CRS SCIENTIFIC JOURNAL

Otology & Audiology Article Review

CONTENT

EDITORIAL

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Dear Reader, the Amplifon Centre for Research and Studies, CRS, houses one of the finest private libraries in the field of audiology and otorhinolaryngology, offering the sector's most important international journals. Every quarter, a team of Amplifon Audiologists from around the globe select the most relevant publications in the field of Otology and Audiology and make a comprehensive review. The Amplifon Centre for Research and Studies coordinates the development of this quarterly review. We are happy to share these new reviews with you. For this issue, our team reviewed 11 interesting articles published in the fourth quarter of 2023.

This review covers four aspects of speech understanding in noise. The first explores enhancing the sensitivity of the digits in noise self-test for individuals with conductive and unilateral hearing loss. The second investigates the disparity in performance between speech in noise and understanding degraded speech in noise in quiet, focusing on people with hearing loss versus normal hearing subjects. The third paper provides guidelines for replacing Word-Recognition in Quiet with Speech in Noise Assessment in the Routine Audiologic Test Battery. Lastly, we provide a systematic review on the Efficacy and Effectiveness of Wireless Binaural Beamforming Technology with a specific view of improving Speech Perception in Noise. Additionally, this issue provides an overview of a clinical trial which examines the listening preference of first-time hearing-aid users, comparing the manufacturer default First Fit and the NAL-NL2 Real-Ear Fit. Unfortunately, this study failed to include Speech Audiometry in Noise, or the Speech, Spatial and Qualities of Hearing Scale.

Turning our focus to cochlear implantation, we present one review exploring the long-term subjective benefit of CI for unilateral and asymmetric hearing loss, and another on the longitudinal benefit of elderly CI users with bilateral hearing loss.

Shifting gears, a compelling study investigates the positive correlation between hearing aid use and decrease in the risk of mortality in adults with hearing loss.

Two other reviews address the emotional states experienced by people with hearing loss and the influence of social networks, self-reported mental health and delivery models on hearing aid outcomes.

This issue wraps up with a publication on the natural course of otitis media with effusion in infants who did not pass universal newborn hearing screening.

We hope you enjoy this issue of our CRS Scientific Journal

Mark Laureyns
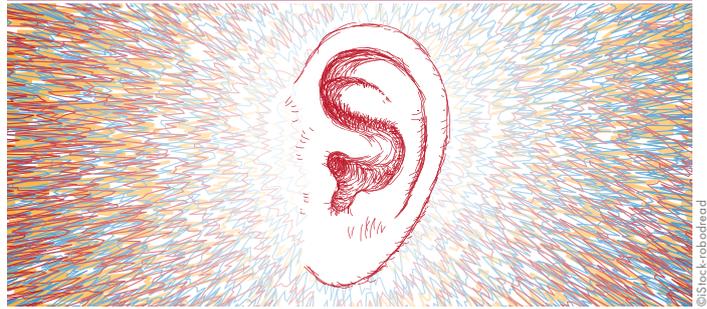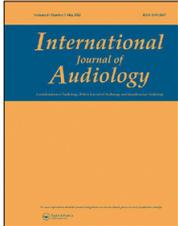Global International CRS
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SENSITIVITY OF THE ANTIPHASIC DIGITS-IN-NOISE TEST TO SIMULATED

UNILATERAL AND BILATERAL CONDUCTIVE HEARING LOSS

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Using a population of normal-hearing listeners, the researchers simulated conductive hearing loss (using ear plugs) in order to assess how unilateral and bilateral conductive hearing loss (HL) may influence the sensitivity of the antiphasic versus the diotic digits in noise test.

INTRODUCTION

Digits in Noise (DIN) stands out as a widely used and easy to administer hearing screening tool with a global track record spanning years. This test has been the focus of extensive research, and ongoing efforts are directed towards improving the sensitivity of the test to detect better different types of hearing loss (HL).

In the typical DIN test, a sequence of digit triplets (e.g. 3-9-4) is presented in steady, speech shaped noise. The test measures patients' speech recognition threshold (SRT), expressed in dB signal to noise ratio (dB SNR), representing the point at which the test user can correctly identify 50% of the digit triplets.

The study aims to achieve the following objectives: (1) to assess the impact of the presentation level of the antiphasic DIN on speech recognition thresholds; (2) to determine the potential accuracy of the DIN (both diotic or antiphasic) in detecting simulated unilateral and bilateral conductive hearing loss; and (3) to evaluate whether increased presentation levels normalise the antiphasic DIN SRT.

Traditionally the DIN is administered as a diotic evaluation where both speech and noise are presented identically and simultaneously to both ears (N0S0). Standard DIN tests exhibit lower sensitivity to conductive hearing loss (CHL) due to the user typically setting the presentation level, often increasing it, potentially compensating for the attenuation caused by CHL. Additionally, because performance is most affected by hearing levels in the better ear, the diotic presentation may limit the detection of unilateral or asymmetric HL, as listeners with normal hearing in the better ear might pass the diotic DIN test.

This study suggests that using antiphasic presentation, characterised by phase inversion of the speech signal between

CRITICAL NOTE
Hearing loss remains a global health epidemic. Early identification of hearing loss is a critical first step for effective treatment. The digits in noise (DIN) test has been shown to be a highly sensitive screening tool which can be used online or via smartphone apps. However, a limitation of many remote screening tools, including the DIN, is their failure to detect conductive hearing loss (CHL). In the DIN, users have the ability to select the presentation level, potentially allowing compensation for the effects of CHL, potentially yielding false negative results. This study offers a clear analysis of the impact of presentation levels on the sensitivity of both antiphasic and diotic DIN tests in detecting unilateral and bilateral CHL.

the ears while maintaining the noise inter-aurally in phase (N0Sp), may be more sensitive to both unilateral loss as well as conductive hearing loss. The attenuation resulting from unilateral and/or conductive HL adversely affects the interaural time difference. Antiphasic presentation relies on binaural unmasking, making it more responsive to such subtle acoustic temporal changes.

METHODOLOGY

This research comprised two distinct experiments, both conducted using younger listeners (mean age of 23 years). Participants exhibited a bilateral pure tone average (PTA) of <20 dB HL, and normal middle ear function (type A tympanograms) in both ears. All testing was performed in a sound-treated booth and Sennheiser HDA200 headphones

were used for both PTA and DIN testing. The standard Dutch version of the DIN test served as the testing protocol. CHL was simulated using Honeywell foam ear plugs, self-inserted by the participants and checked by the examiner. This simulated CHL enabled participants to serve as their own controls.

Testing was conducted under the following conditions:
• Without ear plugs
• With bilateral ear plugs
• With a unilateral ear plug

First, PTA was conducted with no ear plugs. Subsequently, PTA was performed with ear plugs immediately before DIN testing with ear plugs, thereby ensuring the ear plugs did not need to be reinserted and that the attenuation levels remained constant. Participants underwent antiphasic and diotic DINs both in quiet and in noise at different presentation levels (40-,60-, and 80-dB SPL) across all three test conditions. Additional, the binaural intelligibility level difference (BILD), which is the difference in SRT between antiphasic and diotic DIN presentations, was measured.

RESULTS

This study yielded several findings. Firstly, employing normal hearing listeners for both antiphasic and diotic presentations, the Speech Recognition Threshold (SRT) remained consistent above 60 dB SPL, regardless of presentation level. However, the researchers stressed that conclusions regarding the independence of presentation levels for antiphasic DIN SRTs for unilateral or bilateral simulated CHL could not be drawn. This research demonstrated that both antiphasic and diotic DIN SRTs are independent of presentation level in normal hearing listeners, provided the minimum presentation level is above 60 dB SPL. While this had previously been established for diotic SRT, this is a novel contribution for antiphasic SRT. Of particular note is the fact that the accuracy of DIN results in detecting CHL was highest when using the antiphasic DIN compared to either the diotic DIN or the BILD.

STUDY LIMITATIONS

Using foam ear plugs with an average attenuation level of ~ 30 dB creates a high degree of HL compared to typical, CHL. Furthermore, these earplugs generate a high-frequency conductive hearing loss, whereas the majority of CHL cases manifest as low-frequency loss.
Simulating CHL enabled the researchers to control confounding factors such as degree and type of HL, as well as age and cognitive abilities of the DIN test user. The use of earplugs also facilitated the manipulation of HL within participants (unilateral vs. bilateral), a distinction not naturally occurring in CHL.

CONCLUSIONS

(1) In individuals with normal hearing, both diotic and antiphasic DIN SRTs demonstrate independence from presentation level above a minimum threshold (60 dB SPL).

(2) This study confirms that the antiphasic DIN exhibits greater sensitivity in detecting unilateral CHL compared to the diotic DIN. However, the sensitivity of the antiphasic DIN is not superior in detecting bilateral CHL when compared to the diotic DIN. This discrepancy arises from the fact that the DIN is more sensitive when the interaural difference is greater (unilateral loss), whereas its sensitivity becomes more similar to the diotic test when the interaural difference is small (bilateral loss).

(3) The potential compensatory effect of increasing presentation levels in mitigating the impact of (simulated) bilateral CHL may influence DIN accuracy.
The DIN test has served as an effective screening tool for a number of years. This research assesses the sensitivity of the DIN, confirming that the antiphasic version of the DIN can more accurately detect unilateral and asymmetric HL. Additionally, the study comprehensively examines the impact of presentation levels on the DIN, and the authors provide concrete recommendations for applying this research to current DIN test protocols. •
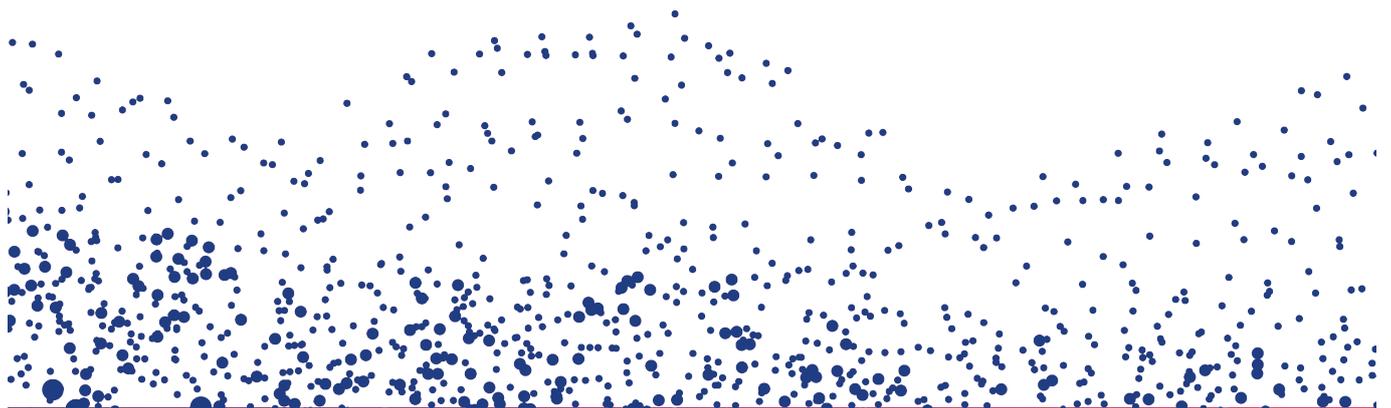
THE NATURAL COURSE OF OTITIS MEDIA WITH EFFUSION IN INFANTS WHO FAILED UNIVERSAL NEWBORN HEARING SCREENING: A RETROSPECTIVE COHORT STUDY

This retrospective cohort study aims to layout guidance for the most suitable observation and follow-up periods for infants who failed the universal newborn hearing screening due to Otitis Media with Effusion (OME).

BACKGROUND

Current practice proposes two strategies for managing infants with Otitis Media with Effusion (OME):
• Tympanostomy tube insertion for infants aged six months or older, with documented bilateral OME persisting for at least three months and associated hearing difficulties.
• Regular follow-up appointments until either surgical intervention is deemed necessary or the OME spontaneously resolves.

Although there is limited research on the natural progression of OME, observations at Wuhan Children's Hospital in PR China indicate that few parents opt for surgery after three months of OME, citing various concerns (e.g. the risks posed by general anaesthesia for infants or complications). This extended observation period presents the ideal opportunity to better understand the natural course of OME.

PATIENT SELECTION AND STUDY DESIGN

The study relied on a sample consisting of 155 infants who did not pass the universal newborn hearing screening between 2009–2019. These infants had a prior diagnosis of OME before reaching three months of age and were subsequently referred to the Otolaryngology Hearing Centre at Wuhan Children's Hospital. Auditory function tests were performed and symptoms were assessed and documented during follow-up appointments every three months for a period of 12 months, or until the effusion resolved naturally or required surgical intervention. Infants with sensorineural hearing loss (SNHL); deformities in the pinna, external auditory canal, or middle ear; a history of ear trauma; and a history of ear canal effusion were excluded from the study.

CRITICAL NOTE
The study provided new insights into existing guidelines regarding the observation period for infants with OME due to the great variety of aetiologies which infants may present. While the study used data from infants with recurrent respiratory infections as the control group, future studies may benefit from considering alternative control groups in their analyses.

DIAGNOSTIC CRITERIA

In the framework of this study, the researchers determined the diagnostic criteria for OME as follows:
• middle ear effusion identified through pneumatic otoscopy;
• abnormal 1kHz tympanometry;
• Distortion Product Otoacoustic Emissions (DPOAEs) showing a fail result;
• atypical Auditory Brainstem Response (ABR) thresholds for air conduction, with bone ABR thresholds within normal range.

Hearing was classified based on air conduction ABR threshold of the ear with poorer hearing, with classes I (25–30 dBnHL) and II (25–40 dBnHL) categorised as mild, while classes III (45–50 dBnHL) and IV (55–60 dBnHL) are considered moderate.

DISCUSSION

The findings suggest that the duration of observation and follow-ups should be tailored to each individual patient, taking into consideration concerns related to speech and language development.
The authors further highlight that in managing OME, it is crucial to consider its aetiology, which may include:

- Amniotic fluid in newborns: the study found a recovery rate of 39.4% at three months of observation. While current guidelines recommend a three-month observation period, this research indicates that not all observed OME cases due to amniotic fluid would have resolved within that timeframe.
- Respiratory tract infection: approximately 50% of cases resolved within one month, and 80% after three months.
- Reflux (fluid passing through the Eustachian tube while swallowing): the study found a recovery rate>60% at three months, and>90% at six months, aligning with previous findings.

Factors affecting recovery times included:
Long-term nasal congestion (e.g. due to allergies): the study found lower rates of recovery compared to respiratory tract infections and reflux as the primary cause of OME. Previous research suggests this may be due to rhinitis, inadequate symptom control or adenoid hypertrophy.

Maxillofacial deformities: there exists a strong correlation between such deformities and gastro-oesophageal reflux, Eustachian tube dysfunction, and poor resistance. Previous studies suggest either (1) resolving maxillofacial deformities, shown to resolve over 20% of OME cases; or (2) early tympanostomy tube placement.

Initial hearing status: the degree of hearing loss (HL) is positively correlated with effusion volume. This study found that infants with mild HL experienced higher recovery rates and shorter recovery times, underscoring the importance of assessing initial hearing levels for guiding clinical decisions. The study proposes extending the observation period to six months after diagnosis for most infants with mild to moderate HL with frequent reflux. However, it emphasises that the maximum observation period should not exceed 12–18 months, so as to avoid interference with the critical period of speech and language development. For infants with maxillofacial deformities and/or moderate HL, timely placement of ventilation tubes is recommended. •

FACTORS ASSOCIATED WITH HEARING AID OUTCOMES INCLUDING SOCIAL NETWORKS, SELF-REPORTED MENTAL HEALTH, AND SERVICE DELIVERY MODELS
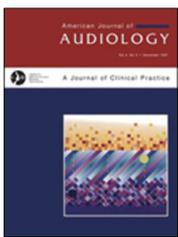
This study highlighted the extent to which the severity of hearing loss (HL), self-reported mental health, social networks, and service delivery models impact hearing aid outcomes. The authors emphasise the importance of a personalised approach in HL management.

Hearing loss (HL) affects over 1.5 billion people worldwide, with 430 million individuals having the potential to benefit from intervention (World Health Organization, 2021). In the U.S., over 30 million people have bilateral HL, creating an opportunity for amplification (Lin *et al.*, 2011). Hearing aids (HAs) serve as the primary course of treatment, with proven effectiveness in improving both hearing and communication (Ferguson *et al.*, 2019). In addition to these benefits, HAs alleviate the psychological effects of HL, leading to a reduction in depression (Tsimpida *et al.*,

2022). Research further suggests that HA users enjoy an improved quality of life and overall better health status (Ferguson *et al.*, 2019).
With the increasing prevalence of HL and the corresponding public health burden, optimising HA outcomes emerges as a global health imperative (World Health Organization, 2021). Assessing treatment efficacy, justifying resource allocation, and conducting cost-benefit analyses all rely on outcome measurements, including self-reported data (Saunders *et al.*, 2005). Self-reported measures, e.g. patient-reported outcome

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measures (PROMs), are pivotal in quantifying behavioural changes in the psychological system, which provides insights into benefit and satisfaction (Bray & Nilsson, 2002).

The International Outcome Inventory for Hearing Aids (IOI-HA) is one such PROM, which assesses seven domains, encompassing the key areas of daily use, benefit, satisfaction, and impact on others (Cox & Alexander, 2002). Numerous studies have explored audiological factors influencing HA outcomes, with a particular focus on HA use, benefit, and satisfaction (Aazh *et al.*, 2015; Arnold *et al.*, 2019; Wu *et al.*, 2019). Recent research conducted by Wang *et al.* (2022) has pinpointed audiological factors such as word recognition score (WRS) and daily HA use, along with non-audiological factors, like HA price and patient age, as contributors to HA outcomes.

Contributing factors to HA use, benefit, and satisfaction encompass HL severity, where mixed associations have been reported (Arnold *et al.*, 2019; Hickson *et al.*, 2014; Tognola *et al.*, 2019). Higher WRS is positively associated with improved HA outcomes (Houmøller *et al.*, 2022). Non-audiological factors, such as higher HA purchase price and fewer HA problems, also play a role in shaping positive HA outcomes (Bennett, Kosovich, *et al.*, 2020; Bennett, Meyer, *et al.*, 2020; Wang *et al.*, 2022).

Recent studies have shed light on previously overlooked factors influencing HA outcomes. Giuliani (2021) identified active neurological disorders as negative determinants of HA use, while Humes *et al.* (2017) found no significant differences in HA satisfaction between audiology best practices and direct-to-consumer models.

This study broadens the current body of evidence by investigating factors such as social networks, self-reported mental health, and service delivery models, which have not yet been studied in sufficient depth. A total of 398 HA users participated in the study, recruited via the Hearing Track network. Thanks to a cross-sectional survey design, the authors were able to explore demographic, audiological, and psychosocial variables. The IOI-HA measured HA outcomes, which was complemented by statistical analyses. These revealed strong associations between these outcomes and a number of factors.

DEMOGRAPHICS OF THE STUDY SAMPLE

The study involved 398 HA users, with a mean age of 66.7 years. Participants had experienced HL for an average of 24 years, with an average period of 6.9 years elapsing before acquiring HAs. Most participants were male (59.3%) and the majority identified as white (87.7%).

CONTRIBUTING FACTORS OF HA OUTCOMES

Several factors significantly influenced the IOI-HA total score. Positive contributors included self-reported hearing difficulty, self-reported mental health, quality of life, and

CRITICAL NOTE

1) Reliance on self-reported measurements: The study's failure to include objective clinical measures (PTA) could introduce a potential risk of data distortion due to participants' subjective perceptions.

2) Potential sampling bias: The use of Hearing Tracker network for data collection introduces a potential sampling bias, as the platform's user population may not accurately represent the overall diversity of hearing aid users.

3) Limited generalisation: The study relied on a specific demographic of hearing aid (HA) users, limiting the generalisability of results to a broader population. The lack of demographic diversity could impact the external validity of the outcomes.

4) Exclusion of known factors: The research appears to fail to consider certain established factors influencing HA outcomes, such as daily usage duration or patient compliance.

5) Exclusion of important variables: Some crucial variables may not have been thoroughly examined, for instance, specific characteristics of the HAs used or the experience of audiologists providing services.

6) Consideration of recent technologies: The research may not fully reflect the impact of more recent technologies on HAs and their effectiveness.

social networks with HL. Conversely, negative contributors included the service delivery model and social networks for HL without HAs. Participants receiving hearing healthcare from private clinics or universities had lower IOI-HA total scores compared to those opting for big-box retailers.

FACTORS INFLUENCING SPECIFIC IOI-HA ITEMS

- Service Delivery Model: poorer outcomes were found for patients using the services of private practice or university clinics as opposed to patients using the services from big-box retailers.
- Work Situation: Being employed negatively impacted HA benefit and satisfaction, but positively impacted the IOI-HA total score.
- Social Networks: Larger networks of people with HL and HAs positively influenced HA benefit and satisfaction.
- Quality of Life: This factor positively contributed to most IOI-HA items, underscoring its significance in HA outcomes.
- Self-Reported Mental Health: Positively associated with overall HA outcomes as reflected in the IOI-HA total score.
- Severity of Self-Reported Hearing Difficulty: Positively influenced HA outcomes.

DISCUSSION

The research identified additional factors influencing HA outcomes, notably the influence of social networks, mental health, and the service delivery model. A broader social network among HA was positively correlated with improved outcomes, highlighting the advantages of shared experiences and knowledge. Addressing negative perceptions and attitudes towards HAs is crucial for mitigating stigma and enhancing outcomes. The positive association between better self-reported mental health and overall HA outcomes highlights the importance of considering mental health in HL management. Service delivery models from big-box stores and third-party payers demonstrated better outcomes compared to private practice or university clinics, emphasising the potential impact of cost-benefit expectations.

LIMITATIONS

The study presented some limitations, including reliance on self-reported measures and possibly introducing sampling bias from recruitment through the Hearing Tracker network. Additionally, the study does not rely on objective measures such as pure tone audiometry (PTA), and the study focused on a specific demographic, thereby hindering broader generalisation.

CONCLUSIONS

Newly identified factors, such as social networks, mental health, and service delivery models, are pivotal in predicting HA outcomes. Future research should explore these factors in greater depth to bolster the existing body of evidence on and support for personalised audiological care for optimal HA outcomes. These findings contribute to advancing public hearing health and improving individualised care within the field of audiology. •
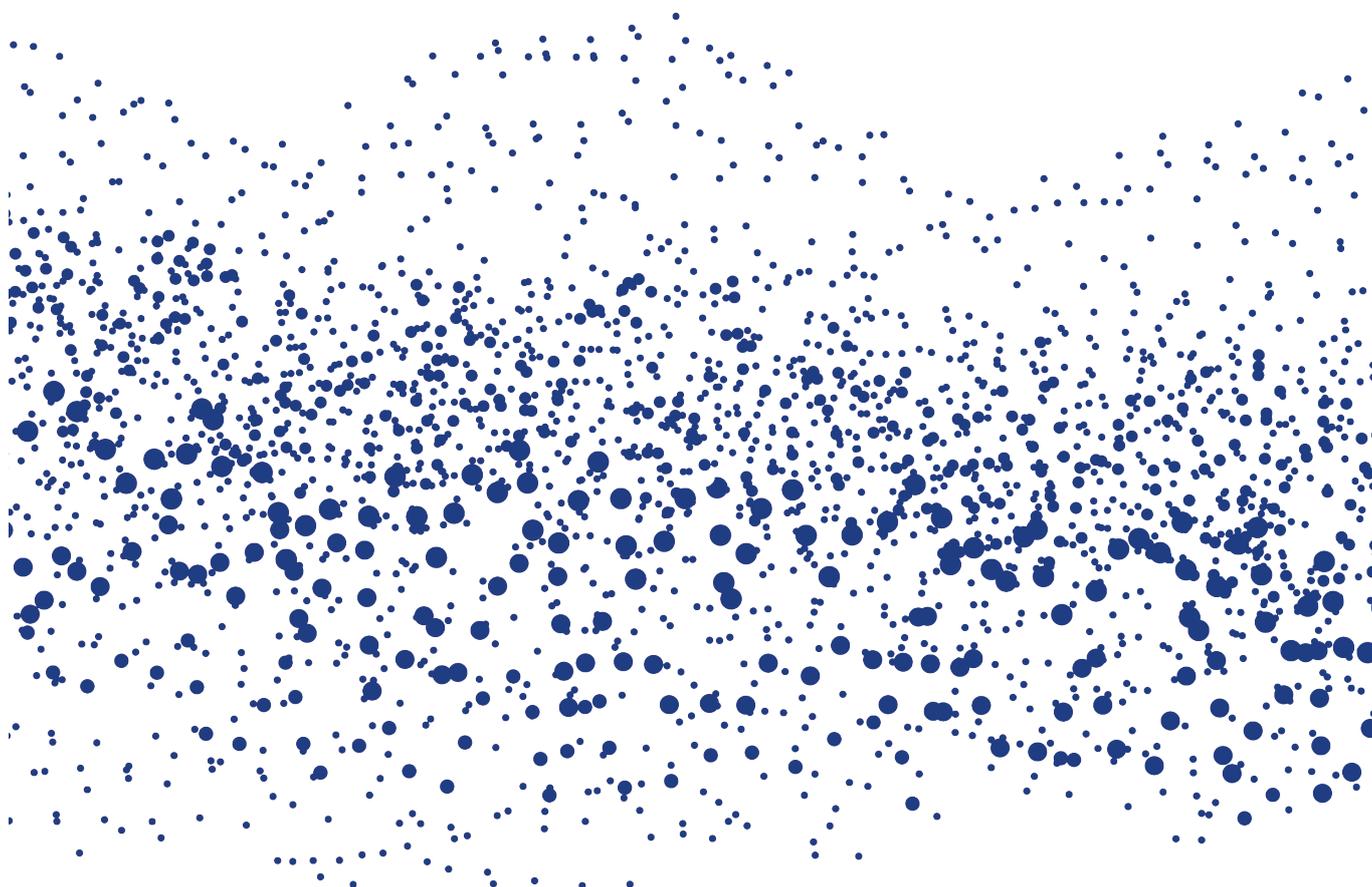
ASSOCIATION BETWEEN HEARING AID USE AND MORTALITY IN ADULTS WITH HEARING LOSS IN THE USA: A MORTALITY FOLLOW-UP STUDY OF A CROSS-SECTIONAL COHORT

In individuals with hearing loss (HL), regular use of hearing aids (HAs) was linked to reduced mortality risks compared to those who infrequently or never used HAs, even after considering factors such as age, degree of HL, and other potential confounders.

CRITICAL NOTE

This retrospective analysis, conducted in the U.S. using a representative sample from the National Health and Nutrition Examination Survey (NHANES), confirmed the existence of a dose-dependent rise in mortality risk corresponding to the severity of hearing loss (HL), consistent with prior research. Among individuals with HL, consistent use of hearing aids (HAs) was found to present a diminished mortality risk, even after adjusting for variables such as age and degree of HL. Further research is required to explore this association in greater depth, probing the potential protective impact of regular HA use on mortality risk. It's a shame they didn't use the latest WHO classification of levels of hearing loss (2019).

There is an increasing body of evidence highlighting the impact of hearing loss (HL) on various health outcomes, including dementia, mental health, communication, quality of life, and even mortality. As HL is anticipated to affect 2.5 billion individuals by 2050, it is imperative to identify and implement interventions to alleviate this burden within the broader context of healthcare initiatives.

Prior research has established HL as a significant risk factor for all-cause mortality, with a dose-response relationship, where each additional 30 dB of HL corresponds to a doubling in the risk of mortality. This cross-sectional follow-up study seeks to investigate whether the use of hearing aids (HAs) as a treatment for HL is associated with a reduction in the risk of mortality.

For the purpose of this study, the authors drew their cohort from the National Health and Nutrition Examination Survey (NHANES) conducted in the United States between 1999 and 2012, with follow-up data on mortality available up to and inclusive of 2019. The analysis involved a total of 9,885 records (51% female, 49% male). Multivariable models were applied to analyse their data, accounting for confounding factors. In order to ensure the generalisability of results to the wider U.S. population, sampling weighting was applied.

HL was assessed by trained examiners, thanks to a four-frequency pure tone average (PTA) of 0,5 kHz, 1 kHz, 2 kHz, and 4 kHz. The severity of HL was further classified according to the "old" World Health Organisation (WHO) definition: mild (25 to <40 dB HL); moderate (40 to <60 dB HL); and severe to profound (≥60 dB HL).

The classification of HA use was determined through the following question as stated in the NHANES:

'Have you ever worn a hearing aid?'

- Participants who answered negatively were classified as 'never users'.
- Participants reporting regular HA use were classified as such ('regular users') under the following conditions (self-reported):
  - (1) 'at least once a week, once a day, or almost always'
  - (2) 'wearing a hearing aid for at least 5 h per week'
  - (3) 'at least half the time, usually, or always'.

This variation in criteria arose from the use of different survey questions across various cycles of participant data collection.

- Participants who reported using HAs but did not meet the specified criteria for regular hearing aid users were categorised as 'non-regular users'.

Mortality status was determined through probabilistic matching between NHANES data and death certificates up to Dec 31, 2019. Additional demographic information such as sex, marital status, race, ethnicity, poverty to income ratio, level of education, insurance status, as well

as medical history including diabetes, hypertension, stroke, cardiovascular disease, smoking status (never, former, or current), and BMI was obtained from interview data. The study explored the association between HL and all-cause mortality, using Cox proportional hazards regression models treating HL as both a binary and categorical variable. The findings were presented in terms of Hazard Ratios (HRs) along with their corresponding 95% Confidence Intervals (CIs).

In the cohort, the weighted prevalence of audiometry-measured HL was 14.7% (95% CI 13.3–16.3%), and the all-cause mortality rate stood at 13.2% (12.1–14.4) over a median 10.4 years of follow-up (range 0.1–20.8).

Overall, a direct relationship was observed between poorer hearing and an increased age-adjusted mortality risk among individuals with any type of HL (HR 1.68 [95% CI 1.47–1.92]). This association displayed a dose-response pattern, with moderate and severe HL indicating a higher risk than mild HL. Moreover, HL emerged as an independent risk factor linked to elevated mortality (adjusted hazard ratio [HR] 1.40 [95% CI 1.21–1.62]) after accounting for demographic and medical factors.

Among adults with HL, the prevalence of regular HA use was 12.7% (95% CI 10.6–15.1), while non-regular HA use was at 6.6% (95% CI 5.4–8.0), with 80.7% never users.

Remarkably, adjusted mortality risk was lower among regular HA users compared to never users (adjusted HR 0.76 [0.60–0.95]), adjusting for demographic factors, HL severity, and medical history. Interestingly, no such difference in adjusted mortality was found among non-regular HA users and never users (adjusted HR 0·93 [0·70–1·24]).

These findings support earlier epidemiological studies which found associations between HL and mortality, displaying a dose-response pattern (with greater HL linked to an increased risk of mortality).

One notable limitation of this study is the disparities in baseline data, with regular HA users having fewer medical issues, greater access to healthcare and higher socioeconomic status. Additionally, the variations in the questions used to assess HA use across the different cycles of the NHANES undermines the reliability of the data and its analysis, as could additional confounding factors beyond control, due to data unavailability.

Despite its limitations, this study successfully demonstrated a lower risk of mortality among individuals with HL who regularly used HAs compared to those who did not, suggesting a potential protective effect of HA.

In order to gain a deeper understanding of the impact of HA use on mortality, further research is needed. Longitudinal and randomised controlled studies would offer the most robust methodology for assessing this relationship, enabling better control over confounding and mediating variables. •
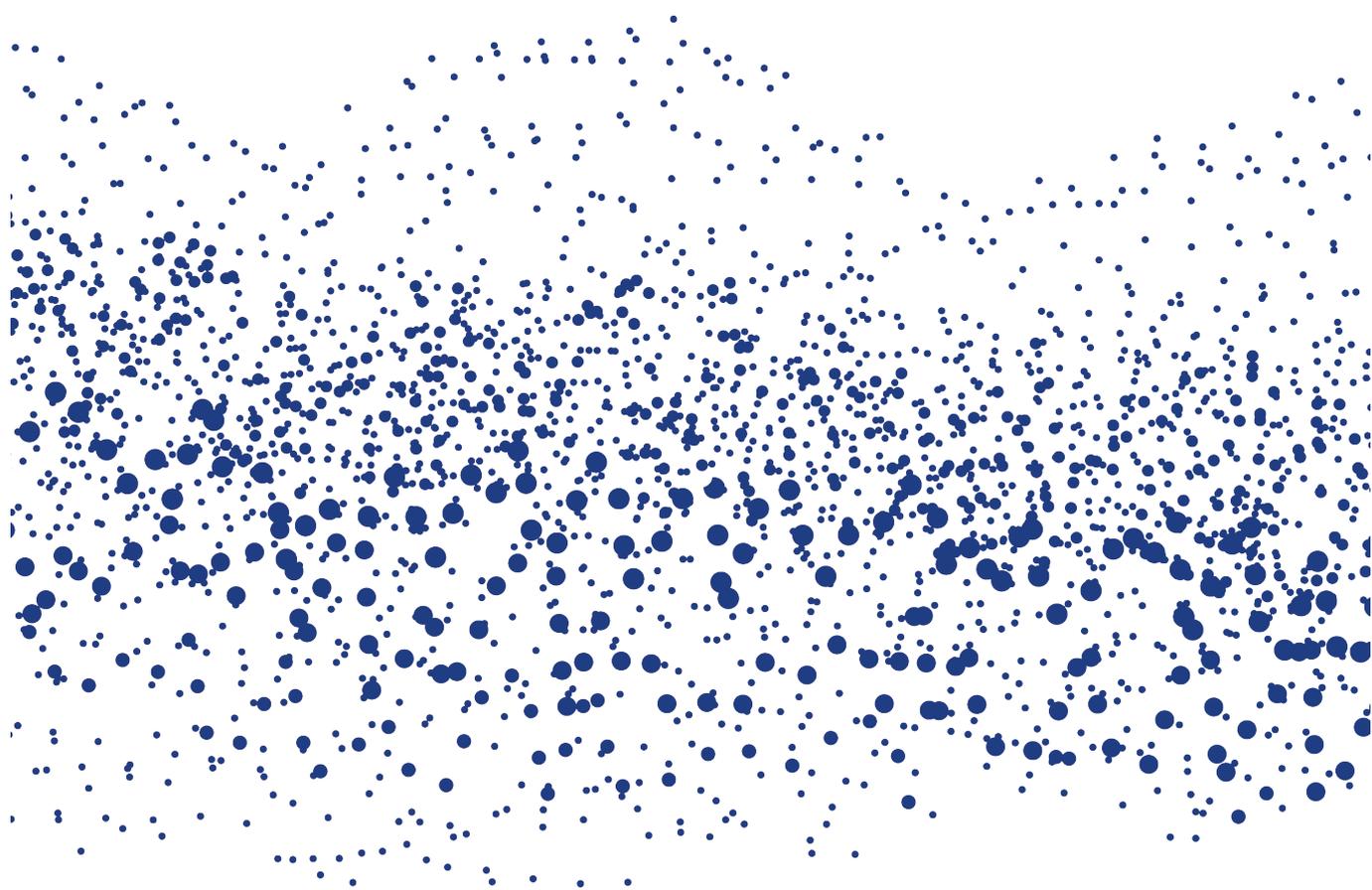
A QUALITATIVE INVESTIGATION OF THE HEARING AND HEARING-AID RELATED EMOTIONAL STATES EXPERIENCED

BYADULTS WITH HEARING LOSS

Adults with hearing loss (HL) have a wide range of negative hearing-related emotions caused by the impact of HL on their everyday lives.

Emotions play a significant role in shaping patients' behaviours and satisfaction with regards to healthcare. The emotional impact of hearing loss (HL) on adults can lead to feelings of frustration, irritation, withdrawal, embarrassment, depression, and anxiety. Studies have successfully demonstrated the positive effects of HA fitting on patients' emotional states. However, this should not overshadow the negative emotional impact they can have on patients' emotions due to factors such as stigma and the lengthy adaptation process required.

This qualitative study set out to explore the emotional experiences of adults coping with HL, particularly concerning their hearing status and the use of HAs. The chosen methodology facilitated an in-depth examination of the emotional phenomena associated with HL and HA use among adults. Remote semi-structured interviews were conducted with 17 participants (9 female) with HL (age 44–74). Because the interviews took place in August 2020, most of them took place over the phone (with one participant opting for written questions and another for a video call) due to COVID-19 social distancing restrictions. All interviews were recorded and subsequently transcribed. Among the participants, ten used bilateral HAs, four used unilateral HAs, and three did not have HAs at the time of the interview.

Applying thematic analysis, the researchers identified four main themes:
- **Identity and self-image** – Participants' perceptions of themselves, assumed perceptions by others, and the impact of HL gave rise to negative emotions such as a negative self-image, isolation, conflict, low self-esteem, shame, feeling inadequate. HAs predominantly elicited positive emotions.

CRITICAL NOTE
Hearing rehabilitation extends beyond the mere act of fitting hearing aids (HAs); it necessitates a holistic approach in order to address the entirety of the individual entering the room, not just their two ears. Recognising and understanding the emotional aspects of patients regarding their hearing loss (HL) and HA use can significantly enhance the effectiveness of hearing rehabilitation.

- **Autonomy and control** – HL generated negative emotions in various work and social settings. Coping strategies, techniques, and technologies, including HAs, played a role in fostering positive emotions such as happiness and enjoyment.
- **Personality and dominant emotional states** – While direct assessments of personality types were not conducted, the findings suggested that participants exhibiting perfectionistic behaviours tended to experience more negative hearing-related emotions.
- **Situational cost/benefit analysis with respect to use of HAs** – The use of HAs generally evoked positive emotions, but occasionally, negative emotions surfaced as well. Participants weighed the positive and negative aspects associated with the use of their HA

Research findings revealed a diverse spectrum of negative hearing-related emotions experienced by adults grappling with HL, stemming from the impact of HL on their daily lives. While the specific hearing-related emotions varied among participants, a universal thread of negative emotions

was found, including frustration, anxiety, and isolation. Factors influencing these emotions encompassed the individual's everyday environments, their personality, their relationship to their hearing condition, HAs and conversation partners, as well as ability to control the conversation setting. The use of HAs was reported to help alleviate negative hearing-related emotions and help cultivate positive ones. Nonetheless, HAs could also trigger negative emotions, due to participants' perceptions of associated limitations. •

COCHLEAR IMPLANTATION FOR UNILATERAL AND ASYMMETRIC HEARING LOSS: LONG-TERM SUBJECTIVE BENEFIT

This article reviews the long-term outcomes of cochlear implantation (CI) for managing tinnitus and subjective benefits in individuals with unilateral and asymmetric hearing loss (HL).

Cochlear implantation (CI) has demonstrated subjective benefits and improvements in perceived tinnitus severity shortly after implantation. However, the long-term benefits and the sustained impact on perceived tinnitus severity remain unclear, with reported variations observed between the unilateral hearing loss (UHL) and asymmetric hearing loss (AHL) groups.

PARTICIPANTS
20 adults with UHL (<35 dBHL in the ear contralateral to CI), mean age of 50.1 years
20 adults with AHL (35–55 dBHL in the ear contralateral to CI), mean age of 70.2 years.
The participants experienced moderate to profound deafness for an average duration of <10 years. Participants were equipped with Medel devices with full electrode insertion; no surgery complications were reported.

METHODOLOGY
The Abbreviated Profile for Hearing Aid Benefit (APHAB), Speech, Spatial and Qualities of Hearing (SSQ), and the Tinnitus Handicap Inventory (THI) questionnaires were administered pre-operatively, at one-month post CI, then at 12-month intervals for up to five years.

CRITICAL NOTE:
As the researchers highlight themselves, the questionnaires used in this study primarily focus on device-related benefits. They suggest that incorporating general quality of life scales in future research would provide an additional dimension. Furthermore, the limited sample size resulted from participants' reluctance to return after the 12-month post-activation appointment.

DATA ANALYSIS
The data were analysed to assess changes in questionnaire responses between the preoperative and post-operative periods and for each 12-month interval up to five years. Additionally, differences between the two groups (UHL and AHL) were examined.

RESULTS
SSQ – Significant differences were observed when comparing preoperative and post-operative results, and these differences persisted over time. No significant difference was found between the AHL and UHL groups.

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APHAP - Significant improvements were observed in both AHL and UHL groups when comparing preoperative and post-operative outcomes, and these persisted over time. Differences were found in the reported perceived difficulty across the subscales between the AHL and UHL groups.

THI - Significant differences were observed between preoperative and post-operative results, with greater improvements recorded for the UHL group. Both the UHL and AHL groups continued to show improvements in perceived tinnitus over time, however, in both groups, some participants reported fluctuations in tinnitus.

DISCUSSION

Significant and sustained improvements were reported on subjective benefit scales (SSQ, APHAP) and tinnitus severity (THI) for participants following CI. Moreover, comparable patterns of improvement were observed for both the AHL and UHL groups.

A difference in perceived improvement in tinnitus severity was found between the two groups, with greater improvement in the UHL group. This was attributed to the greater perceived tinnitus preoperatively in the UHL group. The reasons for this were unclear, although it was observed that participants in the UHL group were younger, the HL was more likely to be sudden rather than long-term, and the hearing level was better in the contralateral ear.

CONCLUSION

Cochlear implant wearers reported improved subjective benefit and perceived tinnitus severity soon after implantation, and these positive changes persisted in the long term. •
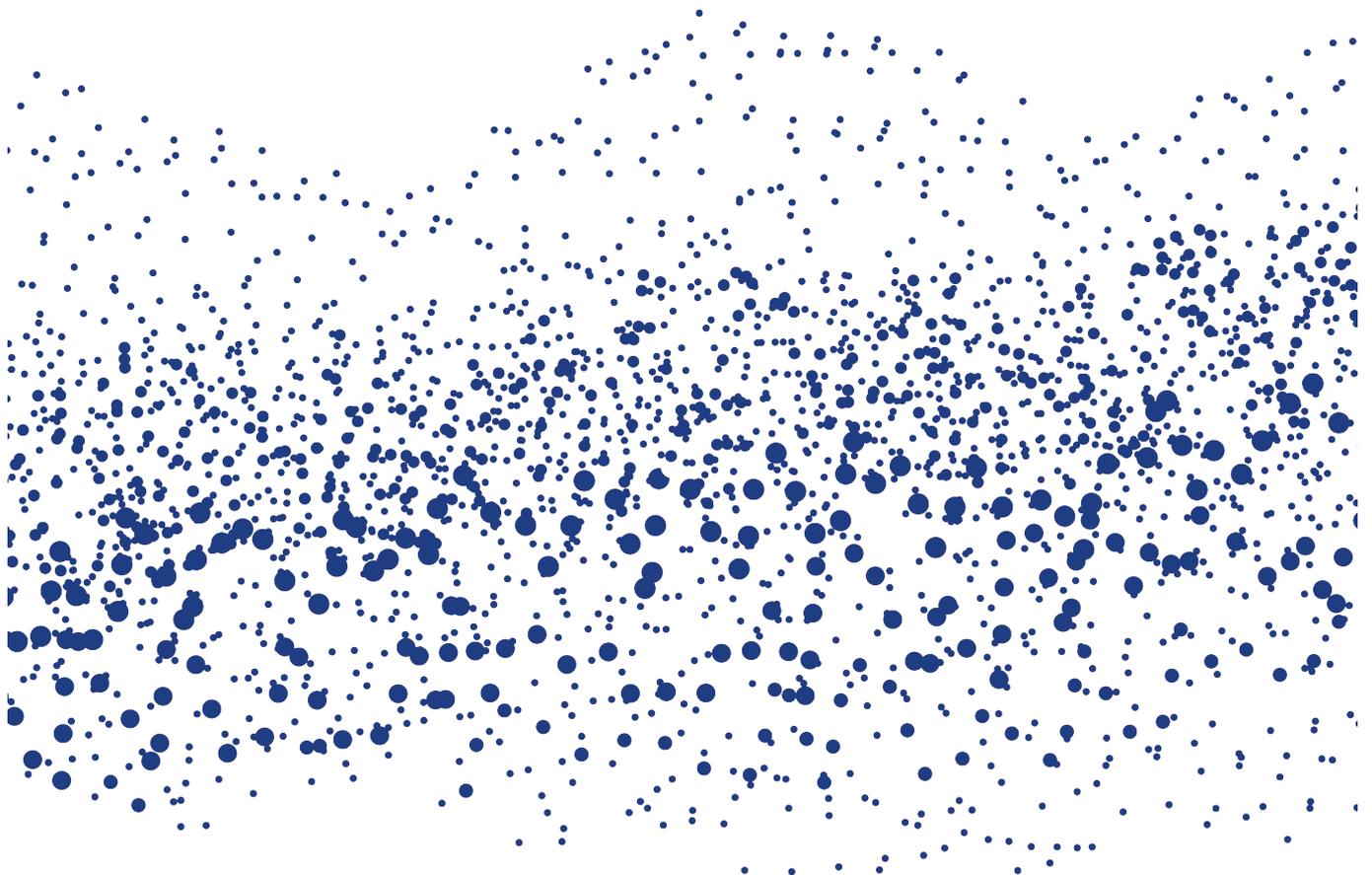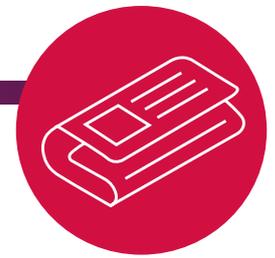
LONGITUDINAL AUDITORY BENEFIT FOR ELDERLY PATIENTS AFTER COCHLEAR IMPLANT FOR BILATERAL HEARING LOSS, INCLUDING THOSE MEETING EXPANDED CENTERS FOR MEDICARE & MEDICAID SERVICES CRITERIA

The study explores the impact of age at implantation on both short-term and long-term improvements in speech recognition following cochlear implantation.

Hearing loss (HL) among the elderly is associated with various health issues, such as an elevated risk of falls, dementia, and depression. While cochlear implantation (CI) is an alternative for cases where hearing aids (HA) fail to provide adequate benefit, research on speech recognition outcomes in the elderly has yielded mixed results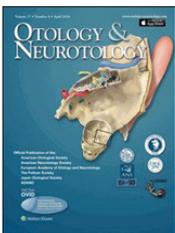. Further research is crucial for discerning whether age influences variability in speech recognition outcomes and whether improvements post-implantation remain stable or show deterioration. A greater understanding of these factors will contribute to more effective counselling for elderly patients.

CRITICAL NOTE
While the authors concede there are several limitations associated with the long-term retrospective nature of the study, their findings, thanks to their substantial sample size and longitudinal approach, provide valuable insights into the consideration of cochlear implantation in the elderly population, insights which are both useful and generalisable.

Participants

The study population consisted of a total of 1,105 people with bilateral moderate to profound sensorineural hearing loss (SNHL) and scores less than 60% in their best aided listening condition, who underwent unilateral CI. They were broken down into three groups, as follows:

- very elderly (>80 years): 86 participants
- elderly (65-79 years): 409 participants
- non-elderly (<65 years): 709 participants.

METHODOLOGY

Participants underwent assessments using: AzBio sentences, Consonant nucleus consonant (CNC) words, and the Hearing in Noise Test (HINT) both preoperatively and postoperatively at regular intervals. The data was analysed retrospectively.

RESULTS

Speech recognition improvement with AzBio sentences showed similar trends across all age groups up to two years post CI. However, beyond two years and up to eight years post-implantation, speech recognition scores plateaued for the very elderly group, while the younger groups continued to show improvement in the medium-term (2–8 years) before also plateauing in the longer term (>8 years). This pattern was consistent for CNC words. Additionally, there was a tendency towards sustained improvement in CNC word recognition beyond eight years for the younger age groups. Conversely, a trend towards declining speech outcomes on CNC words was observed in the elderly and very elderly subgroups in the long term.

Post-operative improvements on the HINT test showed lesser progress for the very elderly group, with no noteworthy improvement in scores across medium- and long-term intervals for any of the age groups. A further analysis was carried out to compare participants with pre-implant aided speech scores of <40% in the best-aided condition and those with scores <60%, the latter group reflecting recent changes in Medicare inclusion criteria for CI candidacy. Results from this analysis indicated comparable improvements for the two

groups across each test during the short-term interval. The analysis of the HINT test, with a larger sample size, revealed similar medium- and long-term improvements for both candidacy groups, with no statistically significant differences among younger, elderly, or very elderly participants.

DISCUSSION

Previous studies have presented conflicting findings regarding the benefits of CI in elderly individuals. While some research indicates that older participants experience less benefit, though with similar quality-of-life outcomes, compared to their younger counterparts, other studies suggest comparable improvements in both audiometric and quality-of-life outcomes. The present study demonstrates that elderly and very elderly individuals experience significant short-term benefits on speech recognition tests following CI, with improvements of a similar magnitude to those observed in younger subjects. Furthermore, these improvements are sustained up to eight years post-implantation. The outcomes are also comparable for individuals with pre-implantation speech recognition scores <40% and those with scores <60%.

Differences were observed for older subjects for continued improvement on speech recognition tasks in the long term. In contrast, younger age groups continued to exhibit improvement in the medium and longer term, while outcomes for the older age groups tended to plateau early and sometimes decline after eight years. The authors suggest that this pattern of findings may be influenced by non-auditory factors, such as declining cognition and neural plasticity, as well as working memory.

The authors emphasise the importance of this research for counselling elderly patients considering CI. Given the proven relationship between HL and cognitive decline, coupled with the findings that the benefits of CI in the elderly and very elderly are both significant and sustained, the authors suggest that early implantation may mitigate the impact of HL on overall quality of life.

CONCLUSION

The study revealed that subjects considered very elderly (>80 years) who underwent CI demonstrated comparable postoperative benefits on speech recognition tasks to their younger counterparts, and these improvements were sustained for up to eight years. •
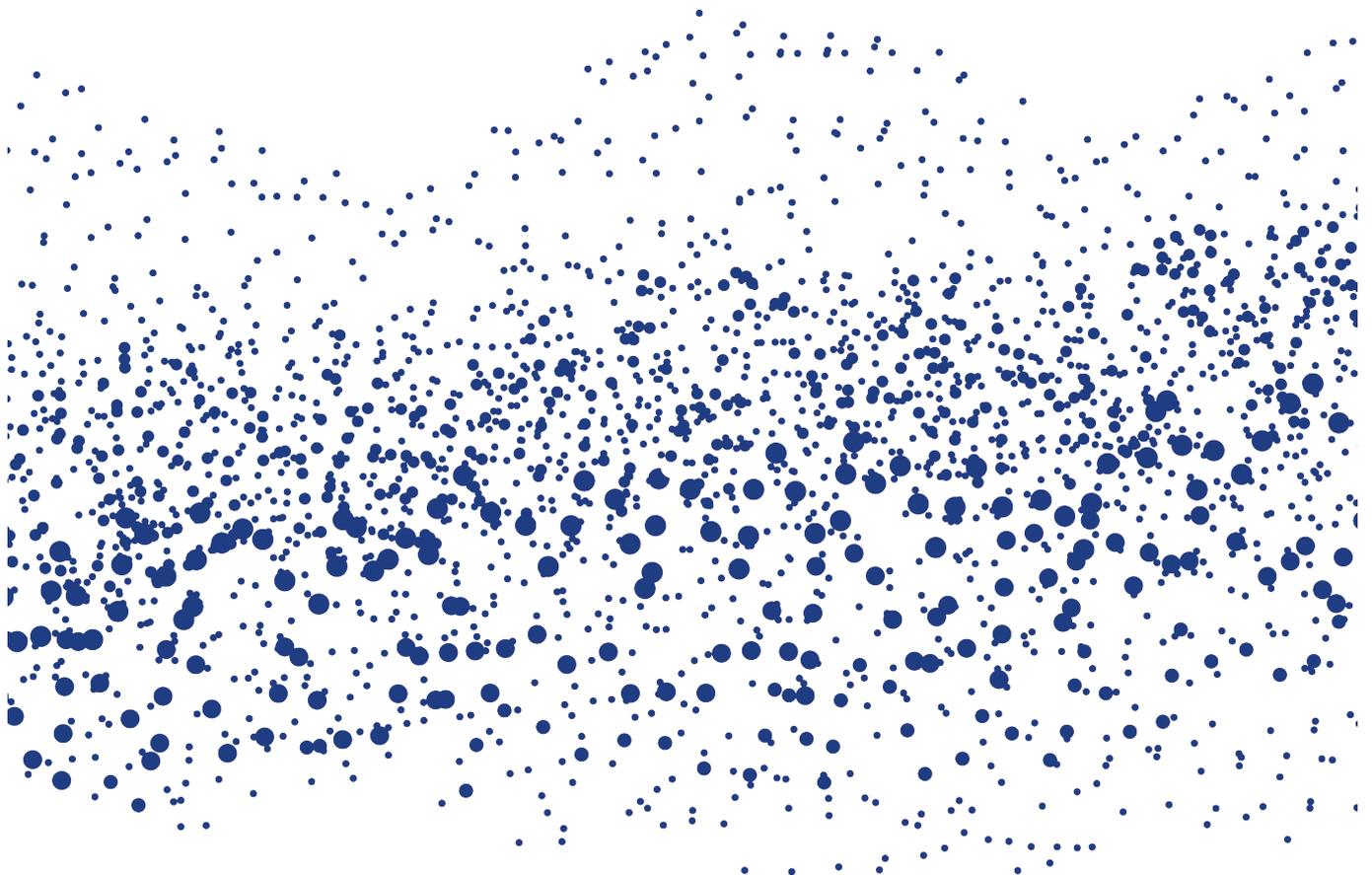
EFFICACY AND EFFECTIVENESS OF WIRELESS BINAURAL BEAMFORMING TECHNOLOGY OF HEARING AIDS IN IMPROVING SPEECH PERCEPTION IN NOISE:

A SYSTEMATIC REVIEW

The authors conducted a systematic review with the goal of assessing both (1) the effectiveness of Binaural Beamformers in noisy environments compared to traditional hearing aid directionality systems and (2) the subjective evaluation of this technology.

Nowadays, the use of information transmission between two hearing aids (HAs) is widely employed for tasks such as volume synchronisation, interaural compression (for certain manufacturers), and the optimisation of directionality, by creating a binaural network with the goal of improving speech perception in noise, particularly based on the azimuth of speech and the detected sound level.

With this study, the authors propose to address two research goals: (1) assess the effectiveness of Binaural Beamformers (BBF) in noisy environments compared to traditional hearing aid directionality systems and (2) assess the subjective evaluation of this technology. A comprehensive literature search yielded 639 articles from various databases. After eliminating duplicates and selecting titles and abstracts, 11 studies were included in the qualitative review. These studies compared wireless BBF to conventional microphone technologies, including Bilateral Omnidirectional Microphone (Bil-Omni-Mic), Bilateral Directional Microphone (Bil-Dir-Mic), and Bilateral Asymmetric Directional Microphone (Bil-Asym-Dir-Mic). The review assessed results related to Speech in Noise (SIN) performance and self-reported subjective evaluations.

The results consistently demonstrate the superiority of wireless BBF over Bil-Omni-Mic in SIN tests across all included studies. However, the comparison with Bil-Dir-Mic yielded mixed results, with some studies indicating the superiority of wireless BBF and others reporting no significant differences. Moreover, evidence comparing wireless BBF to Bil-Asym-Dir-Mic is limited but suggests a potential advantage for BBF. The review also examined subjective evaluations, revealing mixed results across studies. The authors, expressing serious reservations about the reliability of the data and acknowledging notable biases, ultimately concluded that the results were inconclusive.

BBF = Binaural Beamformer
Bil-Asym-Dir-Mic = Bilateral Asymmetric Directional Microphone
Bil-Dir-Mic = Bilatéral Directional Micropohone
Bil-Omni-Mic = Bilatéral Omnidirectional Microphone
HA = Hearing Aid
SIN = Speech Perception In Noise
SNR = Signal-to-Noise Ratio
WDRC = Wide Dynamic Range Compression
ILD = Interaural Level Difference
ITD = Interaural Time Difference •

CRITICAL NOTE

This article is particularly compelling as it represents a significant effort in collecting and compiling a large number of studies. To begin with, while this systematic review focuses on the efficacy of wireless directionality, it found that optimal intelligibility outcomes in noise stem from the combination of various structures. These include, as explored in this study, directional microphones, the selected type of compression (fast, slow, adaptive), and noise reduction features.

Appendix 1 of this systematic review outlines the wireless binaural directionality strategies of four hearing aid manufacturers (Signia, Beltone, Resound, and Phonak). Beltone and Resound share identical information processing treatments, with a common development platform (GN Hearing). While all offer some form of Binaural Beamforming (BBF), certain models do not apply gain compensations between the two ears due to Wide Dynamic Range Compression (WDRC).

Indeed, in the context of 'classic' compression, gains are modulated based on the input signal, to provide more gain for weaker sounds and limited to no gain for louder ones. When the sound originates from the right, the right HA receives a stronger signal than the left one, owing to the head shadow effect. Nevertheless, under this compression paradigm, the gains of the left device become considerably stronger than those of the right ear, causing a considerable reduction in 'natural' Interaural Level Differences (ILD).

Certain manufacturers, including Beltone, Resound, and Oticon, successfully mitigate this distortion by processing information binaurally. HAs exchange microphone data through streaming (using two microphones per hearing aid for behind-the-ear or receiver-in-canal models), and a comparative analysis is performed. If this analysis identifies a difference in capture related to ILD, gains are then equalised between the two HAs to maintain the initial ILD after amplification.

Moreover, Appendix 3 details the experimental parameters for various tests in noise. While comprehensive details are provided regarding the type of vocal material, masking noise, test methodology (fixed or adaptive), and reverberation conditions within the test room, crucial information regarding the quantity and arrangement of speakers used, as well as the azimuths of speech and noise presentation, is notably absent and raises important questions: How was the subject positioned in relation to the speakers? In which speakers were the speech and noise stimuli presented? From the same speaker, or was speech in front and noise behind, or vice versa, or on the sides? Understanding these dynamics is crucial as the fundamental principle of directionality aims to enhance speech in the frontal direction while suppressing noise from behind. In this context, it becomes conceivable that Binaural Beamforming (BBF) might not have yielded substantial or any improvement compared to a Bilateral Directional Microphone system.

Is it possible to conduct a test in noise that is as 'ecological' as possible?
Lastly, in relation to the populations under study, many variables can influence the quality of understanding speech in noise, with both directional and wireless microphones. The authors aptly underscore this consideration, particularly in the context of addressing the second research question regarding subjective ratings. Firstly, the age of participants may significantly influence cognitive abilities to extract information from speech in noisy settings. Moreover, the paper fails to provide crucial details about the participants' history with HAs. It remains unclear whether the subjects have been long-term HA users, having undergone conditioning and training, or if they are newly equipped individuals still adapting to amplification and starting their rehabilitation journey. Additionally, the influence of HL groups using HAs and the aetiology of their hearing impairment on the study outcomes is a critical aspect which warrants exploration.

Furthermore, there are no details about the acoustic couplings used in different subjects, a crucial factor with a significant influence on understanding speech in noise (amplified sound vs. direct sound and the limitation of signal processing algorithm effectiveness).

Lastly, there remains the question of the optimisation of settings for diverse study populations. This includes considerations such as stereo-balancing, which, by achieving a balance in loudness for different input levels (especially for loud sounds in noisy environments), may enhance binaural unmasking (Squelch effect).

This systematic review perfectly illustrates the importance of data quality in any study, as evidenced by the meticulous selection of 11 studies from a pool of 639. In the case of Binaural Beamforming, conducting tests with a more detailed noise protocol and using clustering methods for result analysis could offer valuable insights.
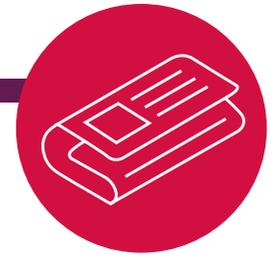
PRELIMINARY GUIDELINES FOR REPLACING WORD-RECOGNITION IN QUIET WITH SPEECH IN NOISE ASSESSMENT IN THE ROUTINE AUDIOLOGIC TEST BATTERY

Given that the score for Word Recognition in Quiet (WRQ) can be predicted from a combination of Speech in Noise (SIN) scores and Tonal Audiometry outcomes, the guidelines recommend testing only WRQ when subnormal results are predicted.

Hearing loss (HL) affects a substantial portion of the population, with 14.3% of individuals aged 12 and older in the U.S. suffering from this condition. HL directly impacts communication abilities, leading to social isolation, and is linked to an increased risk of cognitive impairment. The standard audiological procedure for characterising HL is Word Recognition in Quiet (WRQ), which involves the repetition of phonetically balanced words. The test results are used to assess the need for hearing aids (HAs). Additionally, the silent speech test serves to validate the consistency of the clinical picture and helps in identifying retrocochlear disorders. When it comes to HAs, research has demonstrated that patient satisfaction does not correlate with vocal gain outcomes. In contrast, speech in noise (SIN) is associated with patient satisfaction, providing a more accurate representation of communication skills.

Patients mainly complain of discomfort in noise. Despite the development of numerous voice tests in noise, their routine use remains very low. While speech tests in both quiet and noise are individually associated with age and HL, a result obtained in quiet does not reliably predict performance in noise.

Several factors contribute to the underutilisation of tests in noise, including ingrained habits, a lack of practical knowledge for conducting the test and determining the signal-to-noise ratio (SNR), and the complexity of interpreting test results due to the intricate mechanisms involved. Additionally, incorporating an extra test in noise is perceived as time-intensive.

The authors propose to study whether the SIN test could serve as a substitute for WRQ. The objective of this study is to explore the potential advantages of incorporating testing in noise into standard protocols.

CRITICAL NOTE

Given that the main complaint for most individuals seeking hearing care is difficulty understanding in noise, opting for Speech in Noise Assessment seems a much more logical choice than Word Recognition in Quiet (WRQ). It is relevant to evaluate speech in noise, whatever the test mode, free field or under headphones. Patients generally find this more acceptable, as it addresses what they perceive as their primary issue. The study's large participant pool of over 5,000 individuals and the tests employed are commendable.

While the suggested guidelines are sensible, there is a potential risk of causing frustration for patients with more severe hearing loss (HL) who struggle to comprehend speech in noise. Unfortunately, the study did not include a validated questionnaire, such as HHIE-S or SSQ, and the authors did not incorporate the new WHO (2019)[1] PTA calculation and levels of HL in both the study and the guidelines.

[1]*Humes LE. The World Health Organization's hearing-impairment grading system: an evaluation for unaided communication in age-related hearing loss. Int. J. Audiol. (2019): 58(1), 12–20.*

METHODOLOGY AND MATERIALS

The SIN was administered to a panel of 5,808 patients, aged 18 to 101 years, presenting for routine clinical assessments. The patient cohort encompassed diverse auditory pathologies. The battery of tests performed included: otoscopy; tympanometry; and acoustic reflex measurements; air-conduction and bone-conduction thresholds; speech-reception threshold; and WRQ using NU-6 lists.

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The specific SIN test administered was the QuickSIN test, as proposed by Killion in 2004. It was performed unilaterally on each ear, with no observed preference for the right or left ear. Consequently, the data presented specifically refer to the right ear. Performance on the test in quiet was categorised as follows:>88% categorised as 'excellent'; >76% as 'good'; and below as 'fair to poor'.

Average HL is calculated with the High-Frequency Pure-Tone Average (HFPTA), averaged across 1,000, 2,000, and 4,000 Hz. The SIN results were divided into two categories: the binaural value, divided into 7 dB increments, and the corrected monaural value, divided into 7 + 1 = 8 dB.

DISCUSSION

Through data analysis, it becomes possible to predict the test in quiet result from the HFPTA and QuickSIN with a very high degree of accuracy, particularly for patients with HFPTA <40 and QuickSIN <7, consistently yielding WRQ scores greater than 88%.

While the WRQ result does not serve as a predictor for the QuickSIN outcome, the QuickSIN result proves valuable in identifying patients experiencing challenges in quiet conditions. The test in noise demonstrates greater sensitivity to HL than the test in quiet, and deteriorates more rapidly than the test in quiet.

The authors highlight there is a sizeable population of patients with normal PTA (HFPTA>40 dB HL) and a degraded noise result (44% exhibiting QuickSIN loss>3 and 30% with QuickSIN loss>4). This aligns with individuals reporting difficulty in noise despite a normal tonal audiogram. Suspected pathologies include low-frequency loss (not factored into mean loss calculation here), retro-cochlear damage, conductive HL with tympanic damage, Eustachian tube dysfunction, synaptic deafferentation, and central issues.

IN CLINICAL PRACTICE

QuickSIN exhibits considerable variability and does not directly correlate with HL. The authors issue the following recommendations:
- Conduct a test in quiet when HFPTA>40 dB HL and QuickSIN>7 or 8 dB SNR. This criterion demonstrates high sensitivity and specificity for identifying patients at risk of suboptimal performance in quiet conditions.
- Perform a test in quiet when HFPTA>40 or QuickSIN>7 or 8 dB SNR. In this case, while sensitivity remains high, there is a reduction in specificity.
- It is unnecessary to administer a test in quiet when HFPTA <40 dB and QuickSIN <7 (as 99% of patients have excellent results in quiet, ranging from 88 to 100%). •
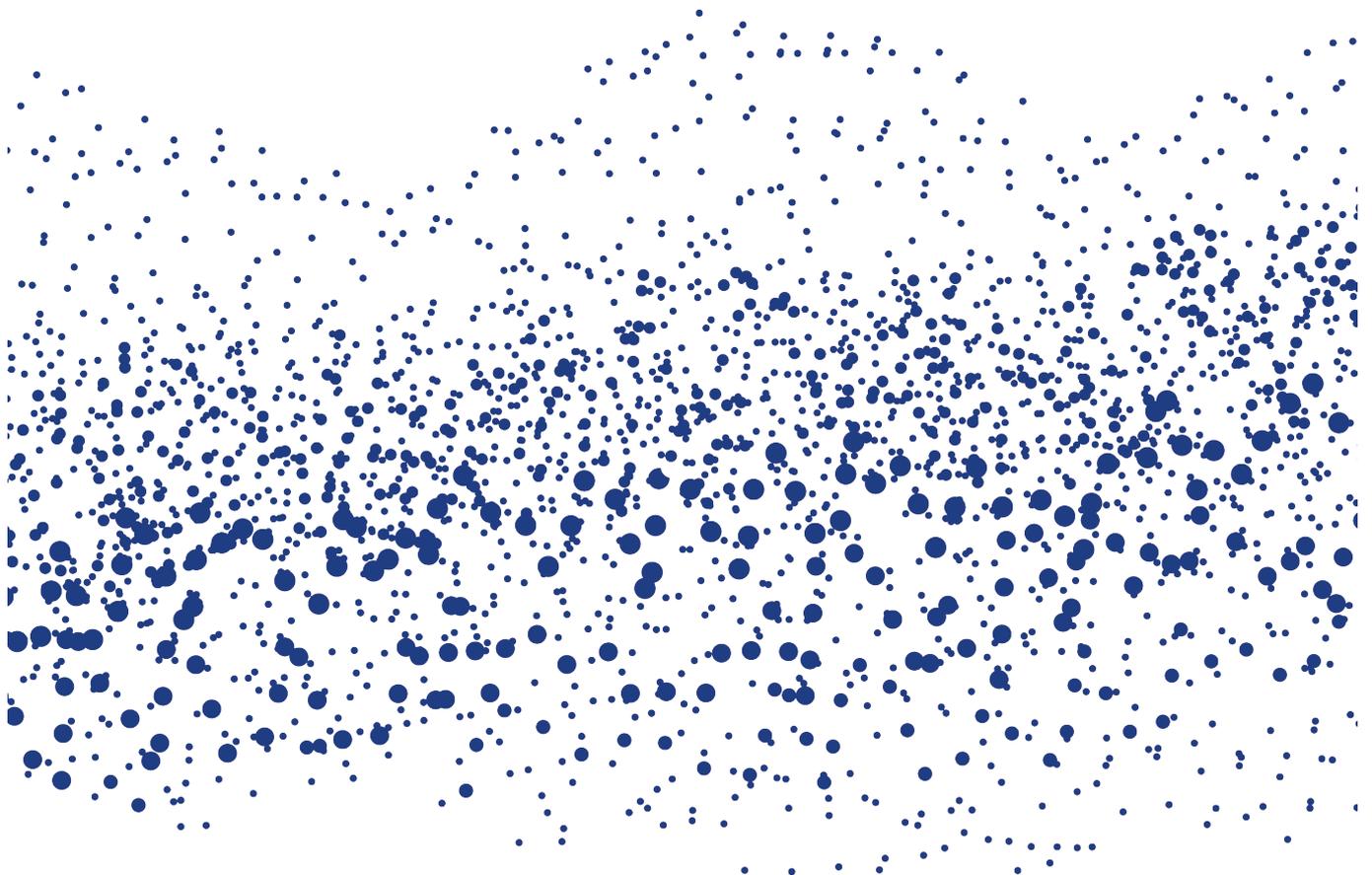
THE INFLUENCE OF SENSORINEURAL HEARING LOSS ON THE RELATIONSHIP

BETWEEN THE PERCEPTION OF SPEECH IN NOISE AND DYSARTHRIC SPEECH

by Connie Loi, New Zealand

The purpose of this study is to investigate the relationship between the perception of neurologically degraded speech (i.e dysarthric speech) and neurotypical speech degraded by noise.

The purpose of this study is twofold: to investigate the relationship between the perception of neurologically degraded speech (i.e. dysarthric speech) and neurotypical speech degraded by noise; and to replicate the study conducted by Borrie, Baese-Berk, *et al.* (2017). The authors pose two research questions: (1) Is there a relationship between intelligibility performance for neurotypical speech in noise and dysarthric speech for listeners with normal hearing (NH) and listeners with hearing impairment? (2) Does the degree of hearing loss (HL) for listeners with sensorineural hearing loss (SNHL) affect the relationship between the perception of the two types of speech?

The ability to understand speech in adverse listening conditions can be challenging and complex, and the relationship between the perception of speech across various types of listening challenges has been investigated at length. Previous studies have shown that individuals with NH exhibit consistency in their ability to perceive degraded speech, suggesting the involvement of global skills in processing such signals. However, the consistency among hearing-impaired listeners is less established across different speech types. This study seeks to extend these findings to the population of hearing-impaired listeners.

> **CRITICAL NOTE**
> *While there was already sound evidence that people with hearing loss (HL) experience difficulty in background in noise, this study reveals they also encounter challenges when dealing with disordered speech. This finding gains significance considering the common aetiologies of dysarthria include age-related conditions, such as Parkinson's disease, and the established association between age and sensorineural hearing loss (SNHL). This suggests that individuals with HL may be inherently more susceptible to difficulties in understanding disordered speech. The findings serve as a crucial reminder for clinical practice, highlighting the potential challenges faced by patients with HL or dysarthria in their everyday conversations. The insights provided by this study can help professionals working with this population in validating patients' experiences, offering adequate counselling, and providing tailored interventions that address their particular communication challenges.*

PARTICIPANTS

- Two cohorts of participants were recruited for this study. All were native speakers of Standard American English and had no prior exposure to individuals with dysarthria.
- First group: 31 NH listeners, aged between 18–65 years (mean age: 22), with PTA thresholds at or below 20 dB HL from 250 to 8 kHz.
- Second group: 36 participants with SNHL, aged between 18 and 81 years (mean age: 66), excluding cochlear implant users and those with cognitive conditions such as dementia. Within this group:
  - All participants were current HA users, and had been for a minimum of six months.
  - A complete hearing assessment was conducted on the day of their enrolment.
  - Participants presented various degrees and configurations of HL.

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- A total of 160 syntactically plausible yet semantically anomalous phrases served as the speech materials.
- These phrases were based on the works of Cutler and Butterfield (1992).
- The phrases were divided into two sets, each comprising 80 phrases, with a balanced number of phrases and words, along with alternating stress patterns.
    - One set was produced by a 72-year-old male control speaker, with no neurotypical speech.
    - The other set was produced by a 72-year-old male with dysarthria, specifically mild-to-moderate ataxic dysarthria resulting from cerebellar disease.

PROCEDURE

- Before the testing, participants were given a familiarisation period lasting approximately 10 minutes, during which they were exposed to stimuli resembling the formal test materials.
- The test involved four blocks, each containing 40 phrases. Each block was dedicated to either neurotypical speech in noise or dysarthric speech in quiet. The starting condition was alternated across listeners.
- The stimuli were delivered through Sennheiser 280 Pro headphones, set at 65 dBA for NH listeners. Participants with SNHL were presented at 65 dBA plus frequency-specific gains prescribed by the NAL-R hearing aid fitting formula.

- Participants were tasked with repeating as much of each phrase as possible, and their responses were scored based on the number of correct words.

RESULTS

- Intelligibility performance, measured by mean percent words correct (PWC) scores.
- The intelligibility performance on SIN for the NH listeners' group was comparable to that of the dysarthric speech group.
- In contrast, the intelligibility performance on SIN for the hearing-impaired group was lower than that of the dysarthric speech group.
- A significant positive correlation was found between PWC scores for SIN and dysarthric speech.
- The results suggest that listeners consistently demonstrate consistent ability to perceive speech across various challenging conditions.
- For normal-hearing speech, a significant correlation was found between the ability to perceive neurotypical speech in noise and dysarthric speech
- Those who performed poorly in background noise also performed poorly on tasks involving dysarthric speech in quiet, suggesting the involvement of a broader skill set, potentially encompassing cognitive-linguistic skills like working memory, as opposed to isolated perceptual abilities. •
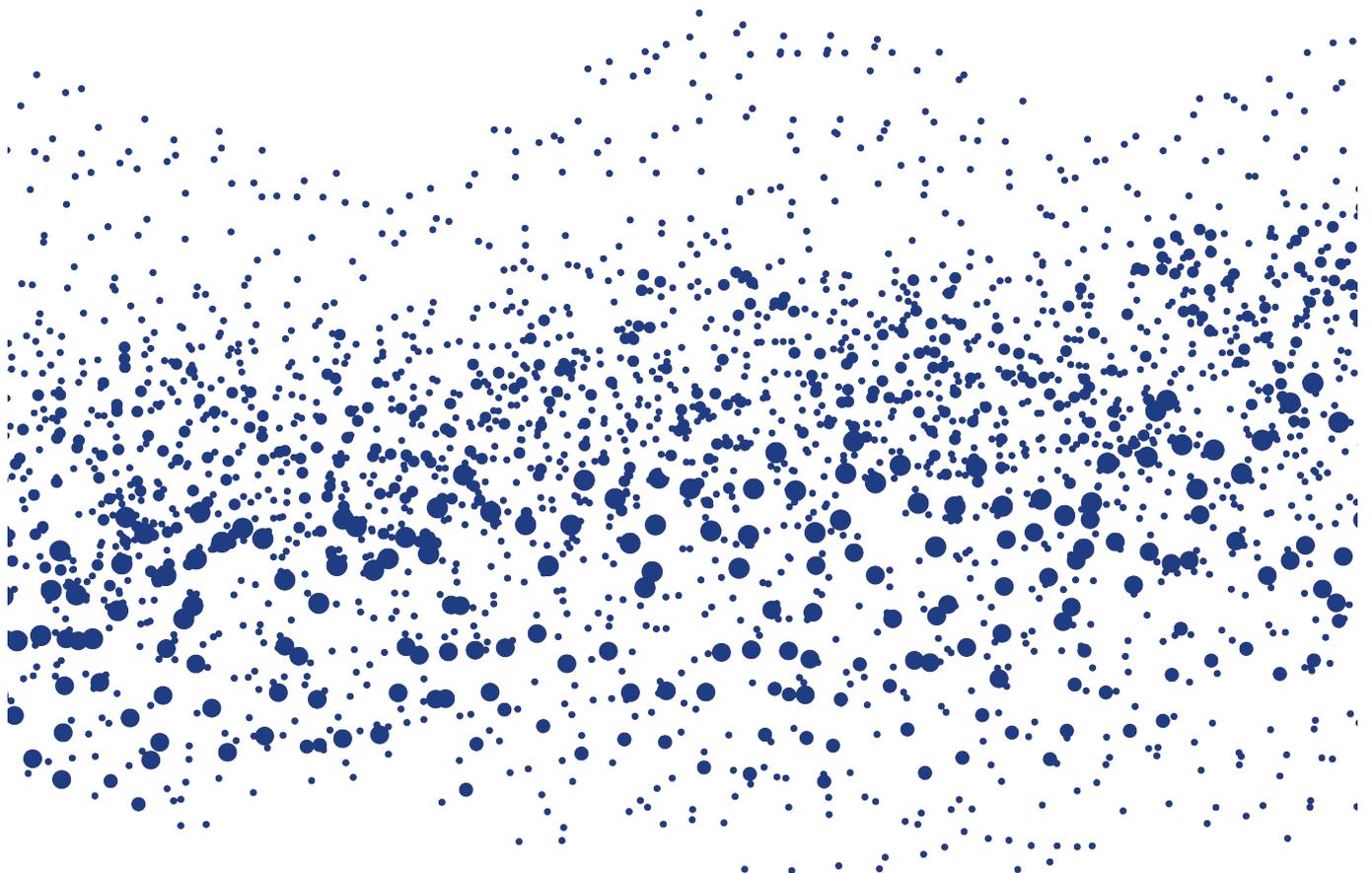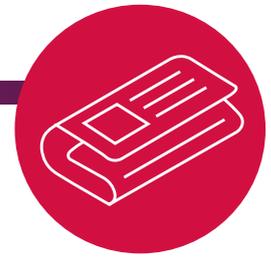
LISTENING PREFERENCES OF NEW ADULT HEARING AID USERS: A

REGISTERED, DOUBLE-BLIND, RANDOMIZED, MIXED-METHODS CLINICAL TRIAL OF INITIAL VERSUS REAL-EAR FIT

The authors found that preference for Initial Fit or Real-Ear Fit may be linked to a preference for comfort or clarity. It was found that new adult hearing aid (HA) users prefer Initial Fit when evaluating comfort, both in quiet and in noise; those who favoured Real-Ear Fit (22% of participants) primarily cited clarity as the main reason for their overall preference.

Over the years, hearing aid (HA) manufacturers have consistently pursued an optimal Initial Fit (IF). As the IF approaches the Real Ear Target, the question arises: is investing time and effort in Real Ear Measurement (REM) still worthwhile for achieving better patient outcomes Do patients prefer a REM fit above an initial fit, regarding comfort and clarity?

METHODOLOGY

In this study, new adult HA users with mild to moderate hearing loss (HL) were provided with a specific HA (Oticon Engage BTE 85 or 105) over a six-week period and were required to complete a preference diary.

The HAs featured two programs: IF vs. REM fit. For the first, following an initial hearing assessment, the HAs were fit with an IF, followed by fine-tuning based on immediate participant feedback. Subsequently, the Real Ear Aided Response (REAR) of this IF programme was measured. For the second programme, the REAR values were matched with NAL-NL2 targets. Programme order was blinded from both the participants and the audiologist.

A total of 45 participants completed the study, providing daily preference ratings on a seven-point scale for clarity in quiet, clarity in noise, comfort in quiet, and comfort in noise, as well as an overall preference on a three-point scale. After six weeks, the diaries were collected, and participants completed a questionnaire to measure reliability and provide reasons for their preferences. The analysis included only the data from the last four weeks to account for a potential acclimatisation period for participants.

CRITICAL NOTE:

Given the increasing accuracy of Initial Fits (IF), it is particularly relevant to question the efficacy of the REM fit. However, it is unfortunate that the authors only evaluated listening preferences immediately after fitting, failed to use a validated questionnaire (e.g. SSQ – Speech, Spatial and Qualities of Hearing Scale), and did not perform aided speech audiometry in noise when comparing the two fitting programmes. This is all the more regrettable, since other studies[2] have demonstrated, through Speech Audiometry in Noise and the SSQ, that, after sufficient acclimatisation time, the REM programme tends to yield better outcomes compared to the manufacturer default (IF). As audiologists, it is our responsibility to guide and encourage first-time hearing aid users to accept and get used to new high-frequency sounds, which will ultimately facilitate improved understanding in challenging situations and enable them to reach their full potential.

[2]*Almufarrij I, Dillon H, Munro KJ. Does Probe-Tube Verification of Real-Ear Hearing Aid Amplification Characteristics Improve Outcomes in Adults? A Systematic Review and Meta-Analysis. Trends Hear. (2021): 25, 2331216521999563. doi: 10.1177/2331216521999563. PMID: 33899603; PMCID: PMC8083001.*

RESULTS

For the IF programmes, 14% of participants requested adjustments to the initial settings, with half of the cases seeking a reduction in gain. The REAR for both programmes barely deviated from the NAL-NL2 target, except at 4 and 8 kHz, where the gain was below target. The deviations in the

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REM were significantly smaller than those in the IF. Preference ratings for clarity were around zero; there was no statistically significant difference between the two programs. However, the ratings for comfort showed a significant preference for the IF, both in quiet and in noise. Overall, 60% of participants preferred the IF, while 22% preferred the REM, representing a statistically significant difference. This study found no significant associations (programme order, age, Pure-Tone Average (PTA), Root Mean Square (RMS) error difference) with preferences.

The second aim of the study was to explain user preference for one of the two programmes.

The preferences cited by participants who preferred the IF could be grouped into three main themes:

- IF is 'mellow and has less annoying sounds'.
- IF is 'clear' (no distracting or interfering sounds). Some acknowledged that the REM provided more clarity in noisy environments.
- Minimal differences between the two approaches.

For those who preferred the REM fit, the three main themes were:

- The REM fit is 'clear and provides access to treble sounds'.
- The REM fit is more 'comfortable', described as 'free from distortion'.
- Minimal differences between the two approaches.

DISCUSSION

Only 20% of the participants asked for an adjustment to the settings, and most of these were minor. This suggests that clinic-based fine-tuning may not necessarily improve participants' outcomes.

The REM fit showed a better match to target than the IF, but the under-fit in this study was smaller than in previous studies. The authors conclude that there is a clear and consistent enhancement in the accuracy of initial fits. Although there is a clear and steady improvement in overall gain between IF and REM, it appears to be sufficient to elicit a preference for most participants.

The comfort rating appears to be better with the IF. It is possible that there was not enough time spent in the REM program for participants to acclimate and benefit from the additional high-frequency gain. Unfortunately, due to the absence of datalogging, this cannot be verified.

The overall preference was unclear for 18% of the participants, with 60% preferring IF and 22% preferring REM. It seems that the greater high-frequency gain of the REM program is not appreciated by participants, especially when assessing comfort. Subjects who preferred REM over IF did so because the sound was more audible, clearer, and improved speech understanding in more challenging situations.

Strengths and limitations:

Only one manufacturer's fitting software was used, which raises questions about applicability to other forms or degrees of HL. Past research indicates a decline in the precision of the IF as HL severity increases. The absence of data logging leaves uncertainty about whether the non-preferred program was used enough for subjects to adapt and derive benefits from the different setting. •

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