item on the Partners in Health scale. For example, item 4 on the Partners in Health scale is: *I share in decisions made about my hearing with my hearing health professional*. The corresponding cue questions include: *How involved do you feel in making decisions about your hearing with your hearing health professional? Does your hearing health professional listen to you? Who else makes hearing health decisions with or for you?* After each item has been discussed, the clinician rates the participant's hearing loss self-management on a scale of 0 to 8. Participant and clinician perspectives are then compared. In cases where the participant and clinician ratings differ by ≥ 3 , the item is discussed further and both the participant and clinician have the opportunity to adjust their ratings. In the end, a single client-clinician negotiated score is agreed upon for each item.

Exploratory factor analysis has found that together, the audiology versions of the Partners in Health scale and the Cue and Response interview tap into three domains of hearing loss self-management: (1) Knowledge (items 1 and 2), which includes knowing about hearing loss and its effects and knowing about appropriate treatment and management options; (2) Actions (items 3-8), which includes attending appointments, adhering to recommended treatments and management strategies, actively sharing in decision-making with hearing health care professionals, accessing the necessary services and resources, monitoring for changes in

hearing and functional status, and taking action to address those changes; and (3) Psychosocial Behaviors (items 9 and 10), which includes managing the effect of the hearing loss on emotional wellbeing and social participation (Convery et al., 2018). Scores for the Knowledge, Actions, and Psychosocial Behaviors domains of hearing loss self-management were calculated for each participant. This was done for each domain by first weighting the participant's ratings on each item of the hearing loss self-management assessment with the factor score coefficients reported in Convery et al. (2018), then summing the weighted ratings. Higher scores in the Knowledge domain indicate poorer hearing loss self-management, while higher scores in the Actions and Psychosocial Behaviors domains indicate better hearing loss self-management.

Hearing aid benefit

Aided hearing aid benefit was assessed with the Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox & Alexander, 1995). The APHAB is a 24-item self-report inventory in which participants use a seven-point scale (*always to never*) to rate the degree of difficulty they experience in everyday listening situations while wearing their hearing aids. Higher ratings represent greater perceived listening difficulty. The APHAB is composed of four subscales, each of which has six items: Ease of Communication, Background Noise, Reverberation, and Aversiveness. In the original validation of the APHAB, internal consistency was high for the unaided scores on each subscale (Cronbach's alpha = 0.84-0.85) and measures of test-retest reliability suggested that there was no systematic tendency for APHAB scores to change over time (Cox & Alexander, 1995).

Hearing aid satisfaction

Hearing aid satisfaction was assessed with the Satisfaction with Amplification in Daily Life (SADL) scale (Cox & Alexander, 1999). Participants are asked to rate the degree of satisfaction they feel they receive from their hearing aids on a seven-point scale (*not at all* to *tremendously*). Higher ratings represent greater perceived satisfaction. The SADL has 15 items and is composed of four subscales, each of which represents a different domain of satisfaction: Positive Effect (six items), Service and Cost (three items), Negative Features (three items), and Personal Image (three items). In the initial report on the SADL's development, Cronbach's alpha was 0.85 for the global score (average of all subscales), indicating good internal consistency. Test-retest reliability, based on repeated measures conducted an average of 23 weeks apart, was high. Upon retest, 71% of the respondents scored within half a point of their original score (Cox & Alexander, 1999). Further validation of the SADL, conducted with a sample of 196 adult participants from 13 audiology clinics, confirmed both the construct and internal validity of the scale (Cox & Alexander, 2001).

The Service and Cost subscale was not used in the present study due to the fact that some participants had paid privately for their hearing aids, while others had received fully subsidized hearing aids as part of a government program. Since the Service and Cost subscale contains the item *Does the cost of your hearing aid seem reasonable to you?*, there was concern that responses to this item would be skewed according to variations in funding source and would thus influence the overall score on this subscale. The instructions for administration on the developers' website (<http://www.harlmemphis.org>) indicate that eliminating the Service and Cost subscale is an acceptable way of utilizing the SADL, particularly when subscale scores will be analyzed individually.

Demographic and audiometric data

Information about gender, age, and length of hearing aid use was gathered with a purposefully developed self-report questionnaire. Participants underwent masked pure-tone air- and bone-conduction audiometry using ER-3A insert earphones and an Interacoustics AC40 clinical audiometer. Thresholds were measured according to the modified Hughson-Westlake procedure (Carhart & Jerger, 1959).

Procedure

Twenty-two participants completed all measures in one appointment of approximately 1-1.5 hours. The remaining 15 participants completed the hearing loss self-management assessment, demographic questionnaire, and audiometric assessment at one appointment and the hearing aid benefit and satisfaction measures at a second appointment approximately 2 weeks later. The procedural differences were due to the fact that the latter group was assessed as part of an unrelated study prior to commencing a hearing aid field trial.

The study was approved by and conducted under the ethical oversight of the Australian Hearing Human Research Ethics Committee (AHHREC2016-4; 2016-10; 2018-1) and the University of Queensland Medical Research Ethics Committee (2016000447; 2018000031) and conformed in all respects to the Australian government's National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council, 2007).

Participants were compensated for their travel expenses.

Statistical Analysis

APHAB and SADL subscale scores were analyzed separately to tease out the extent to which hearing loss self-management could relate to different dimensions of hearing aid benefit and satisfaction. All statistical analyses were performed with IBM SPSS Statistics version 25. Skewness and kurtosis z-scores were calculated for each variable to assess normality of distribution. Four variables were not normally distributed. Years of hearing aid experience and the APHAB Ease of Communication score were positively skewed and were thus transformed using a square root transformation. Age and the SADL Personal Image score were negatively skewed and were thus transformed using a reflect and square root transformation (J. W. Osborne, 2002). Following transformation, the data met the necessary assumptions for performing Pearson's product-moment correlation analysis, namely linearity, a lack of influential outliers, and bivariate normality (Myers, Well, & Lorch, 2010). For each significant correlation, the coefficient of determination (R^2) was calculated by squaring the correlation coefficient. The coefficient of determination reflects the proportion of variance in one variable that is statistically (not causally) explained by the other variable (Myers et al., 2010).

RESULTS

The relationship between the demographic variables (age, gender, and years of hearing aid experience) and the individual hearing loss self-management domain scores was investigated due to previous evidence of significant associations between these variables (Convery et al., 2018). As shown in Table 3, the results of the correlation analysis for the present dataset revealed a significant correlation between age and hearing loss self-management in the Knowledge domain, with older age associated with a higher score (i.e. poorer hearing loss

self-management) in this domain ($r_{35} = .48, p = .003$). No other correlations between the demographic variables and the hearing loss self-management scores were significant.

The hearing loss self-management Actions factor score was moderately positively correlated with the SADL Positive Effect score ($r_{35} = .43, p = .008$). Better hearing loss self-management in the Actions domain was associated with greater self-reported satisfaction with the extent to which hearing aids improve speech understanding, reduce the need for repetition, and produce a natural sound quality. The coefficient of determination was $R^2 = .18$, indicating that hearing loss self-management in this domain statistically explained 18% of the variance in the SADL Positive Effect score.

The hearing loss self-management Psychosocial Behaviors factor score was moderately negatively correlated with the APHAB Background Noise ($r_{35} = -.50, p = .002$) and APHAB Reverberation scores ($r_{35} = -.51, p = .001$). Better hearing loss self-management in the Psychosocial Behaviors domain was associated with less self-reported aided listening difficulty in acoustic environments where there is background noise or reverberation. The coefficients of determination were $R^2 = .25$ and $R^2 = .26$, respectively, indicating that hearing loss self-management in this domain statistically explained 25% of the variance in the APHAB Background Noise score and 26% of the variance in the APHAB Reverberation score.

The hearing loss self-management Psychosocial Behaviors factor score was moderately positively correlated with the SADL Personal Image score ($r_{35} = .46, p = .004$). Better hearing loss self-management in the Psychosocial Behaviors domain was associated with greater self-reported satisfaction with hearing aid appearance and the extent to which

participants believe that others perceive them as less capable because of their hearing aids.

The coefficient of determination was $R^2 = .21$, indicating that hearing loss self-management in this domain statistically explained 21% of the variance in the SADL Personal Image score.

The hearing loss self-management Knowledge factor score was not significantly correlated with any of the APHAB ($r_{35} = -.03 - -.13, ps > .05$) or SADL ($r_{35} = -.17 - -.21, ps > .05$) subscale scores.

DISCUSSION

The intrinsic characteristics of a person – termed personal factors by the ICF – are an acknowledged contributor to the individual experience of health and disability (Geyh et al., 2011; World Health Organization, 2001). The present study supports this assertion with three key findings: (1) that participants who reported better self-management in the Psychosocial Behaviors domain were more likely to report less aided listening difficulty in noisy and reverberant environments; (2) that participants who reported better self-management in the Psychosocial Behaviors domain were more likely to report greater satisfaction with the physical appearance of their hearing aids; and (3) that participants who reported better self-management in the Actions domain were more likely to report greater satisfaction with the sound quality and performance of their hearing aids.

Our finding that participants who reported better self-management in the Psychosocial Behaviors domain were more likely to report less aided listening difficulty in noisy and reverberant environments is sensible given that successful self-management of the psychosocial effects of a chronic condition involves the adoption of a range of coping

strategies to mitigate these effects on daily functioning (Clark et al., 1991; Lorig & Holman, 2003). For people with hearing loss, this may include disclosing their hearing loss to a new conversational partner to ensure their communication needs are met, taking the initiative to request repetition or clarification during a conversation, moving closer to a talker of interest, and employing speechreading tactics (Preminger, 2007). Among people who wear hearing aids, communication strategies can augment the benefit received from amplification, particularly in noisy and reverberant environments, in which hearing aids do not perform as well as they do in quiet environments with a single talker (Dillon, 2012). It is equally possible, however, that participants who have less listening difficulty in noisy and reverberant environments experience fewer psychosocial impacts and thus report better self-management of this domain.

Participants who reported better self-management in the Psychosocial Behaviors domain were also more likely to report greater satisfaction on the Personal Image subscale of the SADL, which asks whether respondents believe other people notice their hearing loss more when they wear hearing aids, how content they are with the appearance of their hearing aids, and whether they believe wearing hearing aids makes them seem less capable (Cox & Alexander, 1999). In addition to the communicative coping strategies discussed above, a further component of psychosocial self-management entails confronting and coming to terms with the stigma associated with having a chronic condition (Kralik, Koch, Price, & Howard, 2004; Lorig & Holman, 2003). Hearing loss and the use of hearing aids are often perceived as stigmatizing because they are associated with aging, a loss of capability, and an alteration of one's identity (Wallhagen, 2009). Among our study participants, those who are coming to terms with the stigma attached to having a hearing loss and wearing hearing aids – that is, those who report better self-management of the emotional impacts of their hearing loss – may

also be less bothered by the physical appearance of their hearing aids or others' perception of their capabilities.

Our finding that the Psychosocial Behaviors domain of hearing loss self-management was most strongly associated with hearing aid outcomes relative to the other hearing loss self-management domains supports previous research suggesting that the psychosocial aspects of hearing loss need to receive greater consideration in clinical assessment and management planning. In a recent study by Convery et al. (2017), 30 older adults – including 15 participants in the present study – completed an assessment of their hearing loss self-management using the Partners in Health scale and the Cue and Response interview. The findings suggested that the psychosocial issues arising from hearing loss remain a mostly unaddressed component of their rehabilitation, despite the fact that all participants in that study were current recipients of hearing health care. Studies in which audiologist-patient interactions have been directly observed confirm that audiologists tend to take a biomedical, rather than biopsychosocial, approach to patient care (Grenness, Hickson, Laplante-Lévesque, & Meyer, 2014; Grenness, Hickson, Laplante-Lévesque, Meyer, & Davidson, 2015; Meyer, Barr, Khan, & Hickson, 2017). It has also been suggested that prioritizing the biomedical aspects of hearing loss may have negative consequences for uptake and adherence to hearing rehabilitation (Ekberg, Grenness, and Hickson, 2014). In a further analysis of the Grenness et al. (2015) data, Ekberg et al. (2014) found that when the patient's psychosocial concerns were left unaddressed by the audiologist, the patient was more likely either to decline hearing aids outright, or to go ahead with a hearing aid fitting but express less commitment to their long-term use.

Participants who reported better self-management in the Actions domain were more likely to report greater satisfaction with the sound quality and performance of their hearing aids. The Actions domain encompasses treatment adherence, participation in shared decision-making, access to services and resources, appointment attendance, and monitoring for changes in hearing and functional status. The link between Actions and satisfaction is a sensible one since it is likely that individuals who actively participate in their hearing rehabilitation and follow up with their hearing health care professional to address any difficulties they encounter are more likely to achieve satisfaction with their hearing aids. Two components of the Actions domain, treatment adherence and participation in shared decision-making, have also been investigated in previous audiology and chronic condition research. First, numerous studies have demonstrated that people who report greater daily hearing aid usage (i.e. better adherence to treatment) also report greater satisfaction with their hearing aids. For example, Uriarte, Denzin, Dunstan, Sellars, and Hickson (2005) used the SADL to investigate hearing aid satisfaction 3-6 months post-fitting in a sample of 1,014 adults. Longer daily hearing aid usage was associated with greater hearing aid satisfaction on all of the SADL subscales. In a systematic review conducted by Wong et al. (2003), the majority of studies reviewed also reported a significant positive association between hours of daily usage and hearing aid satisfaction, even when different measures of satisfaction were used. In the chronic condition literature more generally, there is evidence of a positive relationship between treatment adherence and satisfaction, although it is unclear whether greater adherence leads to greater satisfaction, or whether patients who are more satisfied with their treatment are more likely to adhere to it (Barbosa, Balp, Kulich, Germain, & Rofail, 2012; Dimatteo, Giordani, Lepper, & Croghan, 2002). Second, a systematic review of the broader health literature has additionally demonstrated that shared decision-making results in better treatment satisfaction, particularly in the context of chronic conditions and long-term interventions (Joosten et al., 2008).

The Knowledge domain of hearing loss self-management – which includes knowing about one’s hearing loss and its recommended management strategies – was not significantly associated with either hearing aid benefit or satisfaction in the present study. While knowledge is an important part of hearing loss self-management, its lack of an independent relationship with benefit and satisfaction suggests that knowledge alone is insufficient to lead to good outcomes, a finding that is supported by the existing chronic condition literature (Bodenheimer, 2003). This finding also highlights the need for emphasizing psychosocial, rather than informational, counseling, the latter of which tends to be the focus in current clinical practice.

Study Limitations

Caution should be exercised in generalizing the results of the present study to a wider clinical population. All parameters were assessed with self-report measures, which do not necessarily yield a true or complete picture of experiences in the real world. In particular, the hearing loss self-management measures used in this study reflect the respondents’ subjective assessment of how well they believe they self-manage, rather than capture the actual means by which the respondents self-manage day-to-day or how successful they are at doing so. Relatedly, all assessments were performed at a single point in time, meaning that a definitive statement cannot be made about the direction of the relationship between hearing loss self-management and hearing aid benefit and satisfaction. While it is possible that individuals who obtain greater benefit and satisfaction from their hearing aids do so because they are better self-managers, it is equally possible that benefit and satisfaction inform individuals’ perception of how well they believe they self-manage.

A further limitation of the present study is the choice of benefit and satisfaction as outcome measures. Benefit and satisfaction in the context of hearing aid use are not well-defined (Humes, 2001), as illustrated by the significant moderate correlations we observed in our sample between three of the APHAB subscales (Ease of Communication, Background Noise, and Reverberation) and two of the SADL subscales (Negative Features and Personal Image) (Table 3). While future work exploring the association between hearing loss self-management and hearing rehabilitation outcomes depends to some extent on the development and validation of more precise measures of hearing aid benefit and satisfaction, consideration could be given to the use of pre- and post-intervention assessments of hearing loss self-management to measure outcomes, or existing measures that tap into broader dimensions of living with a hearing loss, such as health-related quality of life (Abrams, Chisolm, & McArdle, 2005). More objective measures of hearing aid usage, such as datalogging, could also contribute to increasing our understanding of the relationship between the adherence component of hearing loss self-management and hearing rehabilitation outcomes.

Since this research was intended to be exploratory, we did not apply a statistical correction to adjust for multiple comparisons. We do note, however, that if a Bonferroni correction is applied to the set of seven correlations performed for each hearing loss self-management factor score, all correlations remain significant except the correlation between the Actions factor score and the SADL Positive Effect score, whose p value drops to .056. By applying this correction, the statistical power is reduced, although given the relative robustness of the uncorrected p values, it is possible that with a larger N , the correlation between the Actions factor score and the SADL Positive Effect score would return to significance.

Future Directions

Our finding that hearing loss self-management statistically accounted for 18-26% of the variance in particular aspects of hearing aid benefit and satisfaction suggests that hearing loss self-management is one of the important components of hearing rehabilitation. Consideration of a patient's personal factors – such as their individual self-management strengths and weaknesses – is considered a key facilitator of patient-centered care (Geyh et al., 2011), a paradigm in which health care is provided in a “holistic, individualized, respectful, and empowering” manner (Morgan & Yoder, 2012). The particular importance of the psychosocial aspects of hearing loss self-management highlights the need for non-technological hearing rehabilitation interventions that directly target this area. Future work should therefore focus on the development and validation of a hearing loss self-management framework for clinical practice, with the aim of determining whether tailored interventions targeting individually assessed self-management needs will positively affect hearing rehabilitation outcomes. Prospective studies, in which hearing loss self-management is assessed at the initiation of a rehabilitation intervention and again at subsequent time points, would assist in achieving this goal.

CONCLUSION

The findings of this study highlight both the importance of hearing loss self-management for patient outcomes and the potential for using information about a patient's hearing loss self-management in different domains as part of clinical decision-making and management planning.

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REFERENCES

- Abrams, H. B., Chisolm, T. H., & McArdle, R. (2005). Health-related quality of life and hearing aids: a tutorial. *Trends in Amplification, 9*(3), 99-109.
- Audiology Australia. (2014). WHO are we hear for? Models of service delivery. Forest Hill, VIC: Audiology Australia Ltd.
- Bainbridge, K. E., & Wallhagen, M. I. (2014). Hearing loss in an aging American population: extent, impact, and management. *Annual Review of Public Health, 35*(1), 139-152.
- Barbosa, C. D., Balp, M.-M., Kulich, K., Germain, N., & Rofail, D. (2012). A literature review to explore the link between treatment satisfaction and adherence, compliance, and persistence. *Patient Preference and Adherence, 6*, 39-48.
- Barlow, J., Wright, C., Sheasby, J., Turner, A., & Hainsworth, J. (2002). Self-management approaches for people with chronic conditions: a review. *Patient Education and Counseling, 48*(2), 177-187.
- Battersby, M. (2005). Health reform through coordinated care: SA HealthPlus. *BMJ: British Medical Journal, 330*, 662-666.
- Battersby, M., Ask, A., Reece, M. M., Markwick, M. J., & Collins, J. P. (2003). The Partners in Health scale: the development and psychometric properties of a generic assessment scale for chronic condition self-management. *Australian Journal of Primary Health, 9*(2-3), 41-52.
- Battersby, M., & Lawn, S. (2009). *Capabilities for Supporting Prevention and Chronic Condition Self-Management: A Resource for Educators of Primary Health Care Professionals*. Canberra, ACT: Commonwealth of Australia.
- Bodenheimer, T. (2003). Interventions to improve chronic illness care: evaluating their effectiveness. *Disease Management, 6*(2), 63-71.

- Brody, B. L., Williams, R. A., Thomas, R. G., Kaplan, R. M., Chu, R. M., & Brown, S. I. (1999). Age-related macular degeneration: a randomized clinical trial of a self-management intervention. *Annals of Behavioral Medicine*, 21(4), 322-329.
- Carhart, R., & Jerger, J. F. (1959). Preferred method for clinical determination of pure-tone thresholds. *Journal of Speech and Hearing Disorders*, 24(4), 330-345.
- Carson, A. J. (2005). "What brings you here today?" The role of self-assessment in help-seeking for age-related hearing loss. *Journal of Aging Studies*, 19(2), 185-200.
- 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 and Hearing*, 28(2), 187-195.
- Chisolm, T. H., Johnson, C. E., Danhauer, J. L., Portz, L. J. P., Abrams, H. B., Lesner, S., . . . Newman, C. W. (2007). A systematic review of health-related quality of life and hearing aids: final report of the American Academy of Audiology task force on the health-related quality of life benefits of amplification in adults. *Journal of the American Academy of Audiology*, 18(2), 151-183.
- Chodosh, J., Morton, S. C., Mojica, W., Maglione, M., Suttorp, M. J., Hilton, L., . . . Shekelle, P. (2005). Meta-analysis: chronic disease self-management programs for older adults. *Annals of Internal Medicine*, 143(6), 427-438.
- Clark, N. M., Becker, M. H., Janz, N. K., Lorig, K., Rakowski, W., & Anderson, L. (1991). Self-management of chronic disease by older adults: a review and questions for research. *Journal of Aging and Health*, 3(1), 3-27.
- Convery, E., Hickson, L., Keidser, G., & Meyer, C. (under review). The Chronic Care Model and chronic condition self-management: an introduction for audiologists. *Seminars in Hearing*.

- Convery, E., Hickson, L., Meyer, C., & Keidser, G. (2018). Predictors of hearing loss self-management in older adults. *Disability and Rehabilitation*. doi: 10.1080/09638288.2018.1457091.
- Convery, E., Keidser, G., Hickson, L., & Meyer, C. (2016). Beyond hearing loss: self-management in audiological practice. *Hearing Journal*, 69(3), 22-28.
- Convery, E., Meyer, C., Keidser, G., & Hickson, L. (2017). Assessing hearing loss self-management in older adults. *International Journal of Audiology*, 57(4), 313-320.
- Cox, R. M., & Alexander, G. C. (1995). The abbreviated profile of hearing aid benefit. *Ear and Hearing*, 16(2), 176-186.
- Cox, R. M., & Alexander, G. C. (1999). Measuring satisfaction with amplification in daily life: the SADL scale. *Ear and Hearing*, 20(4), 306-320.
- Cox, R. M., & Alexander, G. C. (2001). Validation of the SADL questionnaire. *Ear and Hearing*, 22(2), 151-160.
- Danermark, B., Granberg, S., Kramer, S. E., Selb, M., & Möller, C. (2013). The creation of a Comprehensive and a Brief Core Set for Hearing Loss using the International Classification of Functioning, Disability and Health. *American Journal of Audiology*, 22(2), 323-328.
- Dillon, H. (2012). *Hearing Aids (2nd Edition)*. Sydney: Boomerang Press.
- Dimatteo, M. R., Giordani, P. J., Lepper, H. S., & Croghan, T. W. (2002). Patient adherence and medical treatment outcomes: a meta-analysis. *Medical Care*, 40(9), 794-811.
- Duijvestijn, J. A., Anteunis, L. J. C., Hoek, C. J., Van Den Brink, R. H. S., Chenault, M. N., & Manni, J. J. (2003). Help-seeking behaviour of hearing-impaired persons aged 55 years: effect of complaints, significant others and hearing aid image. *Acta Otolaryngologica*, 123(7), 846-850.

- Ekberg, K., Grenness, C., & Hickson, L. (2014). Addressing patients' psychosocial concerns regarding hearing aids within audiology appointments for older adults. *American Journal of Audiology*, 23(3), 337-350.
- Geyh, S., Peter, C., Müller, R., Bickenbach, J. E., Kostanjsek, N., Üstün, B. T., . . . Cieza, A. (2011). The Personal Factors of the International Classification of Functioning, Disability and Health in the literature – a systematic review and content analysis. *Disability and Rehabilitation*, 33, 1089-1102.
- Granberg, S., Dahlström, J., Möller, C., Kähäri, K., & Danermark, B. (2014). The ICF Core Sets for hearing loss researcher perspective. Part I: Systematic review of outcome measures identified in audiological research. *International Journal of Audiology*, 53(2), 65-76.
- Granberg, S., Möller, K., Skagerstrand, Å., Möller, C., & Danermark, B. (2014). The ICF Core Sets for hearing loss: researcher perspective, Part II: Linking outcome measures to the International Classification of Functioning, Disability and Health (ICF). *International Journal of Audiology*, 53, 77-87.
- Grenness, C., Hickson, L., Laplante-Lévesque, A., & Meyer, C. (2014). Communication patterns in audiological rehabilitation history-taking: audiologists, patients, and their companions. *Ear and Hearing*, 36(2), 191-204.
- Grenness, C., Hickson, L., Laplante-Lévesque, A., Meyer, C., & Davidson, B. (2015). The nature of communication throughout diagnosis and management planning in initial audiological rehabilitation consultations. *Journal of the American Academy of Audiology*, 26(1), 36-50.
- Harvey, P. W., Petkov, J. N., Misan, G., Fuller, J., Battersby, M., Cayetano, T. N., . . . Holmes, P. (2008). Self-management support and training for patients with chronic

and complex conditions improves health-related behaviour and health outcomes.

Australian Health Review, 32(2), 330-338.

Helvik, A.-S., Wennberg, S., Jacobsen, G., & Hallberg, L. (2008). Why do some individuals with objectively verified hearing loss reject hearing aids? *Audiological Medicine*, 6(2), 141-148.

Hickson, L., & Scarinci, N. (2007). Older adults with acquired hearing impairment: applying the ICF in rehabilitation. *Seminars in Speech and Language*, 28(4), 283-290.

Humes, L. E. (2001). Issues in evaluating the effectiveness of hearing aids in the elderly: what to measure and when. *Seminars in Hearing*, 22(3), 303-316.

Humes, L. E. (2003). Modeling and predicting hearing aid outcome. *Trends in Amplification*, 7(2), 41-75.

Joosten, E. A. G., DeFuentes-Merillas, L., de Weert, G. H., Sensky, T., van der Staak, C. P. F., & de Jong, C. A. J. (2008). Systematic review of the effects of shared decision-making on patient satisfaction, treatment adherence, and health status. *Psychotherapy and Psychosomatics*, 77(4), 219-226.

Knudsen, L. V., Öberg, M., Nielsen, C., Naylor, G., & Kramer, S. E. (2010). Factors influencing help seeking, hearing aid uptake, hearing aid use and satisfaction with hearing aids: a review of the literature. *Trends in Amplification*, 14(3), 127-154.

Kralik, D., Koch, T., Price, K., & Howard, N. (2004). Chronic illness self-management: taking action to create order. *Journal of Clinical Nursing*, 13, 259-267.

Kramer, S. E., Kapteyn, T. S., Kuik, D. J., & Deeg, D. J. H. (2002). The association of hearing impairment and chronic diseases with psychosocial health status in older age. *Journal of Aging and Health*, 14(1), 122-137.

- Laplante-Lévesque, A., Hickson, L., & Worrall, L. (2010). Factors influencing rehabilitation decisions of adults with acquired hearing impairment. *International Journal of Audiology, 49*(7), 497-507.
- Lawn, S., Battersby, M., Pols, R. G., Lawrence, J., Parry, T., & Urukalo, M. (2007). The mental health expert patient: findings from a pilot study of a generic chronic condition self-management programme for people with mental illness. *International Journal of Social Psychiatry, 53*(1), 63-74.
- Lenth, R. V. (2001). Some practical guidelines for effective sample size determination. *The American Statistician, 55*(3), 187-193.
- Lorig, K., & Holman, H. (2003). Self-management education: history, definition, outcomes, and mechanisms. *Annals of Behavioral Medicine, 26*(1), 1-7.
- Lorig, K., Ritter, P., Stewart, A., Sobel, D. S., Brown, B. W., Bandura, A., . . . Holman, H. (2001). Chronic disease self-management program: two-year health status and health care utilization outcomes. *Medical Care, 39*(11), 1217-1223.
- McArdle, R., Chisolm, T. H., Abrams, H. B., Wilson, R. H., & Doyle, P. J. (2005). The WHO-DAS II: measuring outcomes of hearing aid intervention for adults. *Trends in Amplification, 9*(3), 127-143.
- Meyer, C., Barr, C., Khan, A., & Hickson, L. (2017). Audiologist-patient communication profiles in hearing rehabilitation appointments. *Patient Education and Counseling, 100*(8), 1490-1498.
- Meyer, C., Grenness, C., Scarinci, N., & Hickson, L. (2016). What is the International Classification of Functioning, Disability and Health and why is it relevant to audiology? *Seminars in Hearing, 37*(3), 163-186.

- Meyer, C., Hickson, L., Lovelock, K., Lampert, M., & Khan, A. (2014). An investigation of factors that influence help-seeking for hearing impairment in older adults. *International Journal of Audiology, 53*(S1), S3-S17.
- Morgan, S., & Yoder, L. H. (2012). A concept analysis of person-centered care. *Journal of Holistic Nursing, 30*(1), 6-15.
- Myers, J. L., Well, A. D., & Lorch, R. F. (2010). *Research Design and Statistical Analysis, Third Edition*. New York: Routledge.
- National Health and Medical Research Council. (2007). National Statement on Ethical Conduct in Human Research. In. Canberra, ACT: Commonwealth of Australia.
- Norris, S. L., Engelgau, M. M., & Narayan, K. M. V. (2001). Effectiveness of self-management training in Type 2 Diabetes: a systematic review of randomized controlled trials. *Diabetes Care, 24*, 561-587.
- Ory, M. G., Ahn, S., Jiang, L., Smith, M. L., Ritter, P. L., Whitelaw, N., & Lorig, K. (2013). Successes of a national study of the chronic disease self-management program: meeting the triple aim of health care reform. *Medical Care, 51*(11), 992-998.
- Osborne, J. W. (2002). Notes on the use of data transformations. *Practical Assessment, Research and Evaluation, 8*(6), 1-7.
- Osborne, R. H., Wilson, T., Lorig, K., & McColl, G. J. (2007). Does self-management lead to sustainable health benefits in people with arthritis? A 2-year transition study of 452 Australians. *Journal of Rheumatology, 34*(5), 1112-1117.
- Preminger, J. E. (2007). Issues associated with the measurement of psychosocial benefits of group audiologic rehabilitation programs. *Trends in Amplification, 11*(2), 113.
- Smith, D., Harvey, P., Lawn, S., Harris, M., & Battersby, M. (2017). Measuring chronic condition self-management in an Australian community: factor structure of the revised Partners in Health (PIH) scale. *Quality of Life Research, 26*(1), 149-159.

- Turner, C. W., Humes, L. E., Bentler, R. A., & Cox, R. M. (1996). A review of past research on changes in hearing aid benefit over time. *Ear and Hearing, 17*(3 Suppl), 14S-25S.
- Uriarte, M., Denzin, L., Dunstan, A., Sellars, J., & Hickson, L. (2005). Measuring hearing aid outcomes using the Satisfaction with Amplification in Daily Life (SADL) questionnaire: Australian data. *Journal of the American Academy of Audiology, 16*(6), 383-402.
- Vuorialho, A., Karinen, P., & Sorri, M. (2006). Effect of hearing aids on hearing disability and quality of life in the elderly. *International Journal of Audiology, 45*(7), 400-405.
- Wallhagen, M. I. (2009). The stigma of hearing loss. *The Gerontologist, 50*(1), 66-75.
- Wong, L. L. N., Hickson, L., & McPherson, B. (2003). Hearing aid satisfaction: what does research from the past 20 years say? *Trends in Amplification, 7*(4), 117-161.
- Wong, L. L. N., Hickson, L., & McPherson, B. (2009). Satisfaction with hearing aids: a consumer research perspective. *International Journal of Audiology, 48*(7), 405-427.
- World Health Organization. (2001). *International Classification of Functioning, Disability and Health*. Geneva: World Health Organization.
- World Health Organization. (2002). *Innovative Care for Chronic Conditions: Building Blocks for Action*. Geneva: World Health Organization.

Figure 1. Scatterplots showing the significant relationships between the APHAB Background Noise subscale score and the hearing loss self-management Psychosocial Behaviors factor score (A), the APHAB Reverberation subscale score and the hearing loss hearing loss self-management Psychosocial Behaviors factor score (B), the SADL Personal Image subscale score and the hearing loss self-management Psychosocial Behaviors factor score (C), and the SADL Positive Effects subscale score and the hearing loss self-management Actions factor score (D).