HeAL 2024
Hearing Across the Lifespan
June 6-8, 2024
Cernobbio, Lake Como, Italy
www.heal2024.org

ABSTRACT BOOK

Lectures, Special Sessions & Communications 3
Posters 192
Authors' Index 259

Lectures - Special Sessions & Communications

Symposium

Community-delivered hearing care: bringing WHO guidance into practice

Organized by De Wet Swanepoel and Carrie Nieman

185 - World Health Organization guidance on hearing aid service delivery approaches in low-resource setting

Lauren Dillard [(1)] - Carolina Der [(2)] - Shelly Chadha [(2)]
Medical University of South Carolina, Department of Otolaryngology – Head and Neck Surgery, Charleston, United States [(1)] - World Health Organization, Department of Noncommunicable Diseases, Geneva, Switzerland [(2)]

Access to high-quality, affordable hearing aids and related services is an essential component of integrated ear and hearing care services. The World Health Organization (WHO) has led a-consultative process to develop the first evidence-based guidance on hearing aid service delivery approaches in low-resource settings. This guidance provides practical information for hearing aid service delivery for both children (aged five years and older) and adults. Key principles of this guidance for hearing aid service delivery are as follows. This guidance recommends the use of task sharing from highly trained professionals, such as audiologists, to trained non-specialist providers, such as community health workers, in order to extend hearing care capacity. This hearing aid service delivery approach was designed to be implemented in community-based settings with basic infrastructure. Ideally, hearing aid services should be part of a strategy for integrated, person-centered ear and hearing care implemented through the national health system. Hearing aids must conform to the WHO specifications, as outlined in the 'Preferred profile for hearing aids and related technical specifications,' and must be high-quality, affordable, and easy to fit (pre-programmed or similar).
In this presentation, the speaker will provide a detailed overview of this guidance focused on hearing aid service delivery approaches in low-resource settings. This will include considerations related to the required work force, hearing aids, and all steps of the hearing aid service delivery process, including entry into the program, hearing assessment, hearing aid fitting, counseling, follow-up, and referral criteria.

Keywords: Service delivery, hearing aids, low-resource settings, task sharing

105 - Hearing Aid Service Delivery by Community Health Workers using mHealth Technologies in Low-Income Settings

De Wet Swanepoel [(1)] - Caitlin Frisby [(1)] - Tersia de Kock [(2)] - David Moore [(3)] - Vinaya Manchaiah [(4)] - Bopane Mothemela [(1)]

University of Pretoria, Speech-Language Pathology and Audiology, Pretoria, South Africa [(1)] - HearX Foundation, HearX Foundation, Cape Town, South Africa [(2)] - Cincinnati Children's Hospital Medical Center, Communication Sciences Research Center, Cincinnati, United States [(3)] - University of Colorado Anschutz Medical Campus, Department of Otolaryngology–Head and Neck Surgery, Aurora, United States [(4)]

Objective*:* To synthesize implementation evaluations of hearing aid service delivery models facilitated by community health workers in low-income communities. The study examines the feasibility and impact of CHW facilitated hearing evaluations and low-cost hearing aid fittings supported by innovative mobile health (mHealth) technologies.
Method*:* Leveraging the capabilities of digital health innovations, CHWs conducted basic hearing testing and fitted persons with hearing loss with three types of hearing aids across different study groups: a self-fitting behind-the-ear (BTE) hearing aid, an in-ear bud-style device with preset programs, and a BTE device with preset programs. The participants resided across three low-income communities in South Africa. The feasibility and outcomes of the evaluation, hearing aid fitting, support and outcomes were assessed using a combination of Bowen's framework for the fitting model, the International Outcome Inventory for Hearing Aids (IOI-HA), the Revised Hearing Handicap Inventory (RHHI-S) and qualitative feedback.
Results*:* Within the combined cohort of 449 adults evaluated, a notable prevalence of hearing loss was identified, with varying degrees of severity. A total of 60 adults received hearing aids as part of the service-delivery. Self-reported hearing aid outcomes were comparable to outcomes previously reported in high-income settings. The implementation of the self-fitting BTE hearing aid model was particularly noted for its accessibility and positive reception among users. In-ear bud-style aids and the pre-programmed BTE aids also demonstrated high functionality, including satisfactory performance in environments with background noise. The cerumen management protocol evaluated in a sub-group, showed substantial efficacy in improving hearing thresholds when cerumen impaction was a contributing factor to hearing loss.
Conclusion*:* The study underscores the viability of CHW-led, mHealth-enabled hearing aid delivery models in resource-constrained environments. The use of varying hearing aid types tailored to individual needs, coupled with the strategic use of mHealth tools, has shown to significantly improve the accessibility and quality of hearing care. These findings support the scalability of such models in addressing the global challenge of hearing loss in low-income settings.

Keywords*:* Hearing aid delivery, mHealth, Community health workers, Self-fitting hearing aids, Low-income communities, South Africa.

149 - Building the Evidence on Partnering with Community Health Workers: Lessons from the HEARS RCT

Carrie Nieman [1] - Joshua Betz [2] - Emmanuel Garcia Morales [3] - Jonathan Suen [1] - Jami Trumbo [3] - Nicole Marrone [4] - Hae-Ra Han [5] - Sarah Szanton [5] - Frank Lin [1]
Johns Hopkins University School of Medicine, Otolaryngology-Head & Neck Surgery, Baltimore, United States [1] - Johns Hopkins Bloomberg School of Public Health, Biostatistics, Baltimore, United States [2] - Johns Hopkins Bloomberg School of Public Health, Epidemiology, Baltimore, United States [3] - University of Arizona, Speech, Language, and Hearing Sciences, Tucson, United States [4] - Johns Hopkins School of Nursing, Nursing, Baltimore, United States [5]

Objectives**:** Age-related hearing loss that impairs daily communication is independently associated with adverse health outcomes, but the use of hearing aids by older adults is low and disparities exist. The incorporation of community health worker (CHW)-partnered models, including peer mentors, is an approach that reduces barriers and addresses disparities. Within hearing care, particularly for older adults, CHW-partnered models have received limited study, despite national and international recommendations.
The HEARS (Hearing health Equity through Accessible Research & Solutions) intervention was designed as a structured hearing care program delivered by CHWs in a community setting that incorporates provision of a low-cost amplification device with education and counseling on age-related hearing loss. An initial pilot study demonstrated feasibility and acceptability. To assess the efficacy of CHW-delivered hearing care when provided to older adults, a randomized clinical trial was conducted to test the hypothesis that the intervention improves self-perceived communication function 3-months post-intervention compared to waitlist control.
Design: An open label randomized clinical trial was conducted with a 3-month primary endpoint and participants were followed to 12-months post-intervention. The trial took place in 13 community sites, a low-resource setting, specifically affordable independent housing complexes (n=10), senior centers (n=2), and an older adult social club (n=1) in Baltimore, Maryland. 348 older adults were screened and 151 participants with hearing loss were randomized. Participants were randomized to receive a CHW-delivered hearing care intervention (n=78) versus waitlist control (n=73). The 2-hour intervention consisted of fitting a low-cost amplification device and instruction. The primary outcome was change in self-perceived communication function (Hearing Handicap Inventory for the Elderly-Screening [HHIE-S]) from baseline to 3-months post-randomization. The average treatment effect was estimated using the doubly-robust weighted least squares estimator, which uses an outcome regression model weighted by the inverse probability of attrition to account for baseline covariate imbalance and missing data. Results: Among 151 participants randomized (mean [SD] age, 76.7 [8.0] years; 101 (67.8%) females; 65 (43%) self-identified as African American; 96 (63.6%) with low income [<$25,000 annual household income]), 136 (90.1%) completed 3-month follow-up for the primary outcome. In the intervention group, 90.5% completed the intervention session and reported at least 1 hour of daily amplification use at 3-month post-randomization. Self-perceived communication function significantly improved in the intervention group compared with the control group, with an estimated average treatment effect of the intervention of a -12.98 point HHIE-S change (95% CI: -15.51, -10.42). Self-perceived communication function improvements were sustained out to 12-months post-intervention, with a -10.25 point HHIE-S change (95% CI, –13.11 to –7.56) from baseline to 12-months post-intervention. No intervention-related adverse events were reported. Conclusions: Among older adults with hearing loss, a CHW-delivered hearing care intervention, compared with a waitlist control, significantly improved self-perceived communication function at 3 months and persisted out to 12-months post-intervention. The improvements were comparable in magnitude to improvements documented for older adults who received conventional clinic-based hearing care with provision of hearing aids by audiologists. To the authors' knowledge, this randomized clinical trial was the first of a CHW-delivered hearing care intervention designed for older adults that included provision of amplification. The HEARS RCT also represents one of the largest cohorts to-date of a community-based cohort of older adults with hearing loss with significant representation of African American and low-income older adults, individuals who have not traditionally been included in hearing-related trials in the United States. As part of the symposium, Community-Delivered Hearing Care: Bringing WHO Guidance into Practice, this presentation will share critical insights from the HEARS RCT into the development and execution of CHW-partnered approaches to hearing care built upon the guiding principles of community-engaged research.

Keywords: Hearing health equity, community health workers, older adults, over-the-counter hearing technology

146 - Maintaining the Rigor of Community Health Worker-Delivered Hearing Care through Training, Supervision, and Continuing Education

Jonathan Suen [(1)]
Johns Hopkins University, Otolaryngology-Head and Neck Surgery, Baltimore, United States [(1)]

Community-delivered models of hearing care improves access to hearing loss screening and rehabilitative interventions by underserved demographics. Nascent approaches in addressing hearing loss through community health worker (CHW) programs can help reduce disparities in care. Designing programs that are adaptive to the local needs and unique circumstances of target populations are key to the success of community-delivered care. Nevertheless, a key guiding principle includes the incorporation of technical training, ongoing supervision, and continuing education for CHWs across adapted programs.

Training for CHWs delivering ear and hearing care (EHC) should reflect predefined scopes of practice that align with specific program goals. Modalities of training programs span a variety of strategies with a recent systematic review of CHWs delivering EHC describing a mix of didactic lectures, role playing exercises, and practical sessions. Another critical component of training includes a plan for assessing and defining when respective competencies are achieved and CHWs are authorized to deliver EHC.

Incorporating CHW supervision plans reflect the inherently multidisciplinary feature of community-based EHC programs wherein diverse expertise is leveraged to improve both outreach and care quality. Community engagement principles include advocating for the active recognition of unique expertise that all team members bring to a collectively-shared goal. Terms like “specialist” and “non-specialist” should therefore be applied with caution and in careful consideration of local customs and social contexts.

Finally, through ongoing supervision and discussions between care team members, organizing subsequent continuing education modules allows community-delivered EHC to remain dynamic in addressing intervention targets and more relevant for incidental changes in evolving situations. Arranging for continuing education can also account for the limitations of the initial training program in fully preparing CHWs for working in potentially complex settings and conditions. Furthermore, continuing education may also serve community members by creating additional opportunities for career advancement and upward socioeconomic mobility.

Structuring program infrastructures and processes for training, supervision, and continuing education supports intervention fidelity and can maximize community partnerships for optimizing outcomes. This presentation will describe a few critical components of CHW programs reported in the literature to facilitate discussions around adapting a community-based model for EHC.

Keywords: community health worker, community engagement, training, health disparities

Special Session

Applications, strengths, and pitfalls of Ecological Momentary Assessment

Coordinator: EMA Methods in Audiology Working Group

202 - Opportunities & Challenges for Ecological Momentary Assessment – learning from three years of monthly expert exchange in the "Ecological Momentary Assessment methods in audiology" group

Nadja Schinkel-Bielefeld [(1)]
WS Audiology, Scientific Audiology, Erlangen, Germany [(1)]

Ecological Momentary Assessment (EMA) is a method used to understand the everyday experiences of people. In other areas, it has been used for decades, but only in recent years has it gained popularity in hearing sciences.
Some characteristics of hearing can create challenges for EMA in audiology, that may not be as pronounced in other EMA research areas. Hearing problems strongly depend on the acoustic environment which can change very quickly. Hence objective data on the acoustic situation may be beneficial, but it needs to be accurately matched to subjective data. This is complicated by the fact that there are several situations where participants might be reluctant to answer a survey, e.g. as they feel it would be impolite during social interaction or they do not have the resources for it when they have trouble understanding already. These are however often particular situations that are most relevant for assessing hearing problems in everyday life.
Many questions regarding best practice of EMA in audiology are still open. Originally, we gathered a group of experts and formed the "Ecological Momentary Assessment Methods in Audiology" group with the goal to exchange experiences and work towards a recommendation of more standardized procedures in EMA. Such a standardization would not only facilitate study planning but also enable meta-analyses and comparisons across studies. However, when done too early, it may discourage further exploration and result in premature and suboptimal design guidelines.
We soon realized how many different flavours of EMA exist and continue to arise. Equipment can be as simple as a timer and an online questionnaire tool or a complex system of many sensors, hearing aids, and a smartphone or other electronic device to collect data. Micro EMA may use a smartwatch and a single rating question at a time, while on the other extreme machine learning models are employed to analyze large amounts of free text responses collected in EMA.
Furthermore, research questions can vary to address for example auditory ecology, hearing problems in everyday life, evaluation of treatment or assistive technology like hearing aids or cochlear implants, or EMA use in clinical audiology to facilitate hearing aid fitting and communication between health care provider and hearing aid wearer. Optimal design choices are highly dependent on the research question and setting.
In the end, we concluded that it is too early for any recommendation or standardization, but that there are many details important to consider when planning a study that may not be immediately apparent for researchers new to this area. Hence, we wrote down our collective experiences in a manuscript that hopefully helps new researcher to design a well-rounded EMA study suitable for their research question even without much prior experience. We also collected a list of EMA attributes and questions used in various studies so far. However, further work will be necessary to validate a core question set useful in most studies.

Keywords: Ecological Momentary Assessment, Audiology, Real life evaluation, Survey

273 - Clinical cost-benefit of Ecological Momentary Assessment for fitting hearing aids

Niels Henrik Pontoppidan [1] - Anna Josefine Munch Sørensen [1] - Kang Sun [2] - Tiberiu-Ioan Szatmari [3] - Claus Nielsen [1] - Aleksandra Koprowska [4] - Soffi Skovlund Jensen [1] - Lena Havtorn [1]
Oticon A/S, Eriksholm Research Centre, Snekkersten, Denmark [1] - Oticon A/S, Software Quality, R&D, Smørum, Denmark [2] - Technical University of Denmark, DTU Compute, Lyngby, Denmark [3] - Oticon A/S, Software Solutions, R&D, Smørum, Denmark [4]

An essential outcome when fitting hearing aids is the successful adaption of hearing aid settings to the communication needs of the wearer. Needs are understood as the combination of the individual range of communication situations, the individual hearing capabilities, and the individual communication challenges. Many successful audiologists rely on vast experience and intuition to predict the best outcome from dialogue with hearing aid users. In the first study, Ecological Momentary Assessment (EMA) and continuous data logging from hearing aids was used to collect in situ ratings from hearing aid users during a field study to investigate patterns predicting fitting preferences. In the second study, EMA and hearing aid data logging was used to collect in situ ratings from hearing aid users when they found themselves in a difficult situation or a communication situation that they wanted to improve with hearing aids. During both studies the aim was to compare the continuous logging data from the hearing aids characterizing sound environments and hearing aid operation, and link subjective user ratings from EMA with the objective data from hearing aid data logging. Moreover, the extra clinical effort required to setup, monitor, and support the use of EMA and continuous hearing aid logging was recorded. During the first study almost 50% extra time was spent on each participant, meaning that the clinical effort amounted to 2 hours per participant where 1 hour was used on monitoring, troubleshooting, and supporting the participants. The experiences from the first study led to development of a separate dashboard to visualize individual compliance with the test plans, meaning that participants that struggled with providing data could be quickly identified. This dashboard was used during the second study where the dashboard and the other experiences from the first study reduced the extra time by factor 2-4 per participant. Moreover, first study involved 4-6 weeks of enrollment where the second study involved up to 5 months of enrollment. Thus, the reduced overhead was rather significant. During both study periods we experienced challenges where mobile phone apps needed to be updated during the field trial, and since it was not the same participants, we attribute the reduced overhead to better experience, planning, and monitoring. At the same time the preliminary results from the two field trials indicate relationships between hearing aid preferences and logging data, and that the EMA can be used to monitor benefit of hearing aids in the listening conditions identified by the hearing aid user prior to hearing aid fitting. Taken together, the two studies show both costs and benefits associated with using EMA and logging data for fitting hearing aids and understanding how hearing aids are used by individuals. Moreover, the two studies indicate that it is the challenges with background processes in the phone, and maintaining Bluetooth connections between hearing aids and phones that cause the problems rather than the actual EMA tasks, and thus the participants are quite capable of utilizing the technology to provide their feedback on fitting and communication difficulties.

Keywords: Fitting preferences, Key listening situations, Clinical Cost Benefit, Ecological Momentary Assessment

101 - Strengths and pitfalls of collecting open text data through self-initiated Ecological Momentary Assessment, and using data from real-world hearing aid wearers for research purposes

Charlotte Vercammen [(1)] - Stefan Launer [(2)]
Sonova AG, Research & Development, Staefa, Switzerland [(1)] - Sonova AG, Audiology & Health Innovation, Staefa, Switzerland [(2)]

Ecological Momentary Assessment (EMA) is a method that allows listeners to repeatedly report on their experiences, during or shortly after they take place in order to minimize recall bias, e.g., guided by surveys in a mobile application. Thereby, smartphone-connected hearing aids can provide an effective means to collect (near-)real-time feedback from hearing aid wearers in the real world. Not only has EMA become increasingly popular in hearing research, it has also been proposed as a useful clinical tool.
While EMAs can be sampled at certain times, time intervals, or upon detection of specific parameters (e.g., certain acoustic properties picked up by the hearing aid microphone), EMAs can also be self- initiated. In the latter case, listeners decide themselves when an event of interest takes place and report on their experiences accordingly. Allowing listeners to describe experiences in their own words, e.g., through an open-text field, opposed to selecting an answer from multiple choice options, can ensure that answers are independent of predefined jargon or of how survey questions are formulated.
In this presentation, we will discuss a large, real-world EMA dataset that was collected clinically, as part of adult hearing care. Participants self-initiated EMA surveys and used their own words to describe what they were experiencing. We will especially focus on strengths and pitfalls of this approach and of using clinically collected data for research purposes.

Keywords: hearing rehabilitation, person and family centred care, digital tools, ecological momentary assessment, natural language processing, strengths, pitfalls

165 - Capturing the stigma experiences of adults with hearing loss using Ecological Momentary Assessment

Barbra Timmer [(1)] - Katie Ekberg [(1)] - Nerina Scarinci [(1)] - Monique Waite [(1)] - Mansoureh Nickbakht [(1)] - Carly Meyer [(1)] - Louise Hickson [(1)]
The University of Queensland, Centre for Hearing Research, School of Health and Rehabilitation Sciences, Brisbane, Australia [(1)]

Background Ecological Momentary Assessment (EMA) has been shown to be a reliable, valid and increasingly utilised approach in hearing research. Research in other fields has demonstrated EMA as a suitable methodology to measure stigma related to race, sex, sexual orientation, and weight. A review into the use of EMA to research stigma experiences found EMA to be a valid and possibly more sensitive means of capturing the prevalence of stigma experiences in daily life, when compared to the use of traditional retrospective surveys. The findings suggest that EMA can more readily identify the context of stigma experiences. This is important, as stigma is a product of social processes and experiences of stigma are strongly context-specific. Major and O'Brien (2005) recognized these contextual aspects and developed an identity threat model of stigma. Their model proposes that a stigmatized attribute such as hearing loss puts a person at risk of experiencing threats to their social identity within certain social contexts.
However, to date, EMA has not been used to investigate the experiences of stigma by people with hearing loss. The aims of the current study were to use EMA for the first time to explore a) when and how stigma-induced identity threat is experienced by older adults with hearing loss and b) when and how they respond to such threats in daily life.
Design Twenty adults with mild to moderate hearing loss (mean age 69.4 years, 13 male, 11 hearing aid wearers) responded to EMA surveys over a 14-days period using a smartphone app. Participants could trigger a survey themselves or respond to a prompt, and were asked to answer a survey if they were in a listening situation. Each survey contained up to 17 questions about the context of the listening situation, how well they were hearing, what communication strategies they used (including if they told others about their hearing difficulties) and if they felt they were being treated differently because of their hearing loss. All participants completed semi0structured interviews and a range of validated, self-report questionnaires exploring hearing loss and stigma.
Results A total of 633 listening event surveys were completed. Being treated differently was reported in 12% (n=79) of all the listening events by 12 of the 20 participants. When treated differently, in 84% (n=66) of these 79 events, participants reported being treated positively or very positively. The 13 listening events during which five participants were treated negatively were defined as stigma experiences. Stigma experiences were typically in the participants' home when communicating with family members who were aware of the participants' hearing loss. Results for all EMA listening event surveys were generally similar for people who wore hearing aids and for those who did not, although some key differences were evident. Specifically, compared to people who wore hearing aids, those who did not wear hearing aids were more likely to report being treated negatively (if they were treated differently by others), using maladaptive listening strategies, such as pretending to understand, and feeling negative emotions during listening events.
Participants' scores on the self-report stigma measures were generally not predictive of reported incidences of stigma as measured by EMA. During the interviews, participants spoke broadly about stigma, although some reported they did not personally experience stigma associated hearing loss or hearing aids.
Conclusions The real-world data collected showed that the adults with hearing loss did not experience stigma-induced identity threat in most of their reported listening events. However, although most listening events were within the home, with family and friends, a quarter of the participants still experienced some stigma during the 2-week data collection period. Reports of being treated negatively or having negative emotions were more likely from those not wearing hearing aids. While this research suggests the stigma related to hearing loss and hearing aids differs, further research is required to further investigate the factors involved in the stigma related to both, and the possible role played by stigma in hearing aid uptake and use. It is strongly suggested that EMA be incorporated into such future research.

Keywords: Ecological momentary assessment, stigma, hearing aids

62 - The impact of hearing impairment on autonomic nervous system activity in daily life and Ecological Momentary Assessed mood, listening effort and fatigue

Nicole Huizinga [(1)] - Laura Keur-Huizinga [(2)] - Sjors Van de Ven [(1)] - Niek Versfeld [(2)] - Adriana Zekveld [(2)] - Sophia Kramer [(2)] - Eco de Geus [(1)]
Vrije Universiteit, Biological Psychology, Amsterdam, Netherlands [(1)] - Amsterdam University Medical Center, Otolaryngology-Head and Neck Surgery, Amsterdam, Netherlands [(2)]

Hearing impairment may lead to increased listening effort, fatigue, and stress which impacts work and quality of life. Dysregulation of physiological stress systems may contribute to these complaints but the pathways are unclear. The present study used physiological monitoring of the autonomic nervous system (ANS) in daily life, a battery of hearing assessments, and ecological momentary assessment (EMA) to examine (1) the impact of hearing impairment on autonomic nervous system activity in daily life, (2) the impact of hearing impairment on EMA in regards to mood, listening effort and fatigue.
Design: We examined ANS activity in 133 individuals, aged 37 to 72 years, with a range of hearing ability through a wearable monitor (VU-AMS), which measured cardiovascular and skin conductance outcomes, for two 24-hour periods, including sleep. From these signals we derived hallmark measures of parasympathetic and sympathetic nervous system activity. Using EMA, participants answered prompts with questions about mood, listening effort and fatigue via a smartphone for 5 days. Mixed models were used for data analysis. We compared within-person average daytime and sleep values of the physiological measures (PEP, SCL, nsSCRs, IBI, RSA) across the two measurement days using three between-person assessments of hearing loss (audiometry, speech perception test score, and subjective hearing score). Additional models were computed to assess EMA outcomes.
Results: We did not observe the hypothesized negative effect of hearing impairment on ANS measures in daily life. However, we found an interaction effect of time of day (awake vs sleep) with hearing impaired participants showing a different pattern of sympathetic activity from awake to sleep. For the EMA, hearing impairment was a strong predictor of EMA measures of listening effort and fatigue.
Conclusions: Our study highlights the complex relationship between hearing impairment and physiological stress systems and emphasizes the association between hearing impairment and effort/ fatigue.

GENETICS AND BIOLOGICAL ISSUES

76 - Progressive non-syndromic sensorineural hearing loss: natural history study and gene therapy

Xue Zhong Liu [1]
University of Miami, Miller School of Medicine, Department of Otolaryngology, Miami, United States [1]

Progressive non-syndromic sensorineural hearing loss (PNSHL) is the most common cause of sensory impairment affecting humans. PNSHL can be dominant and recessive. Because of similarities in pathophysiology, therapeutic strategies developed for PNSHL can readily be applied to the most common HL such as age-related-HL (ARHL), which is the single largest modifiable factor risk factor for later-life cognitive impairment and dementia. Recent advances in molecular technology continue to revolutionize human genetics. Gene therapy is emerging as a potentially effective therapeutic strategy for PNSHL. Viral gene delivery approaches have proven successful in human clinical trials for two inherited causes of congenital HL and are being used for HL in a human trial. Non-viral gene therapy approaches are useful in situations where a transient biologic effect is needed or for delivery of genome editing reagents (such as CRISPR/Cas9) into the inner ear. The development of new treatment modalities and use of improved cellular (for example, induced pluripotent stem cells (iPSCs) and animal models of PNSHL will pave the way for future applications in humans leading to improved quality of life for many affected individuals and their families. Our overarching goals are to further improve the clinical care of persons with PNSHL and to provide a more robust foundation for gene-specific precision medicine for PNSHL patients. We will achieve these goals by addressing current knowledge gaps as reflected in the following work:1: To determine causative variants in known PNSHL genes for defining the gene/variant-specific natural history study (NHS) by integrating phenotype (phenome) with the associated genotype (genome). Critical to our approach is the identification and collection of appropriate patients for analysis. This requires an international collaboration to obtain a significantly large enough number of cases to understand the longitudinal clinical progression, ideally with patients from multiple geographical areas. Detected variants and associated audio-vestibular phenotypes will be stored in a database that will be accessible by outside researchers. We have successfully established an international consortium working on the NHS of PNSHL with renowned international experts on PNSHL. This Consortium provides access to suitable patients/families for which in-depth clinical data will be available. We have established the comprehensive Miami Ear Institute Otogenetic Program (MEIOP) and pipelines. We have established the diverse Miami Otogenetic Repository (MOR) that contains biological samples and clinical data on about two thousand families with PNSHL. Our successful international multi-center study on the natural history of TMPRSS3 and related cochlear implant outcomes will be presented as an example. 2: To develop gene therapy strategies to treat HL due to mutations in PNSHL genes in human. We have established and thoroughly characterized two mouse models with PNSHL for human P2RX2 and TMPRSS3 and obtained successful hearing restoration in the mouse models in human PNSHL, which will be presented.

Key words: Progressive non-syndromic sensorineural hearing loss (PNSHL), natural history study (NHS), gene therapy

86 - Exome sequencing leads, to the identification of a novel gene, SLC22A24, for an autosomal-recessive non-syndromic hearing disorder

Ralf Birkenhäger [(1)]
University Medical Center, Department of Otorhinolaryngology, Head and Neck Surgery, Freiburg, Germany [(1)]

Introduction**:** Hearing impairment is the most common sensorineural disorder in humans. Approximately 1 - 3 out of thousand newborns suffer from severe hearing loss or deafness at birth or in the first few years of life. Depending on the form of the physiological defect, hearing disorders are classified into conductive hearing loss, sensorineural hearing loss, or a combination of both. Around 60% of all prelingual hearing disorders are genetically determined. Inherited hearing disorders are divided into syndromal (SHL) or non-syndromal (NSHL). Almost 70% of cases of inherited hearing disorders are non-syndromic and mainly due to sensorineural causes. About 80% of the cases follow an autosomal recessive (DFNB) and 18% an autosomal dominant (DFNA) inheritance, about 2% are x-chromosomal (DFNX) or mitochondrial (MT) linked. A total of 233 gene locations have been described to date, for which 173 genes have so far been identified, 60 genes at least are still unknown. Autosomal non-syndromic hearing loss (ANSHL) is a genetically heterogeneous sensorineural disorder, with prelingual hearing loss and absence of other clinical manifestations. Based on the clinical diagnosis it is not possible to recognize in which genes mutations are present. This is only possible in exceptional cases (7/173). The hearing impairment DFNB1, is caused by mutations in the gene GJB2 (connexin-26) [MIM 121011], as well as by deletions in the gene GJB6 (connexin-30) [MIM604418]. Half of all cases of non-syndromic recessive hearing disorders are due to changes in this gen locus.
The aim is to identify and characterize previously unknown genes and their gene products that cause autosomal recessive inherited hearing disorders, and also in combination with differentiated inner ear malformations, by analyzing already known genes that have so far only been described in mouse models.
Patients and Methods**:** So far, 1382 patients have been included in the study, all of them are clinically clearly characterized. All patients were diagnosed with a serious hearing impairment in the first two years of life, additional organic diseases or syndromes were excluded.
Almost all patients (1382) were recruited between 05/2003 and 12/2023 via a cochlear implant in the ENT clinic in Freiburg or the associated Implant Center Freiburg.
Hearing testing BERA/Electrocochleography and radiological a high-resolution CT scan was made. In these patients, the genes *GJB2* and *GJB6* at the DFNB1 locus were first analyzed. Functionally relevant mutations were identified in 590/1382 (42.7%) of the cases. Important for the project is the group of patients with no mutations in the locus DFNB1, in the genes *GJB2* (Connexin 26) and *GJB6* (Connexin 30); so far 792/1382 (57.3%) patients. In 172 patients in this group, wide varieties of inner ear malformations were identified. A further targeted analysis of other genes was not possible; therefore, complete exome sequencing took place. Whole Exome analyses was performed on selected patients with the “INVIEW HUMAN EXOME” platform; array Agilent Genomics SureSelectXT All Exon V5. To verify identified genetic changes using the NGS method, bi-directional sequencing (Sanger) of the coding exons and the intron transitions was performed.
Results**:** In the gene MYO15A (MIM 602666) two heterozygous pathogenic variations were detected. A deletion c.3141delC, p.Pro1047fsX1124 and a splice-side mutation c.IVS3+1G>A, the mutations were confirmed by Sanger sequencing for all 14 family members. The protein encoded by the gene *MYO15A* is critical for the differentiation and elongation of the stereocilia and has important role in actin organization in hair cells. A heterozygous pathogenic variation was detected in the gene TMC1, c.1249G> A, Gly417Arg, confirmed by Sanger sequencing. The inheritance pattern of the mutation in the family indicates a dominant non-syndromic hearing impairment. So far, mutations have been described in the TMC1 (MIM 606706) gene which, on the one hand, leads to recessive (DFNB7/B11; MIM 600974) or dominant (DFNA36; MIM 606705) inherited hearing impairment. Additionally, a homozygous splice site mutation IVS1+1G>A was identified in the gene SLC22A24 in a consanguineous family. Sanger sequencing confirmed this mutation. This mutation prevents the expression of the gene SLC22A24, detected by quantitative real-time PCR. SLC22A24 belongs to a large family of transmembrane proteins that function as transport of ions across cell membranes.
Conclusion**:** Here, for the first time, the gene SLC22A24 (MIM 611698, Gene ID: 283238) is described, that leads to an autosomal recessive hearing disorder.

249 - Genetic and electrophysiological testing of children with auditory neuropathy spectrum disorder for predicting rehabilitation outcomes

Maria Lalayants [(1)] - Tatyana Markova [(1)] - Olga Shatokhina [(2)] - Alexander Polyakov [(2)] - Vigen Bakhshinyan [(1)] - George Tavartkiladze [(1)]
Russian Medical Academy for Continuous Professional Education, Audiology department, Moscow, Russian Federation [(1)] - Research Centre for Medical Genetics, Laboratory of DNA diagnostics, Moscow, Russian Federation [(2)]

Site of lesion predispose cochlear implantation(CI) outcomes in patience with auditory neuropathy spectrum disorder (ANSD).The aim of this study was to evaluate the applicability of genetic testing and electrically evoked brainstem responses(eABR) registration after CI for revealing site of lesion and predicting rehabilitation out comes in patients with ANSD
Genetic testing (massively parallel sequencing based multigene panels; clinical exome sequencing; whole genome sequencing) of 50 children with ANSD without cochlear nerve aplasia revealed biallelic mutation of the OTOF in 12 children (24% of cases). 10 children with OTOF-related ANSD underwent cochlear implantation, including child with mild hearing loss by pure tone audiometry, but with dramatically impaired speech recognition. After cochlear implantation, the action potential of the auditory nerve to electrical stimulation and electrically evoked brainstem responses were recordable in all tested cases due to preserved cochlear nerve and the auditory pathway of the brainsteam. Rehabilitation outcomes in these patients are the same as in other patients with cochlear hearing loss due to intact spiral ganglion neurons and more proximal structure if they are not affecting with any other mechanism unrelated to OTOF gene mutations. Genetic testing also revealed single cases of TWNK-related ANSD with poor outcomes after CI which corresponded pathophysiological mechanism of hearing loss in such cases.
EABR registration was carried out in 29 children with ANSD (10 - with OTOF-related ANSD, 10 - perinatal risk factors, 3- cochlear nerve hypoplasia and 6- with unknown etiology of ANSD)
The standard stimulation parameters were sufficient for a clear registration of eABR waves in all 10 children with OTOF-related ANSD and in all 10 children with perinatal risk factors for ANSD. Presence of eABRs in OTOF-related cases matches the pathophysiolyof OTOF-related auditory synaptopathy. Presence of eABRs in all cases with perinatal risk factors indicates that main disorder involves inner hair cells in case of prematuruty as it was seen in histological findings and therefore primary synaptopathy type of ANSD. In 3 cases with hypoplastic cochlear nerve eABRs were absent or partially recorded only from basal electrodes in monopolar mode or in bipolar mode of stimulation of basal turn. In children with unknown etiology of ANSD in 3cases eABRs were recordable from all stimulated electrodes in monopolar mode, in other 3 cases eABRs were absent or partially recordable from basal electrodes. Those 3 patients with recordable eABRs probably had auditory synaptopathy type of ANSD, whereas patients with absent eABRshadauditory neuropathy type.
Rehabilitation outcomesafter CI corresponded to the results of registration of eABRs and they were much better among children with eABRs from all tested electrodes in monopolar mode of stimulation. 5 of 6 children with absent or partially recordable eABRs end up with the necessity of using sign language for communication, although they had some benefit from CI.
Genetic testing and registration of eABRs reveals pathphisiological mechanism of hearing loss in children with ANSD, which allows predicting the maximum rehabilitation potential after CI and optimize rehabilitation approach, including planning adding of alternative communication methods in cases of auditory neuropathy type of ANSD.

Key words: auditory neuropathy spectrum disorder, genetic testing, eABR, otoferlin, exome, genome sequencing, cochlear implantation

156 - Evaluation of apoptosis genes polymorphism in patients with noise induced sensorineural hearing loss

Yuliia Dieieva [(1)] - Margarita Amirkhanova [(1)] - Tetiana Golubok [(2)]
Bogomolets National Medical University, Otorhinolaryngology, Kyiv, Ukraine [(1)] - Skarzynski Institute, Otorhinolaryngology, Warsaw, Poland [(2)]

Introduction In recent decades, a growing body of scientific research has emerged, delving into the significance of polymorphism in various genes concerning the pathogenesis of sensorineural hearing disorders. Specific genotypes wield the potential to influence this equilibrium, thereby playing a role in heightening the activity of apoptosis processes. The exploration of polymorphism within genes such as Bcl-2 (anti-apoptotic), Bax, and Bid (pro-apoptotic) and its impact on the onset and progression of perceptual hearing disorders attributed to apoptosis holds promise as a foundation for future genetic diagnostics and gene therapy in addressing sensorineural deafness.
Purpose**:** to determine the presence of a possible association between the polymorphism of the apoptosis genes Bcl-2 (rs2279115), Bax (rs4645878) and Bid (rs8190315) and the development of sensorineural deafness in patients who work in industrial noise conditions by the polymerase chain reaction method in real time.
Materials and methods**:** In order to achieve the established goal of the dissertation work, we conducted an examination of 678 patients aged 18 to 65 years who work in conditions of industrial noise (drivers, drivers' assistants, fitters, fitters of railway tracks) at the State Road Clinical Hospital No. 2 of the Kyiv DTGO station South-west railroad.
The median age in the region was 52 years. The patients underwent a general clinical, otolaryngological, and audiometric examination, as a result of which 89 patients (13.1%) with perceptual hearing disorders were identified. 678 workers who work in noise conditions were examined and strict selection in the study groups created to determine the possible association between the polymorphism of the genes Bcl-2 rs2279115, Bax rs4645878, Bid rs8190315 and the increased risk of developing sensorineural hearing loss.
Results**:** Analysis of genotype distribution and allele frequency among patients in both cohorts during the third phase of the study revealed that not all genes exhibited statistically significant differences. For the Bcl-2 gene (rs2279115), the AlA genotype was present in 19.5%, A/C in 65.9%, and C/C in 14.6% of the main group, compared to 10.4%, 35.4%, and 54.2%, respectively, in the control group ($P < 0.05$). Regarding the Bid gene (rs8190315), the main group showed no C/C genotype, with C/T at 7.3% and T/T at 92.7%, while the control group exhibited 0%, 2.1%, and 97.9%, respectively ($P > 0.05$). In the case of the Bax gene (rs4645878), the A/A genotype was observed in 2.4%, A/G in 24.4%, and G/G in 73.2% of the main group, compared to 2.1%, 12.5%, and 85.4%, respectively, in the control group ($P > 0.05$). All results underwent Bonferroni correction for each SNP's P-value.
Conclusion It was established that the combination of the AA/AC genotype of the Bcl-2 gene (rs2279115) and AG/GG of the Bax gene (rs4645878) statistically significantly increases the risk of developing perceptual disorders in people who work in conditions of industrial noise ($P < 0.05$), OR 6.245; 95% CI 2.312-16.865.
It was established that the polymorphism of the Bcl-2 (rs2279115), Bid (rs8190315) and Bax (rs4645878) gene genotypes did not have a statistically significant effect on the degree of hearing loss, the side of the lesion and the type of curve during the audiometric examination ($P > 0.05$ in in all cases).

245 - Opioids in cochlear afferent neurons

Enrique Soto [1] - Rosario Vega [1]
Universidad Autónoma de Puebla, Instituto de Fisiología, Puebla, Messico [1]

Opioid peptides modulate hearing ability by modulating afferent input. Tracks enkephalinergic are part of the efferent control systems of auditory afferent input, although its precise physiological role is not completely defined, it is known that the consumption of some Opioids for therapeutic or recreational purposes have been associated with hearing loss. In this work.

We use the voltage clamp technique and calcium imaging to study the modulation of ionic currents in the neurons of the spiral ganglion by the activation of receptors for opioid peptides μ, δ, κ in neurons isolated from the spiral ganglion of the rat.

In voltage clamp fixation we found that the μ-type opioid agonist, [D-Ala-N-Met-Fen-Gliol]-enkephalin (DAMGO) 1 μM, allows us to identify two groups of cochlear afferent neurons, one in which the outgoing currents (group 1) and another in which they decrease (group 2). This inhibition is partially dependent on calcium. In current fixation recordings, the application of DAMGO, for group 1, increased posthyperpolarization and decreased the duration of the action potential; For group 2, a decrease in posthyperpolarization and amplitude and an increase in the duration of the action potential were found. The δ-opioid agonist, [D-Pen2, D-Pen5]-enkephalin (DPDPE) 1 μM, inhibits a slow-activating outward current, increasing the amplitude and duration and decreasing the afterhyperpolarization of the action potential. The application of the κ-opioid agonist U-50488 decreases both outgoing and incoming currents and the action potential decreases its amplitude and afterhyperpolarization and increases its duration. In calcium imaging we found that the Mu agonist DAMGO inhibits the increase in calcium due to cell depolarization, while the Delta agonist D-Pen-D-Pen enkephaline and the Kappa agonist U50488 do not exert a significant effect.

We also studied the electrophysiological responses at whole cochlear level. For this experiments adult Long-Evans rats of the strain CII/ZV weighing 180–220 g were used. For the ABR recording drugs were administered intraperitoneally or intravenously. For the CAP and DPOAE drugs were applied by direct perfusion in the middle ear. The opioid agonists (Fentanyl, and Tramadol) produced a consistent increase in the amplitude of the PI component of the ABR and of the N1-P1 amplitude of the CAP. The opioid antagonist (Naloxone) produced no significant changes in the ABR and a reduction of the CAP N1-P1 amplitude. Also, opioid agonists induced a decrease in the amplitude of the DPOAE. These results show that the opioid receptor activation modulates both the afferent response at both the afferent response to acoustic stimuli, and also at the cochlear mechanics as revealed by DPOAE changes.

These results indicate that opioid receptors are functionally found in cochlear afferent neurons and that their activation modifies ionic currents, modulating the electrical activity of these neurons. The role of opioid receptors in hearing loss due to recreational opioid use and their possible role in tinnitus will be discussed.

Key words: auditory loss, drug abuse, fentanyl, morphine, tramadol

SPEECH PERCEPTION / DISCRIMINATION (1)

212 - Is there a relationship between speech discrimination and mean length of utterance?

Kristin Uhler [1] - Sean Anderson [2] - Andrea Warner-Czyz [3]
Colorado University Anschutz School of Medicine, Physical Medicine and Rheabilitation, Denver, United States [1] - Colorado University Anschutz School of Medicine, Physiology and Biophysics, Denver, United States [2] - The University of Texas at Dallas, Speech, Language, and Hearing, Richardson, United States [3]

Background: Presence of childhood hearing loss (CHL) is a known risk factor for delayed spoken language regardless of degree of CHL. Numerous factors have been shown to influence language outcomes. Some of these factors are malleable (e.g., hearing aid use) and others are more static (e.g., socioeconomic status and intelligence quotient). Children with hearing differences identified by 3 months, fitted with hearing aids and enrolled in early intervention by 6 months of age historically have language levels like their typical hearing peers. Our recent work demonstrated no difference on speech discrimination at 9 months or spoken receptive or expressive language as measured using a standard clinical tool at 30 months of age between CHL and their typical hearing peers. Our results were surprising and differed with decades of work suggesting that differences in vocabulary size using standardized measures and higher-order language (e.g., syntax and pragmatics) abilities persist from toddlerhood through late elementary school. Thus, we sought to examine if speech discrimination measured at 9 months of age predicted mean length of utterance in morphemes (MLUm) and number of mental state verbs used at 33 months of age using a 30-minute spontaneous language sample.
Methods:
Participants included 19 children with typical hearing and 35 children with hearing differences (19 with mild hearing loss;12 with ≥moderate). Speech discrimination was assessed at 9 months (M=9.99, sd=2.74) and at 30 months (M=30.58, sd=0.70) using two different tasks. At 9 months, a conditioned head turn paradigm was used in response to a change in speech stimuli (i.e., /a-i/ and /ba-da/). At 30 months, children completed the Open and Closed Set Task, which requires a child to repeat back a word sans visual cues and select correct picture out of three images, yielding scores for phoneme accuracy, word acceptability and word comprehension. At 33 months (M=33.56, sd=0.92), language samples were obtained by asking primary caregivers to interact with their child in their home as they typically would for 30 minutes while being videotaped. All dyads received identical instructions, including encouragement to engage in activities promoting the use of language by parent and child. Speech-language pathologists familiar with deciphering and transcribing the speech of children who are deaf and hard of hearing then transcribed in the Systematic Analysis of Language Transcription (SALT) software program (research version). They transcribed the first 25 minutes of the caregiver-child interactions, coding for bound morphemes abandoned and interrupted utterances, nonverbal utterances, and unintelligible words and utterances.
Results: No differences were observed on speech discrimination abilities as a function of hearing status. A regression model evaluated the relationship between speech discrimination and MLUm. Speech discrimination abilities at 9 months did not predict MLUm. However, the Acceptable Words subtest of the Open and *Closed* Set Task at 30 months predicted MLUm at 33 months ($t(23)=2.00$, $P=0.023$). Children with typical hearing had a larger MLUm than those with hearing differences according to a t-test between groups ($t(48)=4.053$, $p<0.001$). A regression was performed to evaluate the relationship between speech discrimination and MLUm for children with typical hearing, mild, or at least moderate hearing loss. Children with typical hearing, but not children with mild hearing loss, had significantly greater MLUm than children with at least a moderate hearing loss ($t(43)=2.283$, $p<0.05$). Children with typical hearing used significantly more mental state verbs compared to their CHL peers ($t(51)=2.65$, $p=0.011$).
Discussion: Speech discrimination did not differ between groups, but MLUm differed based on hearing status. Moreover, infant speech discrimination did not predict MLUm, a measure of language complexity in a spontaneous sample. These findings contradict our past work, which found (a) a significant predictive relationship between infant speech discrimination and receptive and expressive language skills as measured on standardized tests in children with and without hearing differences; and (b) no significant effect of auditory status on language standard scores. In combination, these results suggest that standardized measures may not capture the nuances of social interactions in young children, regardless of hearing status. That is, spontaneous language samples may better reflect differences in conversational skills among young children as a function of hearing status.

Keywords: Children, hearing differences, language, speech discrimination, early intervention

74 - Phoneme discrimination in noise and reverberation using the DANOK test

Maaike Van Eeckhoutte [(1)] - Regitze Ardenkjær-Husted [(2)] - Chunlong Zhao [(3)] - Torsten Dau [(3)]
Hearing Systems, Department of Health Technology, Technical University of Denmark, Lyngby, Denmark - Copenhagen Hearing and Balance Centre, Ear, Nose, Throat, and Audiology Clinic, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark [(1)] - Copenhagen Hearing and Balance Centre, Ear, Nose, Throat, and Audiology Clinic, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark [(2)] - Hearing Systems, Health Technology, Technical University of Denmark, Lyngby, Denmark [(3)]

In clinical practice, assessing phoneme perception is a common practice during Auditory Verbal Therapy for children with hearing loss. Speech-language pathologists typically use their own voice to produce utterances of real speech phonemes that cover the full frequency spectrum of speech. Moreover, children with hearing loss often report struggling the most in noisy and reverberant environments. The aim of this project was to develop a phoneme discrimination test in noise and reverberation specifically for children with hearing loss in Denmark.

In the initial step, recordings from the DANOK nonsense speech corpus (DAnsk Nonsense Ord Korpus) were carefully selected and incorporated into a user- and child-friendly test designed for clinical practice. The chosen speech trials took the form of “LABI”, with the middle consonant (“B” in the example) changing across trials. The trials were spoken by one female and one male speaker, and a total of 12 middle consonants commonly found in Danish were selected. The test was implemented in a lab setup using a loudspeaker array, varying signal-to-noise ratios (SNRs) between 0, 5, 15 dB, as well as silence, and implementing reverberation times of 0, 0.6, and 1.7 seconds.

Subsequently, this DANOK test was evaluated in several groups. Firstly, young, normal-hearing adults participated, including both native Danish speakers and non-Danes living in Denmark, recognizing phoneme discrimination as a nonsense speech intelligibility test. However, both subgroups were compared. Secondly, normal-hearing children participated, all fluent in Danish, either as native speakers or bilingual Danish-Mandarin speakers. The latter group consisted of children attending Danish primary school but having Mandarin-speaking parents. Thirdly, children with hearing aids are currently being recruited to evaluate the same experimental conditions in this group.

The results indicate that normal-hearing young adults achieved high scores (80% or more on average) as long as the SNR is 5 dB or higher, and reverberation does not significantly affect the results at SNRs of 15 dB or higher. However, a decline in scores was observed when more challenging noise was presented (at an SNR of 0 dB), with the scores further deteriorating with increasing reverberation time, reaching on average 60% at the most extreme reverberation time (1.7 seconds). Furthermore, initial results suggest that the effects of reverberation are more pronounced for children.

We will present the modified DANOK test for use in children with hearing loss and identify test conditions that are challenging yet yield high scores for normal-hearing participants. This information can be utilized in clinical practice as a reference or norm score for children with hearing loss, particularly in hearing aid evaluations.

Keywords: phoneme discrimination, reverberation, noise, children with hearing loss

82 - Neural responses to envelope modulation enhanced speech in children with and without dyslexia

Kanad Mandke [(1)] - Sheila Flanagan [(1)] - Georgia Feltham [(1)] - Fiona Gabrielczyk [(1)] - Angela M. Wilson [(1)] - Joachim Gross [(2)] - Usha Goswami [(1)]

University of Cambridge, Department of Psychology, Cambridge, United Kingdom [(1)] - University of Münster, Institute for Biomagnetism and Biosignal Analysis, Münster, Germany [(2)]

Phonological difficulties are known to characterise developmental dyslexia across languages. There is mounting evidence from various neurophysiological studies indicating that children with developmental dyslexia show impairments in entraining to acoustic speech envelope information in the delta and theta bands (<10 Hz). These studies suggest that atypical entrainment arises in part from reduced sensitivity to amplitude rise times (ARTs or speech edges) in the speech envelope. This likely leads to less accurate encoding of low-frequency speech information. In this study, we adopted the sensory-neural Temporal Sampling Framework (TSF) to explain the aural difficulties found in children with developmental dyslexia and used it to devise sensory-neural modes of remediation. To ameliorate the low-frequency speech-brain synchronisation difficulties, we designed a sophisticated speech-processing algorithm to selectively amplify low-frequency (<10 Hz) modulation in the speech envelope. We termed this the Envelope Modulation Enhancement (EME) algorithm. In this study, we investigated whether EME speech would instantaneously change neural speech encoding for children with dyslexia. We hypothesised that children with dyslexia would show improved neural responses to EME speech, specifically in the delta band.

19 children with dyslexia (DY, mean age: 9.66±0.77, years) and 20 age-matched controls (CA, mean age: 8.81±0.60, years) were studied. Children underwent a standard T1 weighted MRI scan and MEG scan. The MEG scan included 10 minutes of story listening in natural child-directed speech (natural speech or NS) read by a native female British English speaker and 10 minutes of the same speaker and story delivered as EME speech at comfortable listening levels. Our pre-screening showed that all participants were sensitive to sounds within 20 dB HL range (250 Hz – 8 kHz).

The speech recording was divided into 10 one-minute segments. Each section contained a whole phrase/utterance and included 500ms of silence or padding at the beginning to avoid edge effects. The sound files were reduced to mono from stereo at the original sampling rate (48 kHz). Each sound file was filtered using a 28-channel filter bank spanning 100 Hz to 7250 Hz. For each sound file, 28 Hilbert envelopes were generated and low-pass filtered with a cut-off frequency of 15 Hz. This ensured that the canonical modulations of interest 0.5 to 4 Hz (delta) and 4 to 8 Hz (theta) were well within the -3 dB passband. The low-pass filtered envelopes were then processed to form the EME speech.

All the MEG data were subjected to temporal signal space separation (tSSS) to remove external noise and head movements. The continuous data were down-sampled to 250Hz and bandpass filtered between 0.5 to 48 Hz. External surface electrodes were used to mark artifacts in the MEG data, which were removed using Signal Space Projections (SSPs).

In the stimulus material, using an in-house algorithm, we identified rapid stimulus onsets or speech edges that are common in both NS and EME conditions. MEG data time-locked to these speech edges was source-localised using an LCMV beamformer. These trials were subjected to time domain (ERP), phase-domain, and spectral domain analysis.

Neural responses to speech edges were source-localised in the bilateral auditory cortex in both groups (CA & DY) in both conditions (NS & EME). The source reconstructed data from the auditory cortices were subjected to permutation testing (DY vs CA in NS and EME). However, these data were not significantly different between groups. We also did not find a statistically significant difference in the phase domain, in either the delta or theta bands. The spectral power in the delta and theta bands was then extracted using the Hilbert transform for each participant. A repeated measures ANOVA (DV spectral power) showed that there was a significant main effect of both speech condition (NS vs. EME), $F_{(1,37)} = 76.54$, $p<0.001$, $\eta_p^2 = 0.674$ and frequency band (delta vs. theta) $F_{(1,37)} = 4896.06$, $p< 0.001$, $\eta_p^2 = 0.992$. There was also a significant main effect of group, $F_{(1,37)} = 50.14$, $p< 0.001$, $\eta_p^2 = 0.580$. The EME story affected neural processing in the power domain for children with dyslexia, particularly in the delta band (0.5–4 Hz) in the superior temporal gyrus. This may suggest that prolonged experience with EME speech could ameliorate some of the impairments shown in natural speech processing by children with dyslexia.

Keywords: Dyslexia, Speech Processing, Auditory entrainment

112 - Using speech in noise testing to assess hearing asymmetries in children

Lulia Snan [(1)] - Rachel Lim [(1)] - Jaina Negandhi [(1)] - Sharon Cushing [(1)] - Blake Papsin [(1)] - Karen Gordon [(1)]
The Hospital for Sick Children, Archie's Cochlear Implant Laboratory, Toronto, Canada [(1)]

The objectives of this study were to: 1) use spatial separation of speech and noise to quantify asymmetric hearing in children and 2) to compare results from two different speech in noise tests.
Speech in noise testing can be used to identify speech perception challenges in children with hearing loss and have been effective in detecting larger deficits than expected from audiometric thresholds in children with auditory neuropathy spectrum disorder. The location of the noise relative to the speech is also important; benefits of spatial separation for speech perception are expected due to binaural hearing. Our prior work showed that these benefits can be different for noise presented to the left versus right side in children using bilateral cochlear implants (CIs), highlighting asymmetric hearing abilities (aural preference) in children who had pre-lingual deafness in both ears and long inter-implant delays. Moreover, there may be effects of the speech perception task and the type of noise used due to informational masking. The hypothesis was that effects of hearing asymmetries would be present regardless of the task or the type of noise.
In the present study, speech perception in noise was measured in two ways: 1) speech recognition thresholds (SRTs) at 0-degree azimuth were measured amidst a 45 dB HL speech-weighted noise in three spatial positions: co-located with speech, at -90 degrees (left), and +90 degrees (right). 2) Accuracy repeating BKB sentences delivered at 65 dB SLP in three spatial positions (0, -45 and +45 degrees) amidst speech babble presented at two speakers located at -90 and +90 degrees. Speech babble was presented to deliver signal to noise ratios (SNRs) of +10, +5, 0, -5, -10, -15 dB.
Twelve children with bilateral CIs participated (3F:9M). Age at testing was 14.51 ± 2.21 years (mean age ± SD); they received their first CI at 3.6 ± 2.19 years of age and had an inter-implant delay of 1.64 ± 4.86 years. Eight were simultaneously implanted and 4 sequentially implanted (3 implanted on L side first). A group of typically developing peers (5F:7M, age at test 15.33 ± 1.18 years) were also recruited.
SRTs revealed benefits of spatial separation between speech and noise in both groups (NH: $t = 8.2$, $df = 11$, $p = 4.9e\text{-}06$; BCI: $t = 2.5$, $df = 9$, $p = 0.035$). In the typically developing group, these benefits were greater when noise was at -90 degrees, revealing a right ear advantage for this task. The sentence recognition test was consistent with this finding, demonstrating 75% accuracy for speech located on the right at lower SNR than speech located on the left (2-way interaction: $F(1,15) = 93.5$, $p = 0.039$). The bilateral CI group showed more variable asymmetries with some children having a left and some having a right ear advantage on the SRT test. Similar asymmetries were found on the speech sentence recognition test and there was a significant correlation between these measures in the BCI group ($t = 2.3$, $df = 9$, $p < 0.05$).
The findings reveal that children with normal hearing consistently show a right ear advantage for perceiving speech in noise. By contrast, children with bilateral CIs can show an aural preference for either their right or left ears. In addition, consistencies between speech in noise testing using different speech perception stimuli and measures and different noises suggest that these asymmetries are robust and can be detected using different speech in noise test paradigms. Implications for clinical test protocols will be discussed.

Key words: Speech perception in noise; Right ear advantage; Aural preference; Bilateral cochlear implants; Children

92 - Hearing Aids and Speech Perception in Older Adults: The Role of Amplification

Limor Lavie [(1)] - Liat Shechter-Shvartzman [(2)] - Karen Banai [(2)]
University of Haifa, Communication Sciences and Disorders, Haifa, Israel [(1)] - University of Haifa, Israel [(2)]

Background: Hearing aids are the most common intervention for age-related hearing loss, but the benefits they offer in daily listening conditions vary substantially between users and among different types of challenging speech. Some of the variability may stem from differences in amplification-induced plasticity. Such plasticity was found in studies that showed that the contribution of amplification to the identification of speech in noise increases over time. In this ongoing longitudinal study, we examine the effect of short- and long-term hearing aid use on the recognition of fast speech and speech in babble noise at three time points over a six-months period. We assessed the contribution of hearing aid use over time compared to individuals with no hearing aids.
Methods: First-time hearing aid users and non-users (age 63-88) participated in this three-phase study. The first phase was conducted shortly prior to hearing aid fitting and immediately after first fit of the hearing aids, the second phase was conducted two months post-fitting, and the third phase 6 months post fitting. Aided and unaided performance was assessed in both groups. We examined the relative contribution of phase, condition (aided and unaided), and their interaction to the perception of fast speech and speech in babble noise.
Results: Speech recognition accuracy was modeled as a function of phase, condition and their interaction. Hearing acuity and amplification contributed to the recognition of both speech in noise and fast speech. Fast speech and speech in noise were more accurately identified in participants with better hearing and when tested with hearing aids in both users and non-users of hearing aids. At the second phase, a slightly larger effect of amplification on (aided) speech recognition was observed in both groups, mainly for fast speech. Whether further improvement can be expected in the third phase is yet to be determined.
Conclusions: Both hearing and amplification contribute to the recognition of fast speech and speech in babble noise. While the contribution of amplification to the recognition of fast speech increased over time, further, long term, contribution of hearing aid use is doubtful. For speech in noise, immediate effect of amplification was observed, but contrary to former studies, there was no further change over time. Possible explanations for the results will be suggested.

IMPLANTABLE DEVICES – CANDIDACY AND ASSESSMENT

240 - The sensitivity and specificity of aided audibility in pediatric cochlear implant candidacy

Caitlin Sapp [(1)] - Lisa Park [(2)] - Molly Widney [(1)] - Marisa Temple [(1)]
University of North Carolina Medical Center, Pediatric Audiology, Chapel Hill, United States [(1)] - University of North Carolina, School of Medicine, Chapel Hill, United States [(2)]

Language development in children with hearing loss is realized through early identification and early access to intervention (Yoshinaga-Itano et al., 2017). When families choose to pursue spoken language after diagnosis, the choice of hearing technology depends on the degree to which hearing loss compromises auditory access to spoken language. For children with mild to severe hearing loss, well-fit hearing aids can restore auditory access (Tomblin et al., 2014; Kuk & Marcoux, 2002). For children with severe to profound hearing loss, a cochlear implant (CI) is likely a better choice given the limitations of amplification for hearing loss at these levels (Stelmachowicz & Pittman, 2004; Bradham & Jones, 2008). As CI candidacy for children has expanded, the need has emerged for better criteria to support decision making, timing of implants in borderline cases, or motivate a change in recommendations when hearing loss progresses over time (Wiseman et al., 2023; Leigh et al., 2016; Lesinski-Schiedat et al., 2004; Holcomb & Smeal, 2020; Wilson et al., 2016). Today we have access to three objective metrics to identify potential candidates: speech perception scores, pure tone average, and aided audibility. Aided audibility measures a child's auditory access to spoken language with hearing aids on a percentage scale. It is a summary measure that quantifies the benefit of hearing aids and contributes to a child's early auditory experience. While measures of speech perception and calculations of pure tone average have been well studied in this population, aided audibility has only recently been identified as an important construct in developmental and language outcomes for children with hearing loss (Tomblin et al., 2015; McCreery et al., 2020).

There is limited data available in the literature on audibility patterns among children who are referred for CI evaluation and among those who are confirmed to be candidates (Nickerson et al., 2019). Among large, tertiary care centers for pediatric CI and pediatric hearing aid management, it is important to identify gaps in referral patterns and variability in pre-implant audibility to ensure that children who could benefit from CI receive a comprehensive evaluation (Park et al., 2021; Wiley & Meinzen-Derr, 2009). Variability in pre-implant audibility has been linked with post-implant speech perception abilities, despite all CI candidates exhibiting very restricted auditory access under the current guidelines (Nickerson et al., 2019). Children whose aided audibility falls below about 61% appear to be at greatest risk for underperformance with hearing aids (Wiseman et al., 2023). Better information about aided audibility patterns within our patient population may also help ensure that pediatric hearing aid users consistently access high-quality fittings and improve how UNC routes pediatric hearing loss patient referrals in the face of fixed barriers to accessing care.

In this research study, we are examining the audibility profiles of pediatric patients who are referred for CI evaluation at our university-based hospital clinic. Our design is a retrospective chart review that pulled clinical auditory experience characteristics from all audiology clinics in our healthcare system (n=239). Specifically, this presentation will present data contrasting pre-implant unaided and aided audibility (measured using the speech intelligibility index) values in two groups of children: those who qualified for CI (n=193) and those who did not qualify for CI (n=21). Our results show that aided audibility values from published literature (Wiseman et al., 2023) have high sensitivity for CI candidacy (96.9%) with acceptable specificity. Unaided audibility values and overall PTA in our sample had lower sensitivity to separate these two groups compared to aided audibility. In our real-world sample of clinical data, the criterion values proposed in Wiseman et al., 2023 appear to effectively identify pediatric CI candidates.

111 - Attention to interaural level cues measured by cortical and behavioral responses in children with bilateral cochlear implants

Karen Gordon [1] - Lulia Snan [1] - Jaina Negandhi [1] - Rachel Lim [1] - Blake Papsin [1] - Sharon Cushing [1]
The Hospital for Sick Children, Archie's Cochlear Implant Laboratory, Toronto, Canada [1]

The objectives of the present study were to measure cortical access and behavioral responses to interaural level differences (ILDs) in children using bilateral cochlear implants (BCIs); to determine the role of attention on ILD access; and to assess effects of task repetition on ILD access.
One aim of bilateral cochlear implants (BCIs) is to provide access to the interaural cues that are the foundation of spatial hearing. However, prior work has shown that children receiving BCIs do not gain normal spatial hearing and that this could be due to several factors. ILDs are better presented through BCIs than interaural timing differences (ITDs) and hearing loss in childhood could disrupt binaural processing. Although ILDs are available to children with BCIs, they take longer than normal to respond to them, suggesting increased listening effort. In the present study, we hypothesized that: 1) cortical and behavioral access to ILDs can be measured using an oddball task in children with BCI; 2) these measures are related to one another, and 3) task repetition improves both cortical and behavioral responses to ILDs.
Twelve children with bilateral CIs participated (3F:9M). Age at testing was 14.51 ± 2.21 years (mean age ± SD); they received their first CI at 3.6 ± 2.19 years of age and had an inter-implant delay of 1.64 ± 4.86 years. Eight were simultaneously implanted and 4 sequentially implanted (3 implanted on L side first). A group of typically developing peers (5F:7M, age at test 15.33 ± 1.18 years) were also recruited.
Children listened to bilateral stimuli in an oddball paradigm in which frequent stimuli (70% of trials) had ILD=0 and deviations (30% of trials) were ILD=16 dB. They were asked to press a button whenever they heard the deviant stimuli. Trials of 50 stimuli were presented in blocks and 5 blocks were completed. Accuracy and reaction time were measured and cortical responses to all stimuli were recorded using a 64 channel EEG recording system. Passive EEG responses to each of the stimuli were also recorded and presented interspersed with oddball attention blocks in random order. Global mean field power across the recording channels were assessed for amplitude differences from baseline or between conditions objectively by measuring the area under the curve for time windows of 50 ms from -200 ms to 800 ms latency.
Results revealed clear obligatory responses to bilateral stimuli which were larger in amplitude in the active oddball than passive control conditions in both groups. The oddball paradigm revealed larger amplitudes for the deviant ILD bilateral stimuli compared to the frequent at latencies of 250-450 ms in children with normal hearing and slightly later, at 300-500 ms in children using BCIs. Amplitudes to deviant stimuli showed a significant positive correlation with response accuracy ($t = 2.8$, $df = 5$, p-value = 0.037) and near significant negative correlation with response time ($t = -2.3$, $df = 5$, p-value = 0.07) in the BCI group. These relationships were not clear in the typically developing group (accuracy: $t = -0.2$, $df = 6$, p-value = 0.9; response time: $t = -0.9$, $df = 6$, p-value = 0.4). Behavioral accuracy increased (3-way interaction: $F(4,115) = 6.1$, $p = 0.00016$) and response time decreased (3-way interaction: $F(4,115) = 9.2$, $p = 1.7e-06$) with increasing oddball block presentation in both groups. Cortical amplitudes to deviant stimuli with increasing block and relation to behavioral data are being assessed.
Results demonstrate that children with BCIs can use attention to access ILDs. This access is tied to the activation of cortical networks. Importantly, repetition of the oddball task reveals short term learning effects. These results suggest that there may be a role for practise to improve access to ILDs and perhaps spatial hearing in children with BCIs.

Key words: Bilateral cochlear implants, Children, Cortical evoked potentials, Cortical plasticity, Oddball paradigm, P300, Learning

246 - Stream segregation in cochlear implant listeners

Nicholas Haywood [1] - Ben Williges [2] - Marina Salorio-Corbetto [1] - Deborah Vickers [1]
University of Cambridge, Department of Clinical Neurosciences, Cambridge, United Kingdom [1] - Universitätsklinikum Essen (AöR), Essen, Germany [2]

When listening to a sequence of tones which alternate between low (L) and high (H) frequency, those with typical hearing (TH), are more likely to perceive the two subsets as segregated perceptual streams when: 1) The frequency separation (∆F) between L and H is increased and 2) The inter-stimulus interval (ISI) between tones is decreased, increasing the presentation rate. Although cochlear implant (CI) listeners hear greater segregation as ∆F is increased, there is currently no clear evidence that ISI affects segregation judgements.
In this on-going research, we asked groups of TH and CI listeners to detect a temporal delay imposed on the H tone of LHL triplet. Performance was measured in an adaptive procedure where the size of the delay was adjusted. As stream segregation should make the task more difficult, so thresholds were expected to rise as ∆F increased. We also measured performance when the LHL triplet was preceded by a precursor sequence of five L tones. Previous TH studies have shown that such a precursor should further promote the segregation of the H tone, but only when there is a ∆F between subsets. The experiment was run with three ∆Fs (H frequencies corresponding to +0, +3, or + 5 electrode channels from L) and three presentation rates (default ISIs between L and H of 50, 100, or 200 ms).
Preliminary results from the TH group (n = 7) suggest listeners performance was influenced by stream segregation only at the shortest ISI (50 ms). Any influence of ∆F or precursor was not apparent at longer ISIs. This is consistent with the notion that segregation is reduced at slower presentation rates. All listeners tested in the CI group to date (n = 11) performed more poorly than the TH group at the shortest ISI, and ceiling effects obscured the extent to which stream segregation influenced performance. However, CI listeners demonstrated clear stream segregation effects when the ISI was 100 ms, and these effects diminished when the ISI was increased to 200 ms. Overall, these findings suggest CI listeners may experience stream segregation at slower presentation rates than TH. Based on physiological models of stream segregation, we speculate that our results may reflect increased neural adaptation to CI stimulation.
From the CI group's results at 100 ms ISI, we quantified the extent of individual stream segregation effects by calculating a ratio between thresholds in the presence or absence of the precursor (a 'segregation ratio'). This segregation ratio shows a negative correlation with speech-on-speech segregation – those who showed a greater influence of stream segregation on delay detection thresholds achieved lower signal-to-noise ratios (SNRs) when following a target speaker in the presence of a co-occurring irrelevant speaker (as measured using a version of the co-ordinate response measure task). Although data collection remains on-going, our initial findings suggest that stream segregation may be a useful metric for assessing aspects of cochlear implant performance, including; frequency selectivity, neural adaption, and aspects of speech-in-noise performance.

Keywords: Cochlear implants; Auditory stream segregation; Auditory scene analysis

Keynote Lecture

264 - Objective measures at different stages of cochlear implantation

George Tavartkiladze [(1)]
Russian Medical Academy of Continuing Professional Education, Clinical Audiology, Moscow, Russian Federation [(1)]

Recently the auditory evoked potentials to acoustic and electric stimulation are widely used for CI candidate selection, during cochlear implantation and post-surgery rehabilitation. Different classes of EPs provide information on the functional integrity of the auditory nerve fibres at the pre-surgery and surgery stages (eABR), minimize the risk of surgical trauma of delicate cochlear structures (intracochlear ECochG to acoustic stimulation) and provide threshold determination at different CI electrodes for the precise CI mapping (NRT), including investigation of the eCAP amplitude growth function, excitation summation, spread of excitation, recovery function. Additional information could be obtained with estimation of the eABR P_5 thresholds and amplitude growth function as well as the P_5 binaural interaction component. The invaluable information for the cochlear implantation effectiveness prediction can be provided by registration of cortical auditory evoked potentials at the rehabilitation stage (CEAP, eCEAP), which is based on the analysis of the P1-N1-P2 complex. The maturation of the central auditory function in children after cochlear implantation can be monitored based on P1 component dynamics.
The results obtained in early and late implanted children as well as registrations from different electrode systems (straight and peri-modiolar electrode arrays) will be discussed.
The CI effectiveness could be improved with neuroimaging and genetic investigation before implantation.

IMPLANTABLE DEVICES – OUTCOMES

267 - Predicting one-year speech perception outcomes for adults with a CI, within a multi-disciplinary team

Nikki Philpott [(1)] - Ietske Siemann [(1)] - Yvonne Smeele [(1)] - Emmanuel Mylanus [(1)] - Rogier Donders [(2)] - Arno Janssen [(1)] - Wendy Huinck [(1)]
Radboud University Medical Center Nijmegen, Otorhinolaryngology, Nijmegen, Netherlands [(1)] - Radboud University Medical Center Nijmegen, Health Evidence, Nijmegen, Netherlands [(2)]

Objectives
Previously, we investigated how well clinicians working in the field of CI are able to predict one-year post-operative speech perception outcomes when provided with clinical case studies. In this follow-up study, we again looked at speech perception outcome prediction, but within a multi-disciplinary team making predictions together.
Methods
During various CI candidacy meetings where a multidisciplinary team comes together to discuss whether a CI candidate is advised to proceed with the CI journey, an additional point of discussion was to predict the one-year post-implantation phoneme score. Each team member first made their own prediction, followed by a team discussion to reach a group consensus. These team predictions are now compared to each CI user's actual post-implantation outcomes, including whether the five factors clinicians think are most important for outcome prediction are key factors within each case that was predicted.
Results
One-year speech perception scores have been predicted for 70 newly implanted CI users, for whom speech perception scores are available. Predictions were made before the results of our previous study were available, with predictions in the present study being more accurate or even under-predicting speech perception outcomes compared to our previous findings of over-prediction of outcomes. This may point to the importance of a multi-disciplinary team in making predictions. Full analysis is currently underway, and results will be presented at the conference.
Conclusion
The field of outcome prediction continues to expand, and is important for guiding the CI uptake, counselling, expectation management and post-implantation rehabilitation and support process. Our study highlights the value of a multi-disciplinary approach to discussions on predicted outcomes, which remains a difficult but important topic as the number of individuals who may benefit from a CI continues to grow and CI indication becomes more complex.

Key words: cochlear implantation, adults, prediction, speech perception outcomes

115 - A Multicenter Clinical Trial to Address Cochlear Implantation of Children with Single-Sided Deafness

Jill Firszt [(1)] - Laura Holden [(1)] - Noel Dwyer [(1)] - Ruth Reeder [(1)] - Tim Holden [(1)]
Washington University School of Medicine, Otolaryngology, St. Louis, United States [(1)]

Objective: Children with single-sided deafness (SSD) have impaired binaural cues, which degrades communication in daily life. While some evidence suggests benefit from a cochlear implant (CI) for children with SSD, guidelines regarding candidacy criteria, assessment tools and expected outcomes are not well defined. The current study objective is to conduct an FDA-approved, prospective clinical trial to evaluate behavioral outcomes and a range of quality-of-life measures in children with SSD who receive a CI.
Methods: This clinical trial is a multicenter, two phase, longitudinal study, comprised of five geographically diverse sites in the US. A hearing aid phase assesses performance with the most current hearing aid technology and is followed by a CI phase. Approximately 40 children, ages 4-14 years old, with SSD will be enrolled. Hearing criteria for the poor ear expands the current FDA-approved criteria. Objective and subjective measures are designed to elucidate communication challenges encountered by children with SSD, including word understanding at soft levels, speech understanding in spatially separated noise, and localization/lateralization. Quality of life measures address communication in real-world listening situations, general and cognitive fatigue, and social and emotional function.
Results: During this session, an overview of the study design and protocol will be presented. Data collection is ongoing and initial results will be reviewed. To date, 28 children with SSD have enrolled who range in age from 4 to 12 years. Twenty-four children have completed the hearing aid phase and 23 children have had CI surgery and device activation. Post-op study intervals have been completed as follows: 17 at the 3-month interval, 15 at the 6-month interval, and 11 at the 9-month and the 12-month intervals. Initial results for the poor ear alone indicate improvement in audibility after 3 months CI use. Word recognition scores for the poor ear alone suggest word understanding is achieved for some but not all participants, and for the majority, not until 12 months post-operatively. Generally, wear time is higher with a CI than devices worn during the hearing aid phase. In the bilateral condition, after 3 months CI use, some participants show increased lateralization abilities and speech in noise improvements; however, considerable variability exists. Improved parent ratings are reported between the hearing aid phase and the CI phase. However, areas that parents rate as difficult for their child vary and reveal individual differences among children.
Conclusion: A successful multicenter clinical trial is underway to prospectively quantify outcomes and investigate factors affecting successful use of a CI in children with SSD. Our objective measures (e.g., speech in noise, localization) and quality of life questionnaires provide additional unique information for each child with SSD and further quantify the consequences of SSD. Study results will provide new information to inform and improve clinical management and treatment of children with SSD. Funded by the NIH/NIDCD.

Key words: Single-sided deafness, Cochlear implant, Speech perception

63 - Longitudinal developmental outcomes of children with single-sided deafness with and without a cochlear implant

Tine Arras [1] - Birgit Philips [2] - Christian Desloovere [3] - Jan Wouters [1] - Astrid van Wieringen [1]
KU Leuven, ExpORL, Dept. Neurosciences, Leuven, Belgium [1] - Cochlear Technology Centre Belgium, Advanced Innovation, Mechelen, Belgium [2] - UZ Leuven, Otorhinolaryngology, Head and Neck Surgery, Leuven, Belgium [3]

Single-sided deafness (SSD) affects approximately 2 in 10.000 newborns in high-income countries. These children have profound hearing loss (HL) in one ear (> 80 dB HL) and normal hearing (NH) in the other ear. They have no access to binaural hearing, which hampers their ability to localize sounds and understand speech in difficult listening situations. In addition, children with SSD are at risk for speech-language delays and academic underachievement. Finally, unilateral auditory deprivation can lead to cortical reorganization in favor of the NH ear (aural preference syndrome). The only treatment option that can restore hearing in the deaf ear, and possibly enable binaural hearing, is a cochlear implant (CI). Early implantation is likely of key importance to achieve optimal outcomes, given the sensitive period for brain development early in life. Since January 2024, CIs are reimbursed for children with SSD in Belgium, but in many countries worldwide, this is not yet the case.
In our longitudinal multicenter study, twenty infants with prelingual SSD received a CI before the age of 2.5 years. The mean age at implantation was 15.2 ± 5.6 months, which is well within the generally accepted window of opportunity. We documented the children's spatial hearing, language, and cognitive skills at regular intervals throughout their development. We compared their performance to that of two control groups: children with SSD who did not use a CI, and children with bilateral NH. We hypothesized that the CI would facilitate improved spatial hearing, as well as normal language and cognitive development. In contrast, we expected that the children with untreated SSD would achieve poorer outcomes throughout their development, in particular on tests for spatial hearing and language.
At the HEAL conference, we will present our longitudinal data regarding the auditory, language, and cognitive skills of the SSD children. We will focus on the main differences in outcomes between the children with SSD with and without a CI, and how their scores relate to those of the NH reference group. These results provide insight into the benefit of early cochlear implantation for children with prelingual SSD.

Keywords: single-sided deafness; cochlear implants; language development; spatial hearing

69 - Etiology of Single Sided Deafness and Outcomes of Cochlear Implantation

Robert Conway [(1)] - Sandy Porps [(2)] - Yasser Almansour [(3)] - Dennis Bojrab [(1)] - Robert Hong [(1)] - Seilesh Babu [(1)]

Michigan Ear Institute, Neurotology, Farmington Hills, United States [(1)] - Michigan Ear Institute, Audiology, Farmington Hills, United States [(2)] - Michigan State University, College of Medicine, East Lansing, United States [(3)]

Introduction**:** Cochlear implantation (CI) for single sided deafness (SSD) has recently been approved by the Food and Drug Administration (FDA). Even more recently, cochlear implantation has been performed for patients undergoing translabyrinthine resection of vestibular schwannomas. It is unknown how these patients compare to those with other causes of SSD and wear time has not been evaluated. The purpose of this study is to compare audiologic outcomes and wear times between those undergoing CI for translabyrinthine resection and those with other causes for SSD.

Methods**:** Retrospective chart review of patients undergoing cochlear implantation for single sided deafness was performed. Reasons for CI were noted and patients were separated into groups based on those that had translabyrinthine resection and those with other causes, including those with deafness due to idiopathic sudden sensorineural hearing loss (SSNHL), Meniere's disease, labyrinthitis, or labyrinthectomy. Patient information, audiologic outcomes and wear times were compared between the two groups. Statistical analysis involved t-test for continuous variables and chi-square testing for categorical variables.

Results**:** Thirty-four patients that underwent CI for SSD were identified. There were 12 patients in the translabyrinthine group and 22 in the non-translabyrinthine group. Hearing loss etiologies included 12 patients with SSNHL, 7 with Meinere's disease 2 with labyrinthitis, 2 with labyrinthiectomy and 2 with other causes. Age did not differ between the two groups. There was no difference in AzBIO scores in quiet, +10 signal-to-noise ratio (SNR), or +5 SNR when comparing the translabyrinthine group and non-translabyrinthine groups. AzBIO +5 SNR significantly improved from 85.3% preoperatively to 96.3% postoperatively, and 87.0% to 95.9% for the translabyrinthine group and non-translabyrinthine groups, respectively ($p<0.05$). Consonant-Nucleus-Consonant (CNC) testing revealed similar outcomes in the affected ear, 75.5% for the translabyrinthine group, and 71.1% for the non-translabyrinthine group ($p=0.480$). Preoperative pure tone average (PTA) was significantly better for the translabyrinthine group given that these patients had some hearing prior to surgery compared to those that had already lost hearing. Wear times for the translabyrinthine group was significantly lower than for the non-translabyrinthine group, 7 hours and 10.8 hours, respectively ($p=0.037$).

Conclusion**:** Cochlear implant for SSD demonstrates good results for AzBIO and CNC testing in the affected ear for both the translabyrinthine and non-translabyrinthine groups with no difference in outcomes between the two groups. Wear times are slightly lower in the translabyrinthine group compared to the non-translabyrinthine group.

Keywords: Cochlear implant, Single sided deafness, vestibular schwannoma

145 - Age at establishing full-time device use in children with cochlear implants as a predictor of their language outcomes

Jaime Leigh [(1)] - Elizabeth Stroud-Dunn [(1)] - Sandra Lettieri [(1)] - Nicole Cheah [(2)]
Royal Victorian Eye and Ear Hospital, Cochlear Implant Clinic, Melbourne, Australia [(1)] - The University of Melbourne, Audiology and Speech Pathology Department, Melbourne, Australia [(2)]

Objectives**:** The aims of this study were to investigate (a) the duration taken for children with cochlear implants (CIs) to reach full-time device use (FTU) (measured as 80% hearing hour percentage (HHP)), and (b) establish whether time taken to reach FTU will be a better predictor of language outcomes in these children than age at establishing FTU.
Design**:** Retrospective analysis investigated the receptive and expressive language outcomes at 12-months post-implantation for 64 children with CIs. Simple linear regression analyses were run for all children with time taken to reach FTU and age at FTU as the independent variable. Datalogging measurements were recorded to calculate 80% HHP. Descriptive statistics were used to represent the establishment of FTU.
Results**:** Results demonstrated that age at FTU was found to be a better predictor of receptive and expressive language than time taken to reach FTU. An average of 14.7 months was required for the participants in this study to reach FTU, where 59.5% of the cohort reached 80% HHP by the age of 3 years. Children who were able to establish FTU within 12 months post cochlear implantation had better language outcomes compared to those who did not reach FTU.
Conclusions**:** Findings support the provision of FTU establishment by age of 3 years to optimise receptive and expressive language in children with CIs. Consistent device use contributes to the possibility of achieving FTU at a younger age which involves both clinician and family to work together in establishing an early and realistic hearing routine for the child.

Key words: Cochlear Implants (CIs) usage, Full time device use (FTU), Hearing Hour percentage (HHP), paediatric Language outcomes

HEARING CARE IN UNDERSERVED POPULATIONS

241 - Addressing Hearing Health Disparities in Remote Indigenous Communities of Canada: Challenges, Interventions, and Future Directions

Patricia Duchesneau [(1)]
World Wide Hearing Foundation International, Not-for-profit organization, Montréal, Canada [(1)]

Indigenous communities in Canada face disproportionate challenges and disparities in accessing adequate healthcare services. The prevalence of hearing loss in Canada's North is almost three times higher than the rest of Canada[1]. A 2021 study showed that one in five school-aged children in Nunavut had hearing loss that was likely to affect classroom learning[2]. Among the potential causes of hearing loss in Indigenous children, chronic otitis media has been the subject of many studies (e.g., Ayukawa et al., 1997; Baxter, 1999; Tremblay, 1990;). and is reported to be highly prevalent among Canadian Indigenous children.
This abstract highlights the complex interplay of historical, socio-economic, and systemic factors contributing to these disparities. Additionally, it presents World Wide Hearing's initiative to build a community-driven approach that addresses the need for a hearing health strategy tailored to the multiple Canadian Indigenous communities. It highlights our findings and potential avenues for creating a more accessible and equal service to care in Canadian Indigenous communities. **Our Initiative:** World Wide Hearing is an International non-profit organization whose mission is to provide affordable hearing aids and hearing care to people, mainly children and youth, in underserved communities globally. Recognizing the importance of community engagement and culturally sensitive approaches, the organization started working with leaders and service providers in Indigenous communities in 2016. These initiatives encompass community-based screenings, culturally tailored education and outreach programs, training Indigenous healthcare workers in audiology and hearing care, and integrating traditional healing practices with modern healthcare systems. The team has screened over 1,500 children and worked with a dozen Indigenous communities across Canada.
Historical and Socio-economic Context: The historical context of colonization and assimilation policies has had enduring impacts on the health and well-being of Indigenous communities in Canada, including their hearing health. Forced relocation, cultural suppression, and inadequate access to healthcare services have contributed to a myriad of health disparities, including those related to hearing health.
Barriers to Accessing Care**:** Geographical remoteness, limited infrastructure, and staff shortage contribute to barriers to hearing care for Canadian Indigenous communities. Furthermore, cultural beliefs, stigma associated with hearing loss, and mistrust of mainstream healthcare systems often deter individuals from seeking timely interventions. As an illustration of the challenges faced by numerous Indigenous communities in Canada, this abstract will concentrate on a particular region in Northern Canada. Presently, there is a scarcity of healthcare professionals specializing in audiology, with only one full-time pediatric audiologist serving 18,000 children spread out in more than 30 remote communities. Due to limited resources, the audiologist's visits to some communities occur only once or twice annually, resulting in lengthy waitlists for audiological services. Conversely, adults in need of audiological care must travel to distant locations for assistance.
Recognizing the importance of early detection and intervention in mitigating hearing loss and the complications of chronic otitis media, WWH partnered with the audiologist of this region to focus on interventions within schools. This collaboration, which is in its initial stages, will culminate in the presentation of their findings at the HEAL conference following a series of screening campaigns in the spring.
Policy Implications and Future Directions: Policy initiatives addressing hearing health disparities in Indigenous communities should prioritize culturally responsive care, enhance funding for audiological services in underserved areas, and promote interdisciplinary collaborations between healthcare providers, community leaders, and researchers. Moreover, efforts to incorporate Indigenous perspectives into healthcare delivery systems and research agendas are essential for developing sustainable and equitable solutions.

Keywords: hearing screenings, Indigenous children, otitis media

[1] Fitzpatrick EM, McCurdy L, Whittingham J, Rourke R, Nassrallah F, Grandpierre V, Momoli F, Bijelic V. Hearing loss prevalence and hearing health among school-aged children in the Canadian Arctic. Int J Audiol. 2021 Jul;60(7):521-531. doi: 10.1080/14992027.2020.1731616. Epub 2020 Mar 17. PMID: 32180475.

[2] Fitzpatrick EM, McCurdy L, Whittingham J, Rourke R, Nassrallah F, Grandpierre V, Momoli F, Bijelic V. Hearing loss prevalence and hearing health among school-aged children in the Canadian Arctic. Int J Audiol. 2021 Jul;60(7):521-531. doi: 10.1080/14992027.2020.1731616. Epub 2020 Mar 17. PMID: 32180475.

14 - Assessment of Hearing Health Among Adults in Rural Primary Care Clinics

Matthew Bush [(1)] - Mit Patel [(1)] - David Adkins [(1)] - Laura Bellnier [(1)] - Anthony Mahairas [(1)]
University of Kentucky, Otolaryngology - Head and Neck Surgery, Lexington, Kentucky, United States [(1)]

Objective
Hearing loss (HL) negatively impacts all aspects of health, yet poor access to hearing healthcare (HHC) among adults is a pervasive public health problem. The inaccessibility of HHC is amplified in rural adults. Rural primary care clinics (RPCC) are critical healthcare centers tasked with improving health in rural communities and the objective of this study is to assess the prevalence of hearing loss and the utilization of HHC within RPCC.
Methods
Adults were recruited from 10 RPCC throughout rural Kentucky. The primary outcomes were 1) presence of hearing loss on screening and 2) history of an audiogram in the last 1 year/5 years. Additional outcomes included sociodemographic and overall health data (PROMIS-GH). Descriptive and multivariate analyses were conducted.
Results
A total of 388 participants (mean age 49.8) were recruited and 43% had a household income below the poverty line and 10% with less than a high school diploma. A total of 70% of participants screened positive for HL, yet only 3.4% had undergone an audiogram in the past year and 13.4% of participants had undergone an audiogram within the past 5 years. Adults with more than a high school degree (OR 0.58; 95%CI 0.34-0.97) and better self-reported health (OR 0.92; 95%CI 0.89-0.96) had lower odds of HL.
Conclusions
Adults in PRCC have a high prevalence of HL and low utilization of HHC. Promoting and expanding access to HHC in RHCs is promising to improve hearing health among rural adults.

84 - Raising Awareness about Hearing Loss and Early Detection in Regions with Low Screening Coverage

Johanna Reheis [(1)] - Aneesha Pretto [(1)]
MED-EL, Rehabilitation, Innsbruck, Austria [(1)]

Universal newborn hearing screening (UNHS) allows for the early identification of hearing loss in children, and therefore, enables early intervention. As such, successfully implementing UNHS should be the goal of every nation. However, the degree of implementation and coverage of UNHS varies substantially across the world and is closely associated with nations' living standards and economic well-being. Regions with low coverage are confronted with obstacles like poor infrastructure and a shortage of specialists – challenges that are further aggravated by low awareness about the importance of newborn hearing and hearing screenings among the society. In countries where resource limitations do not allow for UNHS, the World Health Organization recommends starting screening programs using selective or targeted (risk factor) screening.

The Hearing Healthcare Alliance (HHA) is committed to improving the diagnosis and rehabilitation of people with hearing loss. In 14 emerging countries in Sub-Saharan Africa and South Asia, the HHA is approaching this challenge through various sustainable projects, including implementing newborn hearing screening programs and the *Hearing Screening Questionnaire*. This low-cost online questionnaire will be available in selected regions without UNHS coverage. It was developed from the Joint Committee on Infant Hearing Questionnaire and includes additional risk-factors unique to the selected countries. The questionnaire aims to:

- raise awareness (via comprehensible infographics and videos) about the importance of newborn hearing, hearing loss, and hearing screening in families of young children
- identify children with high risk for hearing loss and encourage their families to take them for a hearing screening at the nearest screening center

The questionnaire presents easily understandable information in the local language about newborn hearing, hearing loss, and its solutions. Special attention is paid to an intuitive handling and short duration of the questionnaire to increase the acceptance among families and the likelihood of them seeking testing if their child is at risk for hearing loss.
After pretesting and eventually adapting the Hearing Screening Questionnaire in February 2024 it will be trialed in Pakistan. Data will be collected in cooperation with a local hearing healthcare partner to evaluate the effectiveness of this awareness raising campaign in referring at-risk children to nearby hearing screening centers. Additionally, the data will help to determine which factors correlate with high follow-up rates. This should inform further actions in developing newborn hearing screening programs in resource-limited countries.

Keywords: Hearing Screening / Questionnaire / Awareness / Risk Factors / Low-Cost Tool

SCREENING AND EPIDEMIOLOGY (NEWBORNS AND CHILDREN) – (1)

77 - Policy change for extreme premature birth and the effects on neonatal hearing loss

Karin de Graaff-Korf [(1)] - Paula van Dommelen [(2)] - Henrica L.M. van Straaten [(1)] - Paul H. Verkerk [(2)]
Isala, Neonatology, Zwolle, Netherlands [(1)] - The Netherlands Organization for Applied Scientific Research TNO, Child Health, Leiden, Netherlands [(2)]

Objective: In September 2010, the guideline Perinatal Policy for Extreme Premature Birth was implemented in the Netherlands. This guideline announced a change in full neonatal support from 25 weeks and 0 days towards 24 weeks and 0 days gestational age (GA) at birth. This policy contrasted with the 2005 guideline, shifting from "no unless" to "yes unless" starting at 24 weeks and 0 days. Our aim was to evaluate the impact of this policy on hearing loss over consecutive 6-year intervals.
Methods: Results between 2005-2010, 2011-2016 and 2017-2022 of the two-stage automated auditory brainstem response (AABR) screening and diagnostic examination (ABR) in NICUs were extracted from the registration system of the Dutch nationwide NICU neonatal hearing screening program. This registration facilitates screening, tracking and follow-up after abnormal screening results. Newborns with a GA of between 24-31 weeks were selected. GA was truncated to complete weeks (e.g., from 24 weeks and 0-6 days to 24 weeks).
Results: In total, there were 27,297 very premature newborns available, of whom 919 had a gestational age of 24 weeks. The proportion of newborns with a GA of 24 weeks was 1.3% (n=123) between 2005-2010, 4.5% (n=430) between 2011-2016 and 4.3% (n=366) between 2017-2022 ($p<0.001$).The proportions of newborns who survived the admission period at 24 weeks' GA were respectively 43.9% (n=54), 49.3% (n=212) and 50.% (n=183) in the three 6-year intervals (p=0.49). The proportions of neonatal hearing loss in newborns with a GA of 24 weeks were respectively 9.3%, 5.2% and 4.4% in the three 6-year intervals (p=0.37).
Conclusion: The policy shift towards proactive management of newborns born at 24 weeks and 0 days of gestational age increased the proportion of newborns with a 24 weeks' GA. There appears to be a declining trend in the proportion of hearing loss among newborns with a GA of 24 weeks. This might be a result of advancements in medical care, but further research is needed to investigate this.

Keywords: nicu; policy; premature

158 - Spoken expressive vocabulary in 2-year-old children with early detected hearing loss: a community study

Peter Carew [(1)] - Daisy Shepherd [(2)] - Libby Smith [(3)] - Tegan Howell [(3)] - Michelle Lin [(1)] - Edith L. Bavin [(4)] - Sheena Reilly [(5)] - Melissa Wake [(3)] - Valerie Sung [(6)]
The University of Melbourne, Speech Pathology and Audiology, Parkville, Australia [(1)] - Murdoch Children's Research Institute, Clinical Epidemiology and Biostatistics Unit, Parkville, Australia [(2)] - Murdoch Children's Research Institute, Prevention Innovation Research Group, Parkville, Australia [(3)] – La Trobe University, School of Psychological Science and Public Health, Bundoora, Australia [(4)] - Griffith University, Health Group, Gold Coast, Australia [(5)] - Royal Children's Hospital, Centre for Community Child Health, Parkville, Australia [(6)]

Introduction: Despite early detection of congenital hearing loss reducing the median age of congenital hearing loss detection, language outcomes for impacted children remain poorer than normative expectations. When early hearing loss detection becomes routine, this in turn enables exploration of language outcomes on broader groups than those engaged in early intervention programs, and at earlier ages than previously feasible.
Aim: In a large group of 2-year-old children with hearing loss 96% identified via universal newborn hearing screening, we aimed to (1) examine the impact of hearing loss on early spoken expressive vocabulary and (2) investigate how amplification/intervention-related factors impact expressive vocabulary outcomes.
Methodology: We used validated caregiver-reported expressive vocabulary checklists from two longitudinal cohorts representing the same population in Victoria, Australia (302 children with unilateral or bilateral permanent hearing loss, 1742 children without hearing loss). G-computation and multivariable linear regression was used to estimate the impact on spoken expressive vocabulary of hearing loss and amplification/intervention-related factors (amplification device use, age at first amplification, age at first enrolment with early intervention services).
Results: Children with hearing loss at age 2 years had poorer expressive vocabulary scores than children without hearing loss, with mean scores for children with bilateral loss 0.5 (mild) to 0.9 (profound) standard deviations lower than their peers. Marginally lower scores were observed for children with unilateral hearing loss (0.1 to 0.3 standard deviations lower). Early intervention and amplification by 3 months rather than 6 months or older appeared to result in higher expressive vocabulary scores. Overall and despite whole-state systems of early detection and intervention, children with hearing loss demonstrated expressive vocabulary delays at this early age.
Conclusion: Combined, our findings align with calls to achieve a 1-2-3 month timeline for early hearing detection and intervention milestones of screening, identification and intervention.

Keywords: expressive vocabulary, DHH children, early intervention

160 - Language and health-related quality of life outcomes for children with early-detected unilateral and mild bilateral hearing loss

Peter Carew [(1)] - Daisy Shepherd [(2)] - Libby Smith [(3)] - Qi Rui Soh [(3)] - Valerie Sung [(4)]
The University of Melbourne, Speech Pathology and Audiology, Parkville, Australia [(1)] - Murdoch Children's Research Institute, Clinical Epidemiology and Biostatistics Unit, Parkville, Australia [(2)] - Murdoch Children's Research Institute, Prevention Innovation Research Group, Parkville, Australia [(3)] - The Royal Children's Hospital, Centre for Community Child Health, Parkville, Australia [(4)]

Introduction: The outcomes of children early identified with “non-target” hearing losses are understudied when compared to children born with a moderate or greater hearing loss in both ears.
Aim: We aimed to describe the language and health-related quality of life outcomes of children who were early identified with mild bilateral or unilateral permanent hearing loss, including those with auditory neuropathy spectrum disorder, via a population-based databank in Victoria, Australia.
Methods: Participants were children enrolled in a statewide population databank, VicCHILD. Enrolment in this databank is independent of early intervention and amplification decisions. Language and caregiver-reported health-related quality of life outcomes are described by degree and types of loss at three timepoints across childhood: at age 2 years (n=255), 5-7 years (n=173) and 9-12 years (n=45).
Results: For all age groups, average language outcomes were poorer than population norms by a half to two thirds of a standard deviation. Particularly at younger ages, those children with mild bilateral hearing loss demonstrated poorer outcomes than those with unilateral loss. Children with unilateral auditory neuropathy spectrum disorder showed language outcomes comparable to children with profound unilateral sensorineural losses. Health-related quality of life psychosocial scores were poorer than physical scores for children with hearing loss, without an obvious pattern of outcomes linked to degree or type of hearing loss.
Conclusion: Our study demonstrates that from an early age, children with early-detected unilateral or mild bilateral hearing loss have on average poorer language and quality of life outcomes than population normative expectations. These findings represent a contemporary description of outcomes for children with hearing losses identified but not targeted by universal newborn hearing screening. We raise the question of how to provide better support for impacted children and their families.

Keywords: mild hearing loss, unilateral hearing loss, language outcomes, quality of life, DHH children

163 - Emotional Behavioural Outcomes of Children and Families with Unilateral and Mild Hearing Loss

Jun Jean Ong [(1)] - Libby Smith [(2)] - Daisy Shepherd [(3)] - Jessica Xu [(4)] - Gehan Roberst [(5)] - Valerie Sung [(5)]
International Medical University, Department of Paediatrics, School of Medicine, Kuala Lumpur, Malaysia [(1)] - Murdoch Children's Research Institute, Prevention Innovation Research Group, Parkville, Australia [(2)] - Murdoch Children's Research Institute, Clinical Epidemiology and Biostatistics Unit, Parkville, Australia [(3)] - The University of Melbourne, School of Mathematics and Statistics, Parkville, Australia [(4)] - The Royal Children's Hospital, Centre for Community Child Health, Parkville, Australia [(5)]

Background:
High prevalence of emotional/behavioural difficulties are reported among deaf and hard of hearing (DHH) children. However, the prevalence of emotional/behavioural difficulties in children with unilateral and mild HL are not well understood.
Aim:
This study aimed to 1) investigate the emotional/behavioral, health related quality-of-life (HRQoL) and parent psychological distress outcomes of children with unilateral/mild HL, compared to children with moderate to profound HL, and 2) identify predictive factors of emotional/ behavioural difficulties among children with unilateral/mild HL.
Methods:
The Victorian Childhood Hearing Longitudinal Databank (VicCHILD) is a statewide population-based longitudinal databank open to every child with permanent hearing loss (HL) in Victoria, Australia. Data of 339 deaf and hard-of-hearing (DHH) children, aged 5–12 years, enrolled in VicCHILD, between 2012-2022, which include early developmental and medical profiles, parent-reported questionnaires of child's emotion/behavior and HRQoL, and parental psychological distress collected at various stages of child's life were analysed.
Measures:
The Strengths and Difficulties Questionnaire (SDQ) is a parent-rated emotional and behavioural difficulties scale, with 5 subscales, emotional symptoms, conduct, hyperactivityinattention and conduct problems, summed to generate total difficulties and prosocial behaviour scores. The Ages and Stages Questionnaire (ASQ) (≤ 36 months) is a parent-rated early developmental screening with 5 domains, gross and fine motor, problem solving, communication, and social skills. Paediatric Quality of Life Inventory (Peds-QL) is a parent-rated health related quality of life (HRQoL) measure with four domains; physical health, emotional, social and academic functioning. The Kessler Psychological Distress Scale (K6) is a parent self-rated measure of psychological distress.
Analysis:
We used Cohen's d to compare the outcome mean score differences of both DHH groups with published norms; and logistic regression to analyze the predictive factors.
Results:
The proportion of children with unilateral/mild HL and moderate to profound HL experiencing emotional/behavioral difficulties was similar (18.3% vs. 20.6%). Hyperactivity and poor prosocial behavior were reported as the predominant symptoms for both groups. The mean emotion/behavior, HRQoL and parent distress scores of both DHH groups were comparable and substantially higher than normative population scores. Among children with unilateral/mild HL, additional health needs were the strongest predictive factor, demonstrating an approximately 1.7-fold increase in odds of emotional/behavioral difficulties (OR = 1.67; 95% CI 1.29–2.17, $p < 0.001$) with every additional health need.
Conclusion:
DHH children and families experience emotional/behavioral difficulties, irrespective of HL severity/laterality which justifies the provision of early intervention, medical care and support for all DHH children and families.

Keywords: Mild hearing loss, unilateral hearing loss, emotional behavioural difficulties, deaf or hard of hearing, children

238 - ABR-based newborn hearing screening device with integrated and reusable electrodes
Mario Cebulla [(1)] - Ralph Keim [(1)] - Wafaa Shehata-Dieler [(1)]
University Hospital, Otorhinolaryngology, Wuerzburg, Germany [(1)]

With the BERAphone® device the hearing screening of newborns was established at university hospitals in Würzburg in 1997. From the beginning an ABR based method were used for the screening. In 2002 the BERAphone® system was improved by implementing an automatic detection algorithm using click ASSR. Later in 2006 the performance of the screening system could be further boosted by introducing an optimized chirp stimulus. We are using this technique with success in our routine newborn hearing screening. In 2021 we started using the new handheld screening device easyScreen with BERAphone® (MAICO, Germany). Technically, it uses the same stimulus type, level (35 dB HL) and detection algorithm as the MB11 device. The data presented here are hearing screening data collected in 2023 with the easyScreen. During this period, more than 957 healthy newborns were screened on both sides. Compared to the MB11 the detection rate for the automatic ABR was 95.9% with the MB11 and 96.3% with easyScreen with a corresponding referral rate of 4.1% and 3.7%. Both devices work quite fast, the median of the raw detection time (without preparation) was 43s and 48s with MB11 and easyScreen. The statistical comparison showed that detection rates and detections times do not differ significantly between both devices ($p > 0.05$). From our experience, the new easyScreen is a good alternative to the MB11 device and has the advantage of being easier to handle. Both devices are reliable for ABR-based newborn hearing screening and provide results within a very short time with minimal cost of materials, as no disposable electrodes are required for the BERAphone®.

Keywords Newborn hearing screening, auditory brainstem responses, early identification

SCREENING AND EPIDEMIOLOGY (NEWBORNS AND CHILDREN) – (2)

48 - Australian National Child Hearing Health Outcomes Registry (ANCHOR): Innovative solutions for meaningful data collection, storage, and linkage

Valerie Sung [1] - Kayla Elliott [1] - Libby Smith [1] - Rachael Beswick [2] - Lauren McHugh [2] - Melissa Wake [3] - Teresa Ching [4] - Greg Leigh [5] - Patricia Van Buynder [6] - Kelvin Kong [7] - Karolina Kluk [8] - Bonny Parkinson [9] - Daisy Shepherd [10] - Karen Liddle [11] - Claire Iseli [12] - Samantha Harkus [13] - Shani Dettman [14] - Catherine McMahon [15] - Ann Porter [16] - Brett Casey [17] - Helen Lees [18] - Kirsty Gardner-Berry [5] - Zeffie Poulakis [19]

Murdoch Children's Institute, Prevention Innovation, Melbourne, Australia [1] - Children's Health Queensland Hospital and Health Service, Healthy Hearing Program, South Brisbane, Australia [2] - Murdoch Children's Institute, GenV, Melbourne, Australia [3] - Macquarie University, Macquarie School of Education, Sydney, Australia [4] - NextSense Institute, NextSense, Sydney, Australia [5] - Hearing Australia, Principal Audiologist Paediatric Services, Sydney, Australia [6] - University of Newcastle, School of Medicine and Public Health, Newcastle, Australia [7] - The University of Manchester, Manchester Centre for Audiology and Deafness, Manchester, United Kingdom [8] - Macquarie University, Macquarie University Centre for the Health Economy, Sydney, Australia [9] - Murdoch Children's Institute, Clinical Epidemiology & Biostatistics, Melbourne, Australia [10] - Children's Health Queensland Hospital and Health Service, Child Development Program, South Brisbane, Australia [11] - The Royal Children's Hospital, Otolaryngology Department, Melbourne, Australia [12] - National Acoustic Laboratories, Aboriginal and Torres Strait Islander program, Sydney, Australia [13] - The University of Melbourne, Department of Audiology and Speech Pathology, Melbourne, Australia [14] - Macquarie University, Department of Linguistics, Sydney, Australia [15] - Aussie Deaf Kids, Founder and Chief Executive Officer, Sydney, Australia [16] - Deaf Connect Australia, Chief Executive Officer, Brisbane, Australia [17] - Municipal Association of Victoria, Maternal and Child Health, Melbourne, Australia [18] - The Royal Children's Hospital, Victorian Infant Hearing Screening Program, Melbourne, Australia [19]

Bringing together expertise in child hearing health, education, living/lived experience and research, a collaboration was established with the aim of developing the Australian National Child Hearing Health Outcomes Registry (ANCHOR). To date ANCHOR has consulted nation-wide with 47 organisations involved in child hearing health, and will be engaging deaf and hard of hearing (DHH) young people/children and their families to help achieve ANCHOR's aims. With three years of funding from NHMRC, the ANCHOR project will (1) scope Australia's child hearing services and datasets through online questionnaires and meetings; (2) Bring datasets from two Australian states (Victoria and Queensland) into a single system as the prototype; (3) Develop a Core Outcomes Set, through focus groups, interviews, e-delphi surveys and consensus meetings, to measure what matters to DHH children and young people, families, services and funders; and (4) Evaluate the cost and benefit of developing and maintaining ANCHOR. This talk will raise awareness of the ANCHOR project, what work has been established in the first year of funding and demonstrate next steps including how families and professionals can be involved as we work towards a database that links child hearing health data from across Australia. ANCHOR's ultimate vision is to provide a national child evidence base for future hearing policies, service delivery models and supports; a mechanism for improved models of service delivery and equity of access; a pathway to national reporting for educational outcomes; and a national platform to facilitate population-based research for DHH children. Overall, information gathered in this project will help us to better understand whether a database could facilitate data linkage across all of Australia's child hearing health services, and ensure service providers will collect information that is meaningful and useful to DHH children/young people and their families and child hearing stakeholders and policy-makers.

Keywords: Child hearing health; National registry; Deaf and hard of hearing children and young people; Collaboration.

205 - Benefit of using data from the NHS Newborn Hearing Screening Programme national IT system in England to inform screening outcomes and audiology quality improvement initiatives

Hannah Garnett [(1)] - Michael Wilding [(2)] - Catherine Magee [(1)] - Jane Hibbert [(1)]
NHS England, Vaccinations and Screening, London, United Kingdom [(1)] - NHS England, Vaccinations and Screening, Southampton, United Kingdom [(2)]

Positive predictive value (PPV) is the probability that following a positive screen result, the individual will truly have the disease being screened for, in this case Permanent Childhood Hearing Impairment (PCHI). There is a mathematical relationship between PPV, referral rate in the population and the identified rate of the outcome in the tested population. This relationship allows for comparison of behaviours between providers where the number of tests, the number referred and the number of confirmed cases of the condition are recorded.
It is possible to plot onto a chart of PPV and screen referral rate, a line showing what a specific rate of the condition would be at any point. When service level PPV's and referral rates are added to this base plot, variations along each 'rate of condition line' become visible and can be explored.
This visualisation was applied to data for babies immediately referred from the newborn hearing screen. Data was extracted from the NHS Newborn Hearing Screening Programme (NHSP) national IT system, for a 3-year period to determine if any of the 108 screening sites in England had an unusual pattern of referral rate, PPV and/or rate of PCHI. Adding the England rate and standard deviation to the chart showed there were some services unexpectedly outside the normal spread of data.
So that the variations of the data using this visualisation can be compared the following assumptions were made:

1. The data records for the numbers tested, referred, and identified with the condition are complete in the system
2. The processing of the data has not altered the numbers due to an error in the steps
3. The rate of the condition in each sub-group is similar to the rate for the whole population
4. The distribution of the rates of the condition across sites is Normal

Where differences occurred across services these could be investigated to identify areas of weakness or good practice. Differences could be explained as simply as data recording issues or, where referral thresholds fell outside agreed guidance; inexperienced staff, highlighting training requirements, lack of quality assurance or unfamiliarity with equipment. Equally the difference may represent more worrying issues such as inequalities in access, ineffective diagnostic services, or environmental factors affecting the rate of a condition in the population. The analysis cannot identify these but can assist in identifying outliers that can be targeted and investigated further to assure the quality of the service.
Presenting data in this format is an innovative approach for the screening programmes in England.
The data analysis of PPV was the basis for an initial review of these outlying services which led to the uncovering of widespread issues in paediatric audiology services and has subsequently resulted in establishment of a specific programme of work around improving Hearing Services to prevent any further harm to children in England.
This paper describes the benefits of having a national IT system to enable the review of outcomes from the screening programme and the ability to use variations to help identify concerns about the quality of diagnostic audiology for babies referred from the newborn hearing screen and inform quality improvement initiatives in paediatric audiology.

Keywords: Outcomes, data, screen, quality, paediatric audiology, yield, PPV

207 - The impact and challenges of health inequalities related to deprivation or ethnicity on the delivery of newborn hearing screening programmes and the influence these factors may have on the incidence of permanent childhood hearing impairment

Michael Wilding [(1)] - Hannah Garnett [(2)] - Jane Hibbert [(2)] - Catherine Magee [(1)]
NHS England, Vaccinations and Screening, London, United Kingdom [(1)] - NHS England, Vaccinations and Screening, Southampton, United Kingdom [(2)]

Introduction The newborn hearing screening programme (NHSP) for England was fully implemented by the National Health Service by March 2006. The aim of NHSP is to identify cases of congenital moderate to profound permanent childhood hearing impairment (PCHI) as early as possible by offering the hearing screen within the first 4 weeks of life.
NHSP commissions a national IT system, SMaRT4Hearing (S4H), which enables management of all babies eligible to be screened in England through the screening and audiological assessment process and provides data for audit and service development. Detailed information about each baby is stored securely and specified NHS England staff can access anonymised data in line with data protection regulations.
Demographic information is part of the detailed information, including location of the current address for the baby, ethnicity recorded at birth, whether the baby required neonatal intensive care (NICU) support. Recently the IT system was updated to include further details about geographical locations for the address for the baby, including the lower super output area (LSOA). This allowed data in the IT system to be easily linked to the index of multiple deprivation for the LSOA of residence for the baby.
NHSP analysed data from S4H for a 5-year period to identify any patterns in deprivation or ethnicity that might indicate health inequalities, challenges to programme delivery or area of scientific interest.
Method Records for all babies eligible for screening from 1 April 2018 to 31 March 2023 were extracted from S4H and summarised by several demographic categories. Data was visualised and analysed using statistical regression models to test for significant differences.
Results The analysis is incomplete at the time of preparing this abstract. However, initial observations include:

1. There appears to be a small, possibly significant, reduction in coverage in the most deprived 20% of LSOAs compared to the rest of England
2. Referral rates do not appear to be affected significantly by deprivation, but the black ethnic group do appear to have a significantly increase referral rate from the screen to audiology (following AABR) compared to the White British population. This raised referral rate does not lead to a significantly different PCHI rate though.
3. The Asian Pakistani and Bangladeshi groups have a significantly raised PCHI rate in the population examined, compared to the White British population.

Limitations This work is limited by the completeness and accuracy of the data present in the IT system. Particularly data entered for PCHIs by audiology departments can be incomplete or inaccurate. Ethnicity in the IT system is the value recorded at the time of birth and may not always be accurate.
Future work NHSP intend to continue to complete this analysis, improving and confirming initial findings. In addition, we would like to extend this work to cover other aspects of interest, such as whether severity of hearing loss can be included in the models. In practical terms we hope that this information will be of use to sites delivering screening, helping them to understand how their local population might be affected at different stages of the screening pathway.
This paper describes how patterns in deprivation or ethnicity might indicate health inequalities and the challenges that may bring to programme delivery or area of scientific interest, such as the influence these factors may have on the incidence of permanent childhood hearing impairment.

Keywords: Deprivation, inequalities, ethnicity, screening, outcomes, data, hearing loss

237 - Hearing Screening for congenital CytoMegaloVirus – exploring parents experiences of completing targeted congenital cytomegalovirus screening at the time of their infant's newborn hearing screening

Emma Webb [(1)] - Jan Hodgson [(1)] - Alanna Gillespie [(2)] - Cheryl Jones [(3)] - Zeffie Poulakis [(4)] - Janis Wong [(1)] - Valerie Sung [(2)]
University of Melbourne, Department of Paediatrics, Melbourne, Australia [(1)] - Murdoch Children's Research Institute, Prevention and Innovation, Melbourne, Australia [(2)] - University of Sydney, Faculty of Medicine and Health, Sydney, Australia [(3)] - Royal Children's Hospital, Psychology, Melbourne, Australia [(4)]

Background**:** Congenital cytomegalovirus (cCMV) is the leading infectious cause of sensorineural hearing loss and other permanent disability in infants and children. Recent evidence suggests treating cCMV with antiviral treatment within one month of an affected baby's birth may be beneficial to preventing progression or development of hearing loss. Diagnosing cCMV accurately requires early screening for the virus within 21 days of life. There has been little research into the acceptability and feasibility of targeted screening for cCMV in a timely manner in the postnatal period. Whilst screening programmes allow early identification and treatment, there are potential burdens including psychological distress to families. To ensure the success of targeted cCMV screening, it is essential to ascertain parental perspectives and experiences before implementation.
Method**:** Semi-structured interviews with parents of infants who underwent cCMV salivary screening at the time their infant received a second positive 'refer' result on their Newborn Hearing Screening (NHS) result.
Results/Aims: Our aim was to investigate the parental perspectives and acceptability of additional salivary cCMV screening at the time of the second positive ('refer') on the NHS result. 18 parents participated in the semi-structured interviews. We identified several themes relating to parental experiences of targeted cCMV screening, including: parents lacked awareness around CMV prior to cCMV screening, parents had an overall positive experience completing the cCMV screening, parental understanding of CMV post cCMV screening varied and parents were glad they were able to screen their infant for cCMV. We also identified enablers such as the swab being simple and non-invasive, and barriers such as false positives possibly leading to an initial increase in anxiety.
Conclusions**:** This comprehensive understanding of parental experiences and factors facilitating successful delivery of cCMV targeted screening provides evidence of the benefits of implementing routine targeted cCMV screening into an established NHS program.

Keywords: Congenital cytomegalovirus, universal newborn hearing screening, targeted screening, parental experiences

100 - Establishment of the Norwegian Hearing Register for Children

Tone Stokkereit Mattsson [(1)] - Siri Wennberg [(1)] - Ann Helen Nilsen [(1)]
St. Olav's University Hospital, Department of Medical Quality Registries, Trondheim, Norway [(1)]

The Norwegian Directorate of Health approved the Norwegian Hearing Register for Children (NHRC) in 2022. A register secretariat and an electronic medical registration system (MRS5) was established at St Olav's Hospital, Trondheim University Hospital.
The register was officially launched in January 2023, and by 2024, all hospitals were including children. Registration is performed at the ear, nose and throat departments. The register is based on reservation. Information material have been prepared such as patient information about privacy and reservation rights, user manuals for registration and patient responses. This material is available on the register's website. Registration in NHRC is mandatory for health professionals in the specialist health care in Norway.
The main objective of the register is to improve the quality of treatment for children with permanent hearing loss and equalize geographical differences. Inclusion criteria are children who do not pass universal Newborn Hearing Screening (NHS) and/or children with permanent hearing loss < 18 years of age. Hearing loss is defined as pure-tone audiometric threshold of (PTA4) > 20dB in at least one ear.
Data are registered at inclusion and at follow-ups at the age of 3, 6, 10 and 15 years. The register collects information about the child within a holistically perspective. The key elements of the register are a) data concerning NHS such as methods used and results, time of testing and referrals to ear and waiting time; b) data concerning hearing, medical information, hearing amplification and rehabilitation; c) patient reported outcome measures (PROM) registered by caregivers using three questionnaires; Pediatric Quality of live Inventory (PedsQL), Strengths and difficulties questionnaires (SDQ) and Parents' Evaluation of Aural/Oral Performance of Children (PEACH).
The register has established four quality indicators regarding NHS a) the rate of true positive neonatal screens; b) testing for congenital cytomegalovirus (cCMV) within 3 weeks of age for children who do not pass NHS; c) audiologic testing within 4 weeks of age for children who do not pass NHS; c) audiologic evaluation to confirm the hearing status no later than 3 months of age and d) early intervention before 6 months of age.
The quality indicator cCMV was chosen because cCMV has a larger impact than previously recognized being the most common cause of non-hereditary sensorineural hearing loss in children. In Norway, a selective cCMV screening is performed within 3 weeks of age in newborns who do not pass the NHS. The results of the screening are registered in the NHRC, and will provide a unique source for research on cCMV; its cause in the role for progressive hearing loss and need for intervention.
NHRC will include the total population of hearing impaired children over long time periods. Thus, data from the NHRC will be a unique source for research, and study designs with a long follow-up time can be applied. In addition, the register enables each hospital to monitor their quality indicator scores continuously and compare them with national levels in real time. This facilitates and accelerate identification of improvement areas in the hospitals and will be an important contributor for quality improvement in NHS, diagnostics and hearing intervention for children in Norway.

Key words: National medical quality register, Newborn Hearing Screening, hearing loss, Cytomegalovirus, Patient reported outcome measures

277 - Neonatal hearing screening in Uzbekistan: preliminary results of the pilot program

F.I. Inoyatova [(1)] - N.Sh. Nadjimutdinova [(2)] - A.A. Abdukayumov [(2)] - M.U. Mahmudov [(2)] - V. Primako [(2)]
Head of program of Rehabilitation for children with hearing loss, Tashkent, Uzbekistan [(1)] - Republican Specialized Scientific Practice Medical Center of Pediatrics, Tashkent, Uzbekistan [(2)]

The Impact of Hearing Impairment and Early Diagnosis in Children Hearing impairment can have a profound impact on a child's speech, intellectual, social, and emotional development. Early diagnosis of hearing loss in children is possible only through universal neonatal screening. In Uzbekistan, the average age of detection of congenital hearing loss was alarmingly high at 3.5 years and older, while the age of children candidates for cochlear implantation was 4.3 years. The need for universal hearing screening is a requirement of the modern social policy of the state. The efficiency and cost-benefit for healthcare will be evaluated in a pilot project on newborn hearing screening in Uzbekistan, conducted in the city of Tashkent.
Materials and Methods: Hearing screening was performed on 104,770 newborns in 2021-2022 in Tashkent. The protocol included transient evoked otoacoustic emission (TEOAE), automatic auditory brainstem response (AABR), or a combination of OAE and AABR. In 2021, a two-stage screening protocol was introduced: the first stage involved TEOAE in maternity complexes, and in cases of failure, combined screening (TEOAE and AABR) was conducted. The second stage, at the pediatrics center, involved monitoring, tracking, and conducting an extended hearing test with consultation from deaf teachers and a psychoneurologist, accompanied by CT and MRI research. In 2022, the protocol was modified to a three-stage screening protocol: the first stage involved TEOAE in maternity complexes, the second stage involved TEOAE with AABR in the regional center conducted by an audiologist, and the third stage, at the pediatrics center, involved extended complex hearing tests with consultation from deaf teachers and a psychoneurologist, as well as CT and MRI examinations to determine the degree and form of hearing loss, and treatment management.
Results: The results for 2021 showed that screening coverage was 80.7%. At the first stage of the protocol, normal hearing was observed in 72.9%, errors were as high as 26.9%, and the test failed (indicating hearing pathology) in 0.13% of cases. The results of 2022 showed improved screening coverage of 88.4%. At the first stage of the protocol, normal hearing was observed in 88.9%, errors were 10.8%, and the test failed (indicating hearing pathology) in 0.21% of cases. A notable aspect of 2021 was that at the first stage, a combined screening system (OAE plus AABR) was introduced in case of a fail result. However, this combined screening was completed in only 3 cases, while in other cases, the newborn was sent to the second stage. In 2022, the protocol was modified such that at the first stage, combined screening was advised in case of a fail result, and a triple repetition of the OAE check was recommended.
Discussion: For Uzbekistan, the introduction of a three-stage newborn hearing screening system proved to be more effective and yielded better results and control over the first stage, with higher coverage and lower costs. Despite the higher sensitivity and specificity of AABR, its introduction at the first stage was deemed inappropriate, as this would increase the cost of screening and lengthen the time of the first stage. Furthermore, the inclusion of the second stage at the regional level will enable monitoring of the work of regional services for registering children with hearing pathology and maintaining them in the rehabilitation stage.

Keywords: screening programs, hearing, newborn

EDUCATIONAL DEVELOPMENT IN CHILDREN

188 - A multi-sample comparison and Rasch analysis of the Evaluation of Children's Listening and Processing Skills questionnaire

Sam Denys [1] - Johanna Barry [2] - David R. Moore [3] - Nicolas Verhaert [1] - Astrid van Wieringen [4]
UZ/KU Leuven, Otorhinolaryngology - Head and Neck Surgery / Neurosciences - ExpORL, Leuven, Belgium [1] - Nottingham University Hospitals, NHS trust, Nottingham, United Kingdom [2] - Cincinnati Children's Hospital Medical Center, Communication Sciences Research Center, Cincinnati, United States [3] - KU Leuven, Neurosciences - ExpORL, Leuven, Belgium [4]

Assessing listening difficulties (LiD) and associated complaints can be challenging. The range and nature of observed or experienced difficulties might be better captured using a qualitative measure. The Evaluation of Children's Listening and Processing Skills (ECLiPS) questionnaire was designed to broadly profile the auditory and cognitive problems often present in children with LiD. This 38-item questionnaire was initially standardized in British children aged 6-11 years, was subsequently modified for use with North American children, and was recently translated to Flemish-Dutch. This study aimed to compare typical scores of the Flemish version with the UK and US versions, and to evaluate and compare its psychometric quality using Rasch analysis.
We recruited 112 Flemish children aged 6-11 years with verified normal hearing and typical development, and asked two caregivers of every child to fill out the ECLiPS. Data from two comparator samples were analyzed, including responses for 71 North-American children and 650 British children. Typical values for ECLiPS factor and aggregate scores were determined as a function of age and gender, and meaningful differences across samples were assessed. Rasch analyses were performed to evaluate whether ECLiPS response categories work as intended, and whether item scores fit a linear equal interval measurement scale that works the same way for everyone. Item and person metrics were derived, including fit, separation and reliability indices. We investigated whether items function similarly across linguistically and culturally different samples.
ECLiPS scores were found to be relatively invariant to age. Girls obtained higher scores compared to boys, mainly for items related to memory and attention, and pragmatic and social skills. Across ECLiPS versions, the most pronounced differences were observed for items probing social skills.
With respect to its psychometric quality, ECLiPS response categories work as intended, and ECLiPS items fit the Rasch measurement scale. Cultural differences in responses were noted for some items, belonging to different factors. Item separation and reliability indices generally pointed towards sufficient variation in item difficulty. In general, person separation (and reliability) metrics, quantifying the instrument's ability to distinguish between poor and strong performers (in a reproducible manner), were low. This is expected from samples of typically developing children with homogeneous and high levels of listening ability.
In sum, the ECLiPS caregiver questionnaire was verified to be a psychometrically valid qualitative measure to assess listening and processing skills, which can be used to support the assessment and management of elementary school children referred with LiD. Prior to clinical use, for future translated versions of the scale, it is advisable to collect typical values and evaluate gender-based differences.

26 - Classroom design and its effect on academic development in children with listening in noise and attention deficits

Gary Rance [(1)] - Dani Tomlin [(1)]
The University of Melbourne, Audiology & Speech Pathology, Melbourne, Australia [(1)]

Background**:** A child's learning environment can affect health, wellbeing and educational development. This is particularly the case for students with hearing or auditory processing deficits. In this study we explored the effect of school classroom setting on academic progress in 7-10 year old students comparing reading development in "open-plan" (multiple class groups located within one physical space) and "enclosed-plan" (one class group per space) environments.
Methods**:** All learning conditions (class group, teaching personnel etc) were held constant throughout the study, while the physical classroom environment was alternated term-by-term using a portable, sound-treated dividing wall. One hundred and ninety-six students underwent auditory, cognitive and academic assessment at baseline. One hundred and forty-six of these were available for repeat assessment at the completion of 3 x 10 week school terms, allowing within-child changes across an academic year to be calculated.
Results**:** Reading fluency development (change in words read-per-minute) was greater for the enclosed-classroom phases ($P<0.001$; 95%CI 3.7, 10.0) and the children who showed the greatest condition difference (ie slower rate of reading development in the open-plan phases) were those with the poorest speech perception in noise ($F=4.92$, $P<0.05$) and/or weakest attention skills ($F=10.52$, $P<0.01$).
Conclusions**:** These findings highlight the significant role classroom setting plays in the academic development of young students - particularly those with functional hearing and/or attention difficulties.

Keywords: Classroom environment, literacy, listening-in-noise, attention

137 - Development of binaural temporal fine structure sensitivity in children with developmental dyslexia and age matched typical readers

Sheila Flanagan [(1)] - Brian Moore [(1)] - Anji Wilson [(1)] - Fiona Gabrielczyk [(1)] - Kanad Mandke [(1)] - Usha Goswami [(1)]
University of Cambridge, Psychology, Cambridge, United Kingdom [(1)]

Background: The human auditory system is known to continue developing into the early teenage years. Accordingly, speech-in-noise perception is known to mature over the first 10 – 12 years of life. In this age range, children with language and/or difficulties in learning to read and spell, i.e. developmental dyslexia, have been reported to experience poor speech-in-noise perception compared with age matched controls. However, the underlying aetiology for this finding is debated. One sensory factor characterising many children with developmental dyslexia is auditory processing difficulties, a key factor underpinning the core cognitive "phonological deficit" phenotype found in dyslexia across languages. In auditory processing, speech has typically been characterised by the amplitude envelope (ENV) i.e., changes in the amplitude contour, and the temporal fine structure (TFS), that is, the changes in the frequency content. The ENV of speech carries the speech information, whereas the TFS not only encodes the speech information but has been found to aid speech intelligibility in background sounds. The Temporal Sampling theory of developmental dyslexia (TS) predicts that it is the low frequency ENV modulations found in speech which is implicated in the phonological difficulties in developmental dyslexia, conversely the TFS is not.
Sensitivity to differences in the TFS across ears, i.e. binaural TFS (bTFS), is known to be beneficial for attending to sound sources in challenging sound environments such as noisy classrooms. This may be attributed to Spatial Release from Masking (SRM), i.e. the spatial and perceptual separation of signal from interfering sounds. For adults this enhances speech intelligibility by 6 - 7 dB. For young normal-hearing adults (YHNA), the upper frequency limit of bTFS sensitivity is known to be around 1400 Hz, with higher thresholds associated with larger phase differences up to a maximum inter-aural phase difference of 150-180 degrees. In contrast, recent research found the upper frequency limit of bTFS sensitivity to be significantly lower (worse) for typically-developing children with age being a significant predictor of the upper frequency limit. Thresholds for a phase difference of 180 degrees was predicted to reach equivalent YHNA levels in excess of 10 years of age. A phase by frequency interaction showed 30 degrees was significantly harder for children than YNHA. If bTFS sensitivity contributes to impaired speech-in-noise perception in developmental dyslexia (DYS), poorer bTFS sensitivity would be expected in DYS. In contrast to this, the TS theory of developmental dyslexia predicts that the perception of bTFS of speech may be preserved in children with dyslexia.
Research questions: 1. What range of bTFS frequencies are typical primary school aged children sensitive to? 2. Do children with developmental dyslexia have a smaller range of bTFS sensitivity than age matched control children?
Methods: Binaural TFS sensitivity was measured here utilising the Temporal Fine Structure-Adaptive Frequency task with 88 children aged 7-9.5 years (30 age-matched (CA), 20 male and 58 DYS , 31 male). Using an adaptive 2-up-1-down paradigm, the highest frequency at which interaural phase differences (IPD) at two levels of difficulty, (phases = 30 and 180 degrees) could be distinguished from an IPD of 0 degrees was assessed. The starting frequency was 200 Hz. Frequency increased by fixed factors until 8 reversals, or 40 trials had occurred. Frequency thresholds were calculated from the geometric mean of the last 4 reversals.
Results: A Linear Mixed Effects model was fitted to the log-transformed data with independent variables Group (CA, DYS) and Phase (180 degrees, 30 degrees). A Satterthwaite's ANOVA revealed no effect of group (F[1,44] = 0.18, p = .68). There was a significant effect of phase, with thresholds for 30 degrees lower than for 180 degrees (F[1,44] = 214.83, p< .001) for both levels of group tested. There was no frequency by group interaction (F[1,44] = 0.04, p = .84).
Discussion and Conclusions: These results suggest that development of bTFS sensitivity is similar for age matched DYS and CA children. Hence, the developmental pattern of bTFS sensitivity was supported. A smaller frequency range of bTFS sensitivity may limit the benefit gained from SRM contributing to the known speech-in-noise deficit found in children compared with adults. However, bTFS sensitivity was not found to be more impaired in DYS, supporting TS theory.

Keywords: Binaural Temporal Fine Structure, Development, Speech-in-Noise, Dyslexia, Children.

SPEECH PERCEPTION / DISCRIMINATION (2)

181 - Mapping audio-visual responses to speech in the awake infant brain using whole-head high-density diffuse optical tomography

Liam Collins-Jones [1] - Louisa Gossé [2] - Borja Blanco [3] - Chiara Bulgarelli [2] - Maheen Siddiqui [2] - Ernesto Vidal-Rosas [4] - Nida Duobaitė [4] - Reuben Nixon-Hill [4] - Greg Smith [4] - James Skipper [4] - Tim Sargent [4] - Samuel Powell [4] - Nicholas Everdell [4] - Emily Jones [2] - Robert Cooper [5]
University of Cambridge, Clinical Neurosciences, Cambridge, United Kingdom [1] - Birkbeck University of London, Centre for Brain and Cognitive Development, London, United Kingdom [2] - University of Cambridge, Psychology, Cambridge, United Kingdom [3] - Gowerlabs, Ltd., London, United Kingdom [4] - University College London, Medical Physics and Biomedical Engineering, London, United Kingdom [5]

Background: The first year of life is a critical time of neuroplasticity and cortical specialisation to speech, but current brain imaging methods limit the range of environments in which the brain of awake infants can be studied. High-density diffuse optical tomography (HD-DOT) is an optical neuroimaging method that maps changes in cortical haemoglobin concentration, which is a marker of functional activation. HD-DOT uses near-infrared light to sample brain activity from optical sources and detectors placed on the scalp surface. HD-DOT is motion-tolerant and portable, allowing the awake infant brain to be studied in ecologically-valid settings.
Aim: We aimed to map cortical responses to audio-visual speech and non-speech stimuli in awake infants.
Methods: In this work, we applied whole-head HD-DOT, a new technological development capable of sampling activity across the widest possible field-of-view of the cortical surface accessible from the scalp. Whole-head HD-DOT data were collected from infants aged 5- to 7-months with typical hearing (N=24) during the presentation of a screen-based block paradigm. The paradigm consisted of two experimental conditions: a speech condition, where full-colour clips 9-12s in length of actors reciting nursery rhymes were presented with a matched audio component; and a non-speech condition, where full-colour clips 9-12s in length of moving toys were presented with a matched audio component. Trials of the speech and non-speech conditions were presented in a pseudorandom order, where a trial of a baseline condition (12-14.5s silent clips of alternating still images of modes of transport) was presented between consecutive experimental condition trials. Optical data were reconstructed to produce a three-dimensional time-series of images for each individual mapping changes in cortical oxy-haemoglobin concentration. Using a general linear model approach, a design matrix was computed whereby the onsets and offsets of each experimental condition were convolved with a canonical haemodynamic response function, and beta weights for each experimental condition were computed. At the group-level, one sample t-tests were performed for the beta weights in each voxel of the resulting images. Note: an increase in oxy-haemoglobin concentration is a hallmark of a functional brain activation.
Results: For both experimental conditions, statistically significant increases in beta weights ($p < 0.05$, false discovery rate corrected) were found in bilateral temporal areas, spanning from the superior temporal sulcus to the temporoparietal junction, with the superior temporal gyrus response being right-lateralised for the speech condition. Significant responses were also seen in the posterior occipital cortex in both conditions, with activity extending further laterally for the non-speech condition. A response in the medial frontal gyrus was present for the speech condition, while a larger response in the inferior frontal gyrus bilaterally was seen for the non-speech condition.
Conclusion: In this work, we have corroborated findings from previous research on infant brain responses to audio-visual social cues, and we have also mapped activity outside the temporal areas typically sampled in optical neuroimaging research of infant speech perception. In future, the application of whole-head HD-DOT will open new opportunities to map activity in the awake infant brain in a multitude of research contexts outside conventional scanning environments to better understand early cortical specialisation to speech and audio-visual integration.

Declaration of competing interests: This work involves the application of a prototype technology developed by Gowerlabs Ltd., a company to which certain authors (identified in the affiliation list) are affiliated.

Keywords: imaging, infants, speech perception

196 - The role of periodicity in speech-on-speech understanding in normal-hearing and hearing-impaired listeners

Paolo Mesiano [(1)] - Hamish Innes-Brown [(1)] - Tobias May [(2)] - Johannes Zaar [(1)]
Eriksholm Research Centre, Snekkersten, Denmark [(1)] - Technical University of Denmark, Hearing Systems, Kongens Lyngby, Denmark [(2)]

Understanding speech in the presence of one or multiple competing talkers is a challenging auditory task that occurs often in daily life. While normal-hearing (NH) listeners can perform this task successfully, older hearing-impaired (HI) listeners often encounter severe difficulties in understanding speech in the presence of competing talkers. The periodicity information of the competing speech signals, which is connected to the characteristics of their fundamental frequency, can provide useful auditory cues for segregating the target speech from the interfering speech. However, it is unclear how hearing deficits influence the availability of such periodicity cues. This study investigated how periodicity information in target and interfering speech contributes to speech intelligibility in young NH and older HI listeners.
12 NH and 30 HI listeners participated in a two-competing-voices experiment. In the experimental stimuli, the periodicity information of target and/or masker signals was either fully available (natural speech) or removed using noise vocoding (vocoded speech). Additionally, speech intelligibility in quiet was measured as a reference condition. The stimuli were presented through two frontal loudspeakers (one for each competing signal). HI listeners were provided with linear-gain amplification.
In quiet, NH and HI listeners showed high speech intelligibility scores for both natural and vocoded speech. In the masked conditions, NH listeners performed best when natural speech was masked by natural speech. Vocoding the target or the masking speech separately did not affect intelligibility significantly, but vocoding both target and masker produced the lowest speech reception thresholds (SRTs) overall. For HI listeners, speech intelligibility was correlated with pure-tone average (PTA) hearing threshold and the audible contrast threshold (ACT). Compared to NH listeners, HI listeners showed higher SRTs and larger variability at the individual level. Vocoding the masker did not affect speech intelligibility significantly when the target was natural speech. In contrast, vocoding the target worsened speech intelligibility even in presence of a natural-speech masker, and the highest SRTs were measured when target and masker signals were both vocoded.
The obtained findings suggest that (i) the severity of hearing loss is a predictor of speech-on-speech understanding, (ii) NH listeners are challenged only when the periodicity information is removed from both target and masker signals and (iii) HI listeners rely mostly on the periodicity information in the target speech and cannot utilize periodicity information in the masker when the target is vocoded. Further research may be directed at exploring potential strategies for enhancing the relevant periodicity information to improve speech intelligibility for HI listeners.

Keywords: Speech intelligibility, Competing voices, Periodicity

243 - Can the Digit in Noise Test Extend Beyond Hearing Screening to Clinically Measure Speech Intelligibility?

Lena L. N. Wong [(1)] - Shangqiguo Wang [(1)]
The University of Hong Kong, Education Faculty, Hong Kong, Hong Kong [(1)]

Background:
Over the past two decades, the Digit in Noise test (DIN), originally developed by Smits et al. in 2004 has been globally recognized for its role in hearing screening, with implementations in over 20 languages across various digital platforms including telephones, laptops, tablets, and smartphones. Despite its being a fast, simple, and reliable test applicable across a broad demographic—from children with normal hearing to older adults with hearing loss, including cochlear implant (CI) users—its application beyond hearing screening remains limited. Recently, the integrated DIN (iDIN), utilizing 2- to 5-digit sequences as test material, has been developed to broaden its applicability. This study aims to investigate the potential of the iDIN in speech intelligibility measurement, beyond mere hearing screening.
Method:
This investigation comprised three studies.
Study 1 was designed to assess the performance of the iDIN as a tool for evaluating speech perception in noise among older hearing aid users. This segment involved a cohort of 80 participants, all older adults with moderate to severe hearing loss. They were evaluated using the iDIN test, along with established sentence-in-noise tests, that is, the Mandarin Hearing in Noise Test (MHINT) and the Mandarin Chinese Matrix (CMNmatrix) Sentence Test, as well as working memory tests including the Reading Span Test and the Digit Span Test.
Studies 2 and 3, were aimed at examining the effects of dialect and accent on iDIN test outcomes among young adults with normal hearing. A total of 72 individuals participated. Specifically, Study 2 focused on dialect exposure by including 33 participants who were native speakers of both Mandarin and another Chinese dialect within the Wu language group, with the exception of the Ningboese dialect. These individuals were tested using the iDIN in both Ningboese and Mandarin, the latter serving as a reference condition. Study 3 shifted the focus to accentual variations, enrolling 39 native speakers of both Mandarin and Ningboese. Within this group, 19 individuals spoke standard Ningboese, while 20 used an accented variant. Testing for these participants was conducted in both Mandarin and standard Ningboese under fixed signal-to-noise ratios (SNRs) and adaptive measurement procedures.
Results:
In study 1, all participants were able to complete working memory tests and the iDIN but only 56 were able to complete sentence-in-noise tests, and their iDIN SRTs (2- to 5-digit sequences) correlated highly (r = .66 to .73) with sentence-in-noise test results. Reading span and 2-digit SRT were significant predictors for sentence-in-noise perception, notably for matrix-type sentences. 2-digit SRT and the difference in SRT between 2- and 5-digits (SRT5-2) accounted for 57.9% and 61.3% of the variance in MHINT and CMNmatrix SRTs, respectively. When the 2-digit SRT is replaced with the 3-digit SRT, these models yield similar results. The 2-digit SRT (sensitivity: 0.818; specificity: 0.895) and 3-digit SRT (sensitivity: 0.818; specificity: 0.860) accurately distinguished participants who were able to complete sentence-in-noise tests. In Study 2, the analysis revealed statistically significant differences between Mandarin and Ningboese iDIN results in all but the 2-digit condition. Study 3 indicated no significant difference in 3-digit SRTs between standard and accented Ningbonese speakers and significant difference in 5-digit SRT.
Conclusion:
The study highlights the utility of short digit sequences in iDIN (e.g., 2- or 3-digit) as an efficient, rapid, and reliable tool for auditory-dominated speech perception assessment in noisy environments among older hearing aid users. The findings suggest that the iDIN, especially its short sequence variants, coupled with memory function measures, can be used to predict sentence-in-noise perception abilities in older hearing aid users. In mainland China or other regions where linguistic diversity prevails, exposure to a dialect and accent should be accounted for in evaluating speech recognition and a 2-digit DIN may be a more suitable choice for valid hearing screening. The study underscores the potential in expanding iDIN's clinical applications in audiology practice and therefore further research in this area.

44 - Identification and Comprehension of Narrow Focus by Arabic-Speaking Adolescents With Moderate-to-Profound Hearing Loss

Khaloob Kawar [(1)] - Liat Kishon-Rabin [(2)] - Osnat Segal [(2)]
Beit Berl College, Treatment, Kfar Sava, Israel [(1)] - Tel Aviv University, Communication Disorder, Tel Aviv, Israel [(2)]

The processing of narrow focus (NF), a stressed word in a sentence involves both perceptual abilities for detecting the stressed word and semantic-pragmatic abilities for comprehending the implicit linguistic message. Information about NF includes changes in fundamental frequency (fo), duration, amplitude, or a combination, and its perception is considered a measure of the effectiveness of hearing aids (HA) and cochlear implants (CI). The current research aimed to assess the identification and comprehension of NF by Arabic-speaking adolescents using HAs or CIs and to and to associate NF outcomes with speech perception and cognitive and linguistic abilities.
Method: The study involved 46 adolescents, including 18 with moderate to severe hearing loss using HAs, aged 11:7 - 18:8 years (mean 15:4, SD 2:1), 10 with severe to profound hearing loss using CIs, aged 11:2 - 18:8 years (mean 15:5, SD 2:9), and 18 typically hearing participants aged 12:10 - 18:7 years (mean 16:2, SD 1:2). Identification and comprehension of NF were assessed using the Arabic Narrow Focus Test (ANFT), which included three subtests. The first subtest evaluated the identification of NF, the second examined the comprehension of the meaning of NF in simple sentences, and the third assessed the meaning of NF in complex sentences. Additionally, participants completed the Arabic Speech Perception Test (ArAB), a working memory test (forward and backward digit span), and a word knowledge test from the WISC-IV-ARB.
Results: All participants successfully identified the NF without significant differences between the groups. However, comprehension of the meaning of stress was less successful for users of HAs and CIs compared to typical hearing individuals. Speech perception, working memory, and vocabulary knowledge accounted for 18%, 17%, and 26% of the variance in the three subtests, respectively.
Conclusions: Arabic-speaking adolescents using CIs or HAs were able to identify NF, indicating that acoustic cues were accessible to them perceptually. However, similar to findings in Hebrew speakers, they encountered difficulty in comprehending the meaning of NF. Various factors may contribute to this difficulty, including speech perception, auditory working memory, and pragmatic-linguistic knowledge of the potential meanings of the stressed word.

45 - Speech perception by Arabic-speaking deaf and hard of hearing children

Khaloob Kawar [(1)] - Judith Rosenhouse [(2)]
Beit Berl College, Treatment, Kfar Sava, Israel [(1)] - Technion, Humanism, Haifa, Israel [(2)]

The study aims to assess perception of speech pattern contrasts, phonemes and words, by Arabic-speaking deaf and hard of hearing (D/HH) children. For this purpose, two speech perception assessment tools, an "Arabic Picture Speech Pattern Contrast" (ArPiSPAC) test and an "Arabic AB", contrasts, phoneme and word perception test, were developed and administered to thirty-four Arabic-speaking children with moderate to profound sensorineural hearing loss, hearing aids users, aged between 4;5 - 8;11. The ArPiSPaC was also administered to thirty-eight Arabic-speaking hearing children, aged between 2;6 - 5;5, in order to obtain a developmental hierarchy. An evaluation questionnaire was administered to fourteen speech and language pathologists (SLP) to estimate the use of the reported tests. For D/HH participants, vowel contrasts were better perceived than consonants, and articulation manner was better perceived than articulation place. Voicing contrasts were significantly correlated with both phoneme and word perception. A different phonological perception hierarchy was found for the hearing participants whose lowest scores were for vowel length and voicing contrasts. Finally, the evaluation questionnaire indicated that SLPs use both tests as assessment and training tools. The reported tests contribute to better understanding of speech perception abilities by D/HH and improve therapy and rehabilitation.

AUDITORY TRAINING

166 - Individualized, app-based phoneme training for adult CI users

Nikki Philpott [1] - Birgit Philips [2] - Enrico Migliorini [2] - Jan-Willem Wasmann [1] - Bas van Dijk [3] - Emmanuel Mylanus [1] - Wendy Huinck [1]

Radboud university medical center, Department of Otorhinolaryngology, Nijmegen, Netherlands [1] - Cochlear Ltd, R&D, Mechelen, Belgium [2] - Cochlear Benelux NV, R&D, Mechelen, Belgium [3]

Background & Objectives

Current literature on phoneme training for adults making use of a cochlear implant (CI) often focuses on adapting training difficulty rather than customizing training materials to address individual needs. This study introduces a novel approach aimed at improving phoneme confusion errors among adult CI users through individualized phoneme training via a mobile app. By targeting specific phoneme confusion errors based on diagnostic testing, our objective is to enhance overall phoneme perception and ultimately facilitate improved word perception.

Methods

Twenty-five experienced adult CI users with a post-lingual onset of severe-to-profound hearing loss were invited to participate in a four-week phoneme training program using a mobile app. Participants were instructed to train for 20 minutes daily, in five-minute intervals, five days a week. The training materials were tailored to each participant's unique phoneme confusion errors, as determined by the outcomes of a phoneme test in a quiet environment.

Results

Twenty-one participants completed the required four weeks of training. On a group level, participants significantly improved on their overall targeted errors. On an individual level, both for trained phonemes and carry-over to word perception, training had variable results. Final results from all participants will be presented at the conference, shedding light on the effectiveness and participants' experiences of the individualized bottom-up phoneme training approach.

Conclusion

Our innovative approach to individualized bottom-up phoneme training may enhance foundational speech perception at the phoneme level among adults making use of a CI. By addressing specific phoneme confusion errors through personalized training materials, we anticipate that these improvements will extend to enhanced word perception, potentially contributing to improved speech understanding and communication outcomes. This app-based, self-paced training approach allows for greater autonomy and empowerment for these individuals.

Keywords: Phoneme training, individualized intervention, cochlear implants

113 - Improvement of pitch perception and hearing-in-noise abilities in CI users after audiovisual pitch training

Caliani Hoarau [(1)] - Agathe Pralus [(1)] - Lesly Fornoni [(1)] - Pierre-Emmanuel Aguera [(1)] - Nathalie Bedoin [(1)] - Annie Moulin [(1)] - Ruben Hermann [(1)] - Eric Truy [(1)] - Barbara Tillmann [(1)] - Anne Caclin [(1)]
Lyon Neuroscience Research Center, Claude Bernard Lyon 1 University, Inserm U1028, CNRS UMR 5292, Lyon, France [(1)]

The use of cochlear implants (CI) can partially restore hearing in patients with severe hearing loss. However, auditory perception in CI users remains particularly impaired for non-verbal auditory cues, such as pitch perception due to the limited number of electrodes. For example, CI users report hearing-in-noise difficulties and impaired music perception. Interestingly, visual information helps CI users in their auditory perception, and studies investigating multisensory integration observed that visual cues could improve pitch processing in normal-hearing and CI users.
We investigated here the potential enhancement of music perception and speech-in-noise abilities after an audiovisual (AV) pitch training with CI users (n=11) and normal-hearing participants (n=19). The training was composed of three pitch tasks, performed twice per week over 15 weeks, with each training session lasting about 15-20 min. In the pitch change detection task (PCD), participants heard five tones and indicated whether the fourth tone was identical or different from the other. In the direction of change identification task (DCI), they judged whether the change between two tones was “ascending” or “descending”. In the short-term memory task (STM), participants heard two melodies and judged whether the second one was “identical” or “different” from the first one. For each task, half of the trials were auditory only, and the other half were audiovisual. Visual cues were uninformative for the PCD task, but informative for the DCI and STM tasks. For the STM task, visual cues were only presented during encoding and retention. Participants also performed a visuospatial control training during 15 weeks before or after the AV pitch training program. Participants were tested without visual cues before and after each training. During the testing sessions, participants performed the same three tasks as during the training and additional untrained tasks (emotion recognition, stream segregation, hearing-in-noise tasks). We measured hearing-in-noise abilities using two types of noise: SpeechNoise and CocktailParty at a signal-to-noise ratio (SNR) of +6dB and -3dB for CI users and at a SNR of -6dB only for normal-hearing participants. Listening effort in quiet and noise was assessed using the Extended version of the Effort Assessment Scale (EEAS). Moreover, self-report measures for hearing abilities were obtained using a short form of the Speech, Spatial, and Qualities of hearing scale (15iSSQ).
Our results revealed an improvement of the performance of CI users and normal-hearing participants after the AV pitch training (compared to control visuospatial training) with higher accuracy and faster response times notably for the DCI task. Faster response times were also observed after the AV training for PCD and STM in CI patients. Critically, CI users showed improvement in hearing-in-noise abilities after the AV training for the +6dB SNR condition, for both SpeechNoise and Cocktail Party. However, no benefits were observed on self-perceived listening effort and hearing abilities.
These results suggest that pitch perception can be improved thanks to pitch AV training and provide new perspectives to enhance auditory cognition in other cases with hearing loss, such as in presbycusis.

Keywords: Cochlear implants, speech-in-noise, pitch processing, listening effort, auditory training

34 - Auditory training: The Stimulation of Polymodal Sensory Perception by Skarżyński (SPPS-S): presentation of the method

Piotr H. Skarżyński [(1)] - Natalia Czajka [(2)] - Henryk Skarżyński [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(3)]

Objectives**:** The market of rehabilitations, in the segment of hearing therapies dedicated to the patients with auditory processing disorders is constantly growing. This manifests itself in the creation of new methods, new devices and forms of rehabilitations. One of them is The Stimulation of Polymodal Sensory Perception by Skarżyński, which is a therapy, that is used in the many different groups of disorders that cooccur with auditory processing disorder. Presentation of the method is the main purpose of the work.
Methods**:** The Stimulation of Polymodal Sensory Perception by Skarżyński (original name in polish SPPS-S) is a treatment applicable for many different groups of disorders showing comorbidity with auditory processing disorders. The innovative component of the method combines auditory stimulation with psychological training. Inasmuch as individuals may hear well, they can sometimes misinterpret the received information emotion-wise. Integrating psychotherapy and the training of auditory functions offers remarkably ampler opportunities for acting effectively for the benefit of the persons experiencing auditory processing difficulties.
Patient may receive the SPPS-S therapy either in the rehabilitation center or at home.
Results & Conclusions**:** Owing to the attractive form of activities, children have no sense of an unpleasant rehabilitation duty, but of fun and pleasure. The task of good therapists is to constantly expand their knowledge about the available forms of rehabilitation approaches in order to be able to select the optimal therapy for each patient. SPPS-S therapy is part of the latest telerehabilitation solutions, and its effectiveness is confirmed by research results.

Key words: auditory training • SPPS-S • auditory processing disorder • APD •

40 - The Stimulation of Polymodal Sensory Perception by Skarżyński (SPPS-S): comparison of stationary and remote therapy results

Piotr H. Skarżyński [(1)] - Natalia Czajka [(2)] - Henryk Skarżyński [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(3)]

Objectives**:** The main purpose of the work is to present results of therapy of patients who have completed the remote version of the method compared to patients performing therapy in a rehabilitation center.
Methods**:** The Stimulation of Polymodal Sensory Perception by Skarżyński (original name in polish SPPS-S) is a treatment applicable for many different groups of disorders showing comorbidity with auditory processing disorders. Solutions present in SPPS-S offer multifaceted therapy activating different perceptual modalities (hearing, vision and touch) at the same time, as well as their integration and coordination. Patient may receive the SPPS-S therapy either in the rehabilitation center or at home.
The material used to assess the effectiveness of SPPS-S-based therapy included the results of 100 patients who received remote SPPS-S therapy compared to the results of 100 patients who performed therapy at a specialized center.
Results & Conclusions**:** Statistical analysis of the results obtained, which showed that the therapy used resulted in a statistically significant improvement in all auditory functions studied. Results confirm the high effectiveness of The Stimulation of Polymodal Sensory Perception by Skarżyński, both in stationary and remotely implemented form. The quality of telerehabilitation interventions was maintained at the same level as in therapeutic work at the therapeutic center, which was confirmed by the results of patients. Remote SPPS-S therapy as an effective telerahabilitation method has become an effective form of supporting patients in their own homes.

Key words: auditory training • SPPS-S • auditory processing disorder • APD • APD • auditory processing disorder

Special Session

Precision diagnostics and therapy across the lifespan - Hearing4All

Organized by Birger Kollmeier and Thomas Lenarz

272 - Congenital deafness changes functional connectivity in the auditory cortex

Andrej Kral [(1)]
Institute of AudioNeuroTechnology & Dept. of Experimental Otology, ENT Clinics, Hannover Medical School, Hannover, Germany; Australian Hearing Hub, School of Medicine and Health Sciences, Macquarie University, Sydney, Australia [(1)]

A popular model of prelingual deafness are congenitally deaf cats, where plasticity with chronic electrostimulation through cochlear implants have been studied (Kral et al., 2019, Ann Rev Neurosci). Congenital deafness had extensive influence on the organization of the auditory system, with predominant consequences in the cerebral cortex (Kral et al., 2016, Lancet Neurol). In recent years, mathematical tools exploiting analysis of oscillatory cortical activity allowed to decipher specific effects of deafness on cortical processing. So-called induced responses, indicative of corticocortical interactions, were most prominently reduced in the auditory cortex of congenitally deaf cats (Yusuf et al., 2017, Brain). In adult hearing cats (HC) and congenitally deaf cats (CDCs), cortical responses to acoustic and electric stimulation (through a cochlear implant) were compared in the primary auditory field (A1) and the higher order posterior auditory field (PAF). Recordings were performed using multielectrode arrays and the penetrations were histologically reconstructed. For effective connectivity pairwise phase consistency, weighted phase-lag index and nonparametric Granger causality were used as connectivity measures. CDCs demonstrated a substantially reduced stimulus-related corticocortical coupling in the connectivity measures used. Largest deficits were observed in sensory-related top-down interactions, in the alpha and beta band. The data document that corticocortical interactions are dependent on developmental hearing experience. The result suggest that the congenitally deaf brain cannot incorporate top-down prediction information into auditory processing and thus have a deficient mechanism of predictive coding.

Supported by Deutsche Forschungsgemeinschaft (Exc 2177) and MedEl Comp., Innsbruck, Austria.

256 - The impact of age-related hearing loss on brain structure and function

Christiane Thiel [(1)] - Stephanie Rosemann [(1)]
University of Oldenburg, Psychology, Oldenburg, Germany [(1)]

The presentation will provide an overview of our neuroimaging studies involving elderly volunteers with uncompensated age-related hearing loss. I will demonstrate that hearing loss enhances audiovisual integration but does not trigger cross-modal responses in the auditory cortex. Instead, we found increases in the functional connectivity of the auditory cortex to visual, parietal, and frontal regions during task performance. At rest, this functional connectivity was reduced and correlated with the daily listening effort experienced. Changes in gray matter were also more closely associated with listening effort than with hearing loss itself. Furthermore, I will present findings from several of our neuroimaging studies that did not find evidence of hearing loss affecting brain structure and function, neural activity in working memory tasks, microstructural brain integrity as indicated by diffusion tensor imaging, or signs of increased brain aging in morphometric analyses. Therefore, I propose that the effects of uncompensated hearing loss in healthy, well-educated elderly subjects are subtle, primarily manifesting in changes in functional connectivity and are more related to the daily listening effort than to the hearing loss itself.

257 - Precision diagnostics and therapy for audiology

Birger Kollmeier [(1)] - Thomas Lenarz [(2)]
Universität Oldenburg & Hearing4All, Medizinische Physik, Oldenburg, Germany [(1)] - Medizinische Hochschule Hannover & Hearing4All, Dept. Otolaryngology, Hannover, Germany [(2)]

We will review and discuss the activities of the German cluster of excellence Hearing4All which is assuming a broad interdisciplinary approach to increase the level of individualized diagnostics and personalized hearing support with hearing aids and cochlear implants. In “classical” rehabilitative hearing diagnostics, the focus is on suprathreshold processing deficits, characterized, e.g., by the speech-in-noise loss. For mild-to-moderate hearing-impaired listeners this can well be described by Plomps Distortion component D which limits central auditory resolution and – in addition to the Attenuation component A – can be modelled quite convincingly with an “effective” processing model (e.g. FADE) and parameters taken from a precisely measured audiogram. In severely hearing-impaired listeners, the cochlea reserve (remaining information processing capability of the ear) is best predicted prior to a CI implantation by a speech-in-noise test for (simulated) optimum hearing aid conditions using a Master Hearing Aid (MHA). Further diagnostic refinements can be reached using machine learning techniques to extract prototypical auditory profiles from the database combination of Oldenburg and Hannover as well as by extracting molecular and genetic markers of the individuum. A further longitudinal assessment can be implemented with mobile testing, e.g., the virtual hearing clinic.
To transmit advances in precision diagnostics to a tailored treatment with hearing devices (e.g., hearing aids and cochlear implants), a focus has been laid on the prediction of expected benefit as well as on the advanced configuration and fitting of the devices. Relying on machine learning methods, nonintrusive processing model (e.g., FADE) were shown to be particularly successful for hearing aids, whereas in cochlear implants, empirical prediction of benefit based on pre-implantation data is promising a breakthrough in clinical practice. Hence, a promising set of new, interdisciplinary methods for increasing audiologic diagnostics and treatment options to a yet unforeseen precision has been developed so far in Hearing4All. Further work will focus on bringing these methods to clinical usage on an international level and to mobile hearing health surveillance and preservation which will help to shape the future of audiology.

204 - The virtual hearing clinic: basic audiological support across the lifespan?

Lena Schell-Majoor [(1)] - Birger Kollmeier [(1)]
Carl von Ossietzky University, Medical Physics and Cluster of Excellence "Hearing4all", Oldenburg, Germany [(1)]

The virtual hearing clinic (VHC) generally aims at providing low-threshold hearing diagnostics and hearing support using mobile devices to reduce the barrier for individuals to test their hearing and get access to basic hearing support at an early stage. The modular concept comprises a) self-administered diagnostic procedures, b) auditory profiling, c) hearing support of the VHC and d) user-driven optimization and individualization. For diagnostical purposes established measurements have been adapted and validated for self-administered application. One focus was the comparison of different interfaces for conducting the matrix sentence test (Saak et al., https://arxiv.org/abs/2401.17202, 2024). For threshold measurements a new method was proposed, which has shown to be efficient and robust against different conditions of user inattentiveness in a simulation study (Xu et al., https://psyarxiv.com/9ytd6/download, 2023). Robust measurements on mobile devices allow for lifelong testing and collecting longitudinal data. Analyzing these data is interesting in the context of, e.g., mobile health applications and assistive hearing technology to monitor and analyze long-term development diagnostical results. Within the VHC, diagnostical data provides a basis for auditory profiling employing a machine learning approach (Saak et al, https://www.frontiersin.org/articles/10.3389/fneur.2022.959582/full#B23,2022). Current work addresses deriving individualized recommendations for the different auditory profiles and self-adjustment procedures for a software hearing aid. Self-adjustment of hearing support can enable the user to explore individual preferences and also bears the potential to transfer settings between different devices. Hence, the VHC can offer basic audiological support across the lifespan, but moreover pave the way towards early engagement in hearing health which might enhance the effect and satisfaction with hearing support throughout the lifespan. This talk will give an overview of the current status of the VHC and discuss further perspectives and also limitations.

Keywords: mobile health, self-adjustment, remote audiology

Keynote Lecture

255 - Universal Hearing Screening and intervention programs for people with intellectual disability in their live environment - implementation in Germany

Katrin Neumann [1] - Philipp Mathmann [1] - Lukas Prein [1] - Karolin Schäfer [2] - Jasmin Filip [2] - Anja Neumann [3] - Awa Naghipur [1] - Susanna Zielonkowski [1] - Anna Schotenröhr [1] - Anna Sophia Schwalen [1] - Susanne Wasmuth [1] - Martin Scharpenberg [4] - Vincent Jankovic [4] - Katharina Schwarze [3] - Antoinette am Zehnhoff-Dinnesen [1] - Werner Brannath [4] - Philip-Hendrik Höhne [5] - Sibel Altin [5] - Oliver Kanaan [1] - Sandra Diekmann [6] - sarah Schlierenkamp [6] - Nicole Stuhrmann [7] - Ruth Lang-Roth [8] - Muhittin Demir [9] - Corinna Gietmann [1]
University Hospital Muenster, Department of Phoniatrics and Pediatric Audiology, Muenster, Germany [1] - University of Cologne, Department of Special Education and Rehabilitation, Education and Aural Rehabilitation of People who are Deaf or Hard of Hearing, Cologne, Germany [2] - University of Duisburg-Essen, Institute for Health Care Management and Research, Essen, Germany [3] - University of Bremen, Competence Center for Clinical Trials Bremen, Bremen, Germany [4] - AOK Health Insurance, Rheinland/Hamburg, Duesseldorf, Germany [5] - EsFoMed GmbH, Essener Forschungsinstitut für Medizinmanagement, Essen, Germany [6] - Helios HSK, Phoniatrics and Pediatric Audiology, Head and Neck Surgery, Wiesbaden, Germany [7] - Medical Faculty University Hospital Cologne, Department of Otorhinolaryngology, Head and Neck Surgery, Cologne, Germany [8] - University Medicine Essen, Department of Otorhinolaryngology, Division of Phoniatrics and Pediatric Audiology, Essen, Germany [9]

Introduction**:** People with intellectual disabilities (ID) suffer from hearing loss about 5-10 times more frequently than the general population which often remains undiagnosed and untreated. Recently, the Germany-wide implementation of a program for hearing screening, diagnostics and intervention in the living environment of people with disabilities (residential facilities, workshops, kindergartens, schools) was evaluated (Schwarze et al. 2023).
Methods**:** To investigate the feasibility of such a program, 1050 individuals with ID (all ages) received hearing screenings in their living environment. Failed screening was followed by audiometric diagnostics and, in case of hearing loss, initiation and monitoring of therapy. One-hundred-forty-one control participants were invited by their health insurer to undergo the same program in a clinic. Both cohorts performed the program one year later to assess its outcome.
Results**:** Screenings and diagnostics in the living environment of people with ID were feasible and reliable by hearing care professionals in most cases. Tele-monitoring by a physician was performed in about 20% of cases. Partly under COVID-19 pandemic conditions, it appeared difficult to gain access to people with ID. Of 810 facilities contacted, 19% participated, and from initial contact to hearing screening required an average of 8.0% conversations. Screenings in clinical settings were hardly taken up.
Discussion/Conclusion**:** Hearing screenings, on-site diagnoses and interventions, including hearing aid fittings, appear to be feasible (Prein et al. 2023), but access to people with ID in their facilities is a barrier that must be overcome for such a program to be implemented nationwide. Education of caregivers about the usefulness of regular hearing screenings for people with ID is needed.

**Funding: Germany's Federal Joint Committee (G-BA): FKZ: 01NVF18038*

References**:**
Schwarze K*, Mathmann P*, Schäfer K, Brannath W, Höhne PH, Altin S, Prein L, Naghipour A, Zielonkowski SM, Wasmuth S, Kanaan O, Am Zehnhoff-Dinnesen A, Schwalen AS, Schotenröhr A, Scharpenberg M, Schlierenkamp S, Stuhrmann N, Lang-Roth R, Demir M, Diekmann S, Neumann A, Gietmann C‡, Neumann K‡. Effectiveness and costs of a low-threshold hearing screening programme (HörGeist) for individuals with intellectual disabilities: protocol for a screening study. BMJ Open. 2023 May 18;13(5):e070259. doi: 10.1136/bmjopen-2022-070259. *shared first authorship, ‡shared senior authorship
Prein L, Vogt N, Neumann K. Hörgeräte-Versorgung von Menschen mit geistiger Behinderung in ihrem Lebensumfeld. [Hearing aid provision for people with intellectual disabilities in their living environment]. Hörakustik. 2023 Sep;10;8-12.

Keynote Lecture

271 - Extended High Frequency Hearing Loss Hiding Underneath a Normal Audiogram

Srikanta Mishra [1]
The University of Texas at Austin, Speech, Language & Hearing Sciences, Austin, United States [1]

Humans can hear up to 20 kHz; however, clinically, hearing is measured up to 8 kHz. Hearing in the extended high frequencies (EHFs; e.g., 10- 16 kHz) can be impaired despite a normal audiogram. Little is known about the general characteristics and perceptual consequences of EHF hearing loss. This talk will present findings from our ongoing studies on EHF hearing loss. Specifically, we will report: (1) the prevalence and risk factors associated with EHF loss in adults and children who have an otherwise normal audiogram; (2) the effects of EHF hearing loss on auditory resolution and speech-in-noise recognition; (3) the effects of EHF hearing loss on self-reported hearing ability in young adults; and (4) the predictive value of EHF hearing in determining future hearing loss among the normal-hearing adults.
Data from adults (n= 222; 19-38 years) and typically developing children (n= 542; 4-18 years) with normal hearing are reported. In a case-control design, participants were categorized into EHF-normal and EHF-impaired groups. In Experiment 1, we measured hearing thresholds from 0.25 to 16 kHz and speech recognition thresholds (SRTs) in multi-talker babble using the digit triplet test. In Experiment 2, we measured frequency change detection thresholds (FCDT) at 0.5 and 4 kHz. In Experiment 3, SRTs and self-reported hearing ability was assessed using the original version of the Speech, Spatial, and Qualities of Hearing Scale in adults. In Experiment 4, we monitored hearing thresholds over a period of 24 months.
Experiment 1: EHF hearing loss was observed in 19% of adults and 7% of children. Hearing thresholds in the standard frequencies (0.25 through 8 kHz) were higher (~3 dB), and SRTs were lower (poorer; 2 dB) for the EHF-impaired relative to the EHF-normal group after adjusting for age effects. Sex appears to have no direct effect on hearing thresholds or SRT; however, the age at which EHF hearing starts to decline was higher (later) in females than males. Experiment 2: Individuals with EHF hearing loss had higher (poorer) FCDTs for the 4 kHz but not for 0.5 kHz compared to the EHF-normal group. Experiment 3: machine learning was applied to model SRTs based on hearing thresholds. Experiment 4: SSQ ratings were significantly lower for EHF-impaired adults compared to the EHF-normal group. SRTs and SSQ ratings were significantly related. Experiment 5: Hearing thresholds were measured twice over a period of 24 months.
EHF hearing loss is associated with poor auditory resolution and speech-in-noise recognition. Individuals with EHF hearing loss report hearing-in-noise deficits regardless of a normal audiogram. Modeling results suggest that speech-in-noise recognition development is altered for children with EHF loss. In addition, adults with EHF hearing loss had a significant decline in hearing in the standard frequency range over 24-months period. Machine learning models suggest the value of EHF audiometry in predicting speech-in-noise recognition.

Special Session

Coordinators: Dona Jayakody & Rob Eikelboom

147 - Empowering healthcare professionals in supporting older adults with comorbid hearing and cognitive impairment

Dona Jayakody [(1)] - Robert Eikelboom [(1)] - Faheema Mahomed-Asmail [(2)] - Sophia Kramer [(3)] - Leon Flicker [(4)] - Xinxing Fu [(5)] - Dinukshi Ileperuma [(6)] - Hatice Akçakaya [(7)] - Nahal Mavaddat [(8)] - Layla Barr [(1)] - Andrea Serrano [(1)] - Damir Kekez [(1)] - Sangamnatha Veeranna [(9)]
Ear Science Institute Australia, Brain and Hearing, Subiaco, Australia [(1)] - University of Pretoria, Department of Speech-Language Pathology and Audiology, Pretoria, South Africa [(2)] - Amsterdam UMC, Dept. of Otolaryngology-Head and Neck Surgery, section Ear & Hearing, Amsterdam, Netherlands [(3)] - University of Western Australia, WA Centre for Healthy Aging, Perth, Australia [(4)] - Beijing Tongren Hospital, Beijing Institute of Otolaryngology, Beijing, China [(5)] - University of Kelaniya, Department of Audiology and Speech Language Pathology, Colombo, Sri Lanka [(6)] - Mugla Sıtkı Kocman University, Department of Special Education, Muğla, Turkey [(7)] - University of Western Australia, Medical School, Perth, Australia [(8)] - The University of Southern Missisipi, Audiology, Hattiesburg, United States [(9)]

1. Knowledge, Attitudes, and Practices of Australian Healthcare Professionals on Comorbid Hearing Loss and Cognitive Impairment

Presenter: Dona Jayakody

Background**:** We conducted a survey to explore the KAP of Australian hearing healthcare (HHC) professionals, General Practitioners (GPs) and Gerontologists in assisting comorbid patients.
Methods**:** A cross-sectional survey was developed and distributed via Qualtrics. Data were summarised and analysed with binary logistic regression models.
Results**:** 133 HHC professionals, 17 GPs and 49 Gerontologists responded. Although participants who responded to the survey possessed a modest awareness of the practices surrounding diagnosing, referring, and treating patients with hearing loss (HL) and dementia.
Conclusions**:** These findings can be used to develop training programs to empower these professionals to deliver optimal healthcare services to patients with HL and dementia.

2. Analysis of the knowledge, attitudes, and practice of hearing-related healthcare professionals regarding cognitive impairment and dementia in China

Presenter: Rob Eikelboom

Objective**:** This study identified KAP of HHC professionals towards HL and dementia in China.
Methods**:** A cross-sectional survey was developed and distributed to eligible hearing-related healthcare professionals in China.
Results**:** 334 HHC professionals responded. Respondents showed a high level of knowledge and a positive attitude towards providing an ear and hearing care to patients with potential cognitive impairment. However, practice scores were relatively a lot lower.
Conclusion**:** There is a need for practice guidelines and training to improve KAP of managing people with HL and cognitive impairment.

3. Current gaps in Knowledge and practices of South African Audiology sector in treating older patients at risk of dementia

Presenter: Faheema Mahomed-Asmail

Background**:** The growing recognition of the intricate interplay between HL & cognitive decline accentuates the need for an exploration of the knowledge and practices within the South African audiology sector.
Methods**:** A KAP survey was sent out to the HHC professionals in South Africa through South African Society of Audiology.
Results**:** Twenty-six audiologists responded to the survey. The majority (77.28%) believed they had the ability to recognize cognitive impairment in their patients. Respondents were less confident in their ability to formally deliver and interpret cognitive screening tests (63.63%).
Conclusions**:** The results are indicative of the need for clinical guidelines and training for HHC professionals to support older adults.

4.The prevalence of cognitive problems in a typical audiology adult patient population
Presenter: Sophia E. Kramer
Background**:** Research on the association between HL & dementia is mainly focusing on the causal direction of this association. Little is known about the prevalence of cognitive problems in a representative audiology patient population. The aim of this study was to examine the prevalence of self-reported cognitive complaints (SCC) and well-known dementia risk factors (RF) in a typical audiology patient population.
Methods**:** This study included 1105 consecutive adult patients of two audiology clinics in the Netherlands. All patients completed an online intake tool based on the International Classification of Functioning Disability and Health. The intake tool included questions on memory and concentration (SCC) as well as on risk factors for dementia (RF), including loneliness, depression, sleep, vision and self-reported hearing problems.
Results**:** SCC appeared to be highly prevalent in the audiology patients, with over half of the population reporting some degree of memory or concentration problems.
Conclusion**:** This descriptive cohort study highlights a notable prevalence of self-reported cognitive complaints and dementia risk factors within a typical audiology patient population.

5. Multidisciplinary approach to screening, referring, and discussing memory impairments in clients with suspected cognitive impairments
Presenter: Leon Flicker
With no cure or effective treatment currently insight, it is vital that factors are identified which will help prevent or delay both age-related and pathological cognitive decline and dementia. HL is a modifiable risk factor for dementia. Hence the audiologists must be empowered to address potential memory problems of their older clients. This presentation aims to provide a better understanding of the memory screening tools that are suitable for hearing impaired older adults, referral pathways for the clients with memory problems and how to address challenges associated with the rehabilitation of hearing-impaired clients with memory problems.

Keynote Lecture

21 - The Importance of Global Partnerships for Multiple Disabilities!

Karen Keyes [(1)] - Roxanna Spruyt [(1)]
DeafBlind Ontario Services, Service Provider, Newmarket, Canada [(1)]

Description**:**
The goal of this presentation is to introduce the conference participants on new evidence-based practices, key global initiatives and value-added resources to improve services and quality of life of individuals who are Deaf, hard of hearing, deafblind and non-verbal with development disabilities.
Subject matter areas covered:
Advocacy
International Services & Global issues
Multiple disabilities and deafblindness
Presentation Summary
DeafBlind Ontario Services provides services for people who are deafblind, Deaf, hard of hearing or non-verbal in addition to living with a developmental disability in Ontario Canada.
Our approach is individualized and holistic, led by the wishes of each person supported. We challenge people to try new things, new methods and new activities in an effort to seek out new opportunities, relationships and enriching experiences.
Our team of professionals assist people with communication, empowering them to live their best lives and achieve greater independence. The specialized support team is the backbone of our highly regarded service model, providing a holistic approach to each individual's personal plans so they can achieve their goals and aspirations.
The presenters will focus on:

- Overview of program and services at DeafBlind Ontario Services in Canada –
- Key new initiatives
  - Self- Advocacy Manual – developed and used for people who are deafblind
  - Collaborations and partnerships - WFDB Second Global Report 2023: relationship in building self-advocacy model
  - Global initiative – Development of The International Classification of Functioning, Disability and Health Core Set for deafblindness – our involvement and current update

Learning Objectives

- Learn "what is new" in advocacy issues local, national and international level for individuals who are Deafblind
- Learn about the global initiative World Health Organization's International Classification of Functioning (ICF) Core Set Development for Deafblindness and how it will impact the future
- Review the WFDB Second Global Report 2023: and how it relates to DeafBlind Ontario Services self advocacy model and future plans

PATIENTS WITH COMPLEX CONDITIONS

11 - Auditory Brainstem Response Findings in Speech Delay and Autism

Kelley Dodson [(1)] - Christian Blue [(1)] - Rajanya Petersson [(1)] - Stephanie Wong [(2)]
Children's Hospital of Richmond at Virginia Commonwealth University Medical Center, Otolaryngology/Head and Neck Surgery, Richmond, United States [(1)] - Mount Sinai Medical Center, Otolaryngology/Head and Neck Surgery, New York, United States [(2)]

Educational Objective: At the conclusion of this presentation, the participants should be able to identify changes in ABR findings in pediatric patients with ASD and speech delay post-DSM-5 change.
Objectives: Evaluate pediatric auditory brainstem response (ABR) findings in children with Autism Spectrum Disorder (ASD) after the 2013 DSM-5 update.
Study Design: This was an IRB-approved, five-year retrospective cohort study evaluating ABR results from pediatric patients with speech delay. Diagnosis of ASD and other neurodevelopmental abnormalities were collected for patient stratification.
Methods: From 2017-2022, 148 pediatric patients with speech delay were identified through diagnosis of speech delay and underwent ABR testing. Patients were then separated into two groups: Neurotypical (N=79) and ASD (N=69). ABR results were obtained through chart review and waveform and interpeak latency (IPL) results were recorded. Differences in waveform and IPL results were determined via Pearson's chi-square test, with univariate analysis accounting for race, sex, and age.
Results: 27 patients with ASD (39.1%) had at least one waveform/IPL prolongation. Analysis showed an increased incidence of waveform III ($p=0.029$) and IPL III-V ($p=0.03$) prolongation in the ASD group compared to their neurotypical counterparts. Waveform III prolongation was noted more in females with ASD ($p=0.001$) than in males. There was no statistically significant difference when comparing race and age.
Conclusions: There were higher percentages of prolongation for all waveforms and IPLs in the ASD group versus neurotypical, though not as high as previously reported. Race and age did not appear to be factors in ABR findings though more data is needed to make clinical associations.

126 - Exploring the challenges facing deafblind children and young people, and the challenges of engaging them in research: Insights from focus group studies

Claire Manford [(1)]
Anglia Ruskin University, School of Vision and Hearing Sciences, Cambridge, United Kingdom [(1)]

Deafblindness is a strong, emotive, and misunderstood label. It does not mean full deafness and blindness, rather a 'combined sight and hearing impairment [that] causes difficulties with communication, access to information and mobility' (Department of Health, 1995). For children and young people (CYP) this can be a hidden, misdiagnosed, fluctuating, or deteriorating condition, affecting all aspects of their educational and social development. Even a mild loss in both senses negatively impacts academic outcomes at Key Stage 2 and GCSE level (Hill et al., 2019). In the UK this is an under-researched and relatively new field, prevalence is unknown and challenging to establish, the cohort is heterogeneous, and each child is unique. International estimates suggest that deafblindness affects between 0.05% (1 out of 2,000 CYP) and 0.70% (1 out of 140 CYP) (Rune, 2023). Due to the low-incidence nature of deafblindness, many teachers have never met a deafblind child, subsequently knowledge and understanding of deafblindness amongst teachers and peers is lacking. There is a lack of national guidelines to address the barriers, and limited specialists to provide support, sporadically spread across the country. To address this knowledge gap focus group research is in progress, aiming to ascertain the views and experiences of key stakeholders with deafblind teenagers at the heart of this research. Topic guides were created with broad questions around 1) priorities for stakeholders, 2) academic and social challengers and successes, and 3) awareness of deafblindness amongst teachers and peers, aiming to provoke reflection and debate. Focus groups with professionals working in the field and parents of deafblind CYP are completed, and groups of deafblind CYP are being recruited. Participants were recruited through existing contacts of the research team. Parents were white (British, Irish, French) and British Asian, one father and 10 mothers, aged 25-60 currently living across the UK and Ireland. Professionals were white, 12 females and two males, aged 30-60 years, averaging over 10 years' experience of working with deafblind CYP. Meetings for professionals and parents were hosted on Teams and recorded for ease of transcription. They lasted between one and two hours and had between one and six participants. Pseudonyms were applied and transcripts anonymised. Data was transferred into NVivo and coded using reflective thematic analysis by the author and conferred by the supervisory team. The themes include 1) barriers - with subthemes for different groups of sensory impaired CYP and staff (professionals), and limitations, lack of support, isolation and the uniqueness of the child (parents), 2) facilitators - with subthemes for adaptations to the curriculum, communication and environment, and specialist support (professionals), and bespoke provision, networks, communication support, multiagency support, and knowledge and understanding (parents), and 3) ideology - with subthemes for terminology and provision (professionals) and labels (parents). Results show that professionals need to get to know deafblind CYP to effectively support them. Professionals and peers should not judge by labels but take time to get to know an individuals' true ability, their communication and access requirements, and be prepared to go 'Heath Robinson' to meet individual needs. Deafblind CYP need support from specialist teachers working collaboratively with other professionals, families, and the young people themselves, to give each unique deafblind individual every opportunity to reach their full potential. An alternative methodology for CYP is in development to ensure that a group of deafblind CYP can communicate collaboratively to share their ideas, to deepen understanding of the barriers and facilitators for academic and social success for this cohort. This combined information will be used to co-create an intervention aiming to raise awareness of deafblindness within the education sector. Additional research beyond the remit of this study is also indicated, including the need for an international agreed label and definition of deafblindness, and how modern technology can be used to support the complex needs of this heterogenous cohort.

Keywords: Deafblindness, Children, Awareness

References

Department of Health. 1995. *Think Dual Sensory*.
Hill, M, A. Hall, C. Williams, and A.M. Emond. 2019. "Impact of Co-Occurring Hearing and Visual Difficulties in Childhood on Educational Outcomes: A Longitudinal Cohort Study." *BMJ Paediatrics Open; BMJ Paediatr Open* 3 (1)
Rune, J. 2023. *Good Practices and Recommendation for the Inclusion of Persons with Deafblindne*ss, World Federation of the Deafblind: Oslo, Norway

138 - Awareness of the impact of combined hearing and vision difficulties on accessing healthcare services amongst healthcare practitioners in the United Kingdom

Saima Rajasingam [(1)] - Eldre Beukes [(1)] - Jane Macnaughton [(1)] - Peter Simcock [(2)] - Liz Duncan [(3)] - Teresa Quail [(4)]
Anglia Ruskin University, Vision and Hearing Research Centre, Cambridge, United Kingdom [(1)] - School of Education and Social Work, Birmingham City University, Birmingham, United Kingdom [(2)] - Deafblind UK, Research, Peterborough, United Kingdom [(3)] - British Association Teachers of Deaf Children and Young People, London, United Kingdom [(4)]

Background: Dual sensory impairment (DSI), Deafblindness and multi-sensory impairment are all terms that refer to the presence of a combined vision and hearing impairment, estimated to affect 9-21% of adults older than 70 years (Saunders & Echt, 2007). People with DSI have an increased risk of mortality (Gopinath et al, 2013) at a significantly increased risk for dementia (Hwang et al., 2020) and higher levels of depression (Viljanen, et al., 2014). Despite older adults being at increased risk of multiple sensory impairments is unclear how healthcare professionals, in particular audiology or vision professionals, modify their clinical practice or ensure services are accessible for adults with dual sensory impairments.
Aim: This study aimed to evaluate existing knowledge and awareness of deafblindness/dual sensory impairment/multisensory impairment amongst healthcare practitioners (HCPs) in the United Kingdom.
Methods: An online survey (hosted on Qualtrics) was used to record healthcare practitioners' views on (1) awareness of the terms deafblindness/dual sensory impairment/multisensory impairment and (2) ratings of service accessibility and current use of adjustments in practice to improve care for patients with dual sensory impairments. Participants were recruited using social media and via healthcare professional networks.
Results: Initial analysis indicates that most respondents identified both the terms "dual sensory impairment" and "deafblindness" as referring to the co-occurrence of hearing and vision difficulties but interpreted "multisensory impairment" as referring to the co-occurrence of more than two sensory deficits. 61% of respondents had not received any training on dual sensory impairments, and only 10% had received training as part of their degree or professional training course. 58% of respondants reported that it was "difficult" or "very difficult" for someone with hearing and/or vision difficulties to access their service and receive care.
For healthcare professionals working with children, 81% reported not sharing information with the relevant specialist teacher (e.g., Qualified Teacher of children with MSI, Vision Impairment or deaf children.) Adaptations to make clinical care more accessible included providing tactile opportunities around fitting hearing aids, writing in large print, using specialist equipment, involving carers and family members as appropriate, and providing additional support through a nominated team member. 76% of respondents were not aware of the Accessible Information Standard (a UK law defining a consistent standard to ensure the information and communication needs of people with a disability or sensory loss are met). Amongst those who were aware, only 37% felt their communications met the Accessible Information Standard.
Conclusions: These findings indicate that although healthcare professionals, particularly those who work in audiology or vision services, are likely to encounter patients experiencing combined vision and hearing difficulties, few receive any formal training in this area and the majority do not consider their services easy to access for someone with combined sensory difficulties. There is a clear need for training on deafblindness to be included in the curricula and professional development training for healthcare professionals, particularly those working with patients at increased risk of sensory impairments, and for improved awareness of accessible communication.

Key words: Dual sensory impairment, deafblindness, vision impairment, hearing loss, healthcare

209 - Datalogging and speech recognition outcomes in pediatric cochlear implant users with comorbidities

Sarah Crow [(1)] - Mihika Thapliyal [(2)] - Sophia Heussner [(1)] - Emily Kaplan [(1)] - Samantha Anne [(3)] - Andrea Warner-Czyz [(1)]
The University of Texas at Dallas, Speech, Language, and Hearing, Dallas, United States [(1)] - Cleveland Clinic, Lerner College of Medicine, Cleveland, United States [(2)] - Cleveland Clinic, Otolaryngology, Cleveland, United States [(3)]

Introduction Children who are deaf and hard of hearing can gain access to sound via a cochlear implant, but they must wear the device to develop speech perception skills. That is, poor daily device use may result in underdeveloped auditory skills in children and adolescents using cochlear implants. This effect may be exacerbated in children who are deaf and hard of hearing with additional comorbidities, who historically show poorer outcomes, greater variability, and less predictability in their communication outcomes. Traditionally, clinicians rely on objective measures and parent report to guide knowledge of audiologic progress in pediatric cochlear implant users with comorbid conditions, but most studies pool data across different disabilities without consideration of which developmental domain is affected (e.g., motor, cognition). This retrospective study focuses on the relationship between daily device use and auditory skill development in pediatric cochlear implant users with additional diagnoses. Methods A retrospective chart review across two sites yielded 168 data points across 36 unique participants. Participants contributed a mean of 5.2 sessions (SD=4.3, Range 1-16). Data included demographic characteristics (e.g., chronologic age, biological sex, comorbidity type), auditory history (e.g., age at device fitting, duration of device experience), daily device use (i.e., datalogging), and speech recognition outcomes including parental report of auditory skills (e.g., Auditory Skills Checklist, LittlEARS), closed-set tests (e.g., Early Speech Perception), and open-set tests (e.g., Lexical Neighborhood test; Consonant-Nucleus-Consonant). Comorbidities were categorized into one of five groups: conditions with cognitive disability, conditions without cognitive disability, auditory neuropathy spectrum disorder, autism, or cytomegalovirus. Results Participants included 36 pediatric cochlear implant users (30% female) with a mean age at first hearing aid fitting of 27.5 months (SD=41.3, range: 0-149), mean age at first cochlear implant activation of 37.5 months (SD=34.1, range: 0-138), mean duration of cochlear implant experience of 55.4 months (SD=46.7, range: 0-162), and mean chronologic age of 90.7 months (SD=53.1, range: 17-180). As a group, children with comorbidities had a mean daily device use of 7.2 hours per day (SD=4.2, range=0-16.3). The overall group scored a mean of 34.4% (SD=25.2%, range=0-97%) on the Auditory Skills Checklist and 51.8% (SD=25.4%, range=6-100%) on the LittlEARS. Twelve children completed the Early Speech Perception test with six achieving either some or consistent word identification. Scores on open-set measures ranged from 40-96% (M=76.8%, SD=20.0%) on the Easy list and 68-84% (M=74.3%, SD=6.05%) for the Hard list of the Lexical Neighborhood Test, and 8-98% (M=72.3%, SD=22.7%) on the Consonant-Nucleus-Consonant test. Children with longer duration of implant experience had higher scores on the Auditory Skills Checklist ($r(97)=.45$, $p<.001$) and the LittlEARS ($r(61)=.43$, $p<.001$) parent report measures. Age at first cochlear implant activation significantly correlated with Lexical Neighborhood Test Easy words such that earlier implantation coincided with better speech recognition performance ($r(6)=-.91$, $p=.011$). Children with longer daily device use, measured via datalogging, had higher scores on the Auditory Skills Checklist ($r(97)=.52$, $p<.001$) and the Consonant-Nucleus-Consonant open-set test ($r(13)=.86.$, $p<.001$). Type of comorbidity influenced outcomes such that children with auditory neuropathy spectrum disorder and children with comorbidities that did not influence cognitive outcomes (e.g., Waardenburg Syndrome) were more likely to complete open-set speech recognition than children in the other comorbidity categories. Moreover, children with auditory neuropathy spectrum disorder had the highest mean datalogging values and the highest Auditory Skills Checklist scores. In contrast, children with comorbid disorders impacting cognition (e.g., global developmental delay) had the lowest datalogging values and the lowest Auditory Skills Checklist scores. Discussion Pediatric cochlear implant users with additional disabilities showed vast variability across datalogging, parental report, and speech recognition measures. Participants acquired auditory and speech recognition skills after cochlear implantation, but their scores lag behind expected outcomes in neurotypical children with cochlear implants as published in the literature. As expected, children with longer durations of daily device use showed higher scores on the Auditory Skills Checklist and the Consonant-Nucleus-Consonant. However, lack of correlation between datalogging and other word and sentence recognition tests may reflect the smaller number of participants who could complete closed- and open-set measures. Type of comorbidity affected both datalogging and progress in speech recognition testing, highlighting the importance of considering the specific implications of the syndrome or condition to set realistic expectations for communication development after implantation.

Keywords: Children, cochlear implant, comorbidities, datalogging, speech recognition

275 - Correlation between otoneurological symptoms and continuous use of medication in patients in Public Health in Brazil

Marcia Marcelle Vasconcelos Santos [(1)] - Helena Renata Silva Cysneiros [(1)]
Universidade Federal de Pernambuco, Fonoaudiologia, Recife, Brasil [(1)]

Introduction: Auditory and vestibular disorders, such as dizziness, vertigo and tinnitus, impact quality of life, affecting more than 30% of the Brazilian population. These disorders have multifaceted origins, including labyrinth changes and adverse drug effects. Combined use of medications that affect the central nervous system may result in hearing changes due to summation effects. This is due to changes in the absorption and metabolism of the drugs, leading to symptoms such as instability, imbalance, and weakness, thus elevating the risk of falls and fractures. This risk is even higher in people who make continuous and simultaneous use of four or more medications, known as polypharmacy. Consequently, this practice is associated with a three-fold increase in the risk and severity of adverse drug reactions and, especially, with an increase in drug interactions by up to 100%. Thus, the multiple consumption of medications is a major alert for Brazilian Public Health, considering the increase in limitations in social activities frequently mentioned during consultations, in addition to the greater probability of vestibular and cochlear toxicity. Thus, this practice is directly related to care costs, which include more medications and consequences arising from this use.
Objective: To analyze the relationship between otoneurological symptoms and continuous use of medications by patients in Brazilian public health.
METHODS: The study included adults over 18 years of age, of both sexes, who regularly used medications for at least 30 days, according to the Anatomical Therapeutic Chemical classification. Participants were randomly selected from health facilities in Brazil, with consent provided. They answered a questionnaire about the drugs used, including type, amount, and duration of use. Then, they were submitted to an anamnesis to determine the prevalence of otoneurological symptoms, such as dizziness, vertigo, imbalance, tinnitus, hypoacusis, ear fullness and ear pain. The frequency and intensity of these symptoms, as well as the occurrence of falls, were recorded. Participants were divided into three groups for comparative analysis: those who used a medication; two or three medications; and polypharmacy (four or more medications).
Results: In the study, 90 patients on continuous medication were divided into groups of 30 people according to the number of medications. It has been observed that younger patients tend to consume fewer medications, while older patients concentrate on polypharmacy. The association between age and medication consumption was statistically significant ($p < 0.05$). Regarding the most consumed pharmacological classes, antihypertensive drugs were predominant, followed by antidiabetics, antidepressants and anxiolytics ($p < 0.001$). Antiulcers, anti-inflammatories, and antilipemics were also significant ($p < 0.001$), but varied slightly between groups. The study investigated otoneurological symptoms in relation to the use of different medications, finding significant correlations. 73% of patients with one medication had no complaints, but the number increased with the consumption of multiple drugs, being more expressive in polypharmacy, since only 11.90% did not present otoneurological symptoms. Vertigo (p-value 0.001), tinnitus (p-value 0.009), hearing loss (p-value 0.004) and imbalance (p-value 0.001) were the most statistically significant symptoms. In other words, the study shows that more medications are correlated with more otoneurological complaints, highlighting the relevance of polypharmacy in these symptoms. The frequency of otoneurological symptoms varied among the groups, being more prevalent in group 3. As for the intensity, it also increased with the number of medications, being more significant in polypharmacy, proven by the p-value in Fisher's Exact Test. Regarding falls, in group 1, 3.3% reported falls of 2 to 5 times. In group 2, 6.7% had a fall, 6.7% from 2 to 5 times, and 3.3% more than 5 times. In group 3, half suffered falls, indicating a statistically supported correlation with the use of multiple medications.
Conclusion: It is concluded that, in the analysis of otoneurological symptoms in relation to the number of medications used by Brazilians, a significant correlation is revealed. Therefore, the greater the number of medications, the greater the incidence and intensity of these symptoms, indicating a potential influence of polypharmacy on patients' hearing health and balance. These results highlight the importance of a careful approach to prescribing medications, especially in cases of multiple therapies, in order to mitigate the risk of otoneurological symptoms and associated falls.

Keywords: Audiology; Public Health; Drug Utilization

230 - Investigating the Family and Child's Experience of Microtia and Hearing Loss

Saira Hussain [(1)] - Amanda Hall [(1)] - Helen Pryce [(1)]
Aston University, Audiology, Birmingham, United Kingdom [(1)]

Aim**:** This study aims to explore the family experience of microtia as part of a PhD. There are two aims of the study; 1. To investigate children and young people's experiences of microtia and 2. To explore parent/carer experiences of their child's microtia.
Methods**:** An inductive qualitative method was used. Participants were invited to either interviews (children and young people with microtia) and parents of children to focus groups. These either took place online using Microsoft Teams or in person. The interviews and focus groups were semi-structured with questions exploring home, social and school life. This included discussions around any challenges, decision making and auditory management to include amplification and/or reconstructive surgery. Purposive sampling was utilised to account for varied patient demographics, including age, gender and location.
Results**:** 12 parents of children with microtia and 11 children/young people with microtia took part in the interviews and focus groups. Data was analysed using a constant comparative approach in line with Grounded Theory methods. Participants were from across England with a mixture of those who used auditory amplification. Only one participant had reconstructive surgery for their ear. The role microtia played in the families was an iterative and changing process with differing needs at different life stages.
Parents and children/young people with microtia shared similar views on decision making and autonomy with the young person for choices on amplification and/or reconstructive surgery. Support and information seeking was a key factor in making choices; these sources included healthcare clinicians, family support and networking. Overcoming barriers and not allowing microtia to dictate futures was highlighted by participants.
Conclusion**:** The experience of living with microtia varies amongst individuals and families. The findings from this study are the first of its kind looking at the child/young person and family experience of microtia. The next stage of the PhD is to create a toolkit based on participant preference that is aimed at young children before starting secondary school.

Key words: Microtia, Family, Involvement, Decision-making

280 - Normal Values for Cervical and Ocular Vestibular-Evoked Myogenic Potentials: Comparison of air conducted (AC) and vibratory stimuli (bone conduction-BC)

Navid Shahnaz [(1)] - Elbar May [(1)]
School of Audiology & Speech Sciences, University of British Columbia, Vancouver, BC Canada [(1)]

Overview

The use of vestibular-evoked myogenic potentials (VEMP) can be an effective diagnostic tool when investigating the presence of various vestibular and audiological disorders. However, the scientific community lacks consistent normative clinical techniques and a baseline understanding of responses for a diverse population. These factors limit clinicians from utilizing VEMP in an effective diagnostic manner. The current protocols show variability in results, replicability, technical procedures, and population diversity (age, gender, race, structural differences, etc.).

Objectives:

1- Obtain normative data on using a bone conductor during cVEMP and oVEMP testing.
2- To obtain and compare VEMP response rates, wave morphology quality, thresholds, absolute latency, loudness judgment, and interaural amplitudes using air and bone conduction across a diverse population.

Methodology

A total of 13 young adults with normal hearing between the ages of 18 and 29 years of age were recruited to participate in repeated measures of VEMP and auditory assessment. Twenty-six typical ears will be included in the study. All participants have attended a single 120-160-minute test session.

Stimulation Methods:

Air Conduction: Insert headphones were used. 500 Hz tone burst at the intensity of 97 dB nHL (111dB SPL) was used. Bone Conduction: B-81 Radioear bone conductor was used on the ipsilateral mastoid. 500 Hz tone burst at an Intensity of 75 dB nHL (113.4 EFL) was used.

Polarity: Rarefaction and Alternating Polarity were used.

Inclusion Criteria:

Adults between the ages of 18 to 29 years old.

Normal hearing thresholds: ≤25dB HL between 250 Hz and 16000 Hz.

Free of any history of severe head accidents, balance dysfunction, noise exposure, or ototoxic drug

Have no hearing loss. No outer ear defects are visible by otoscopy.

All participants should have normal middle ear function in wide-band tympanometry.

Inclusion Criteria:

Adults between the ages of 18 to 29 years old.

Normal hearing thresholds: ≤25dB HL between 250 Hz and 16000 Hz.

Free of any history of severe head accidents, balance dysfunction, noise exposure, or ototoxic drug

Have no hearing loss. No outer ear defects are visible by otoscopy. All participants should have normal middle ear function in wide-band tympanometry.

Positioning:

cVEMP: Supine position with the head elevated and turned to one side.

oVEMP: setting position and looking up at a target (30 degrees above the horizontal)

We used the nasal alar montage for electrode placement in oVEMP for both air and bone conduction. (Shahnaz & David, 2021).

Results

Waveform morphology was significantly better in BC cVEMP and BC oVEMP compared to AC VEMP using an expert judge. The loudness scale of the stimulus was considerably lower in BC cVEMP and BC oVEMP compared to AC cVEMP and AC oVEMP.

Bone conduction stimulation produces a significantly higher response rate (100%) in oVEMP when compared to AC oVEMP response rate (90.9%). BC oVEMP has a significant reduction of N1 latency and interaural asymmetry ratio. There was a significant reduction in P1 latency in BC cVEMP.

Conclusion

In cVEMP, air conduction and bone conduction stimulations had comparable VEMP wave latency and amplitude with higher response rates and better waveform morphology in air-conducted stimulation.

For oVEMP, the use of bone conduction stimuli (BCS) resulted in a significant decrease in N1 latency, improvement in waveform morphology, a higher response rate, and a reduction in perceived loudness.

270 - Global Prevalence of Dual Sensory Impairment and the Associated Risk of Cognitive Decline

Esther Yanxin Gao [(1)] - Brian Sheng Yep Yeo [(2)] - Benjamin Kye Jyn Tan [(1)] - Chee Yit Lim [(2)] - Benedict Ding Chao Ong [(2)] - Ryan Wei Yang Cho [(2)] - Vanessa Yee Jueen Tan [(1)]
Singapore General Hospital, Department of Otorhinolaryngology-Head & Neck Surgery, Singapore, Singapore [(1)] - National University of Singapore, Yong Loo Lin School of Medicine, Singapore, Singapore [(2)]

Background**:** Hearing and vision impairment are two sensory deficits that often plague the older population. They are important risk factors for poor health outcomes, especially cognitive decline. Dual sensory impairment (DSI), or concomitant hearing and vision impairment, carries additional morbidity. While the prevalence of each impairment is well-known, it is unclear how common DSI is. Additionally, it is unclear if the associated risk of poor health outcomes is synergistically impacted by having dual impairments. This systematic review and meta-analysis thus seeks to establish the global prevalence of DSI and its attributable risk of cognitive decline.
Methods**:** PubMed, Embase and the Cochrane Library were systematically searched. Two independent reviewers screened articles for eligibility, extracted data, and assessed the risk of bias using the Newcastle-Ottawa Scale. Population-based epidemiological studies of adults aged 18 and older were included if they reported either (i) the prevalence of DSI, or (ii) the association of DSI with objective cognitive decline. As greater heterogeneity was anticipated in the analysis of DSI prevalence, only objectively defined DSI was used for that analysis, while both subjective and objective DSI were accepted for the association with cognitive decline. Studies were excluded if they reported outcomes in special populations or were published in languages other than English. Random-effects inverse variance meta-analyses were performed to estimate the pooled prevalence of DSI, and the association between DSI and cognitive decline. Subgroup analyses and univariate meta-regression were conducted to explore potential sources of heterogeneity, while funnel plots and trim-and-fill sensitivity analyses were conducted to assess publication bias. The population attributable risk of cognitive decline associated with DSI was calculated using published formulas.
Results**:** From 1568 non-duplicated records, 1509 articles were excluded based on title and abstract screening, 100 articles were excluded based on full-text review, and 41 studies were included in the meta-analysis. The risk of bias was low to moderate in the majority of studies. The pooled global prevalence of DSI was 5.05% (95%CI=2.49-9.97, 95%PI=0.13-68.91, I^2=100%, τ^2=3.06, 22 studies, N=3,917,520), with variations across regions, ethnicities and age groups. DSI was associated with prevalent cognitive impairment (OR=1.98, 95%CI=1.61-2.44, 95%PI=1.07-3.67, I^2=72%, τ^2=0.05, 7 studies), prevalent dementia (OR=1.28, 95%CI=1.01-1.61, 95%PI=0.47-3.48, I^2=99%, τ^2=0.04, 4 studies), incident cognitive decline (OR=1.72, 95%CI=1.37-2.15, 95%PI=0.70-4.25, I^2=92%, τ^2=0.1647, 16 studies) and incident dementia (OR=1.52, 95%CI=1.33-1.75, 95%PI=1.07-2.18, I^2=45%, τ^2=0.02, 9 studies), after adjusting for demographics and comorbidities. Subgroup analyses demonstrated lower heterogeneity among the studies which used objective measurements of DSI, and among the studies that used participants with normal vision and hearing as the comparator (instead of any participant without DSI). Age, percentage male, study design and follow-up duration were not significant effect moderators on meta-regression. The population attributable risk of incident cognitive decline associated with DSI was 3.51% (95%CI=0.91-10.29).
Conclusion**:** DSI is globally prevalent and associated with incident cognitive decline. This study highlights the worldwide imperative to address DSI, and may guide resource allocation at a policy level amidst an ageing population.

Keywords: dual sensory impairment, hearing, vision, dementia, cognition

251 - Candidacy for self-test procedures and the use of smart devices in audiology

Mark Laureyns [1] - Laura Delmarcel [2] - Limme Mateusen [2] - Wieske Pullens [2] - Tine Bijnens [2]
Amplifon, Centre for Research and Studies CRS, Milano, Italy; Thomas More University College, Audiology, Antwerp, Belgium [1] - Thomas More University College, Audiology, Antwerp, Belgium [2]

Background and Aim:
The use of self-test procedures and smart devices in ear and hearing care, is growing fast and has huge potential, but what about the candidacy? How do we make sure that the test-procedure or the extra service adds value to the user and the audiologist?
Method:
We created a E-profile questionnaire for the audiology practice in 2022, where we first asked the subjects to indicate which smart devices they use and further they were asked to self-rate the ease of use of the devices they use on a visual analogue scale. This questionnaire proved to have an excellent test-retest reliability and is a good predictor of manipulation problems and the duration when self-performing audiology related tests on a smart device.
This year (2023_2024) we recruited 120 subjects, matched in age and gender and clustered in 4 age cohorts (50_59 years, 60_69 years, 70_79 years, >=80 years).
The subjects also completed tablet-based questionnaires (Auditory Functionality and HHIE-S) and self-test audiometry (PTA), Digit Triplet Test in Noise (DTT) and the ANL video-self-test (ANL). These tests were performed twice to evaluate the test-retest reliability. The subjects were observed and the “overall performance”, “visual”, “manipulation” and “auditory” problems were rated on a 5-point scale.
Results:
We will present the devices used by the different age groups and the ease of use of the devices.
Compared to last year’s study, the older age groups used more smart devices.
The E-score correlated with, Age, Test-retest absolute error for the Self-test audiometry and ANL test, observed overall performance, and manipulation problems.
Overall, we see that the self-test HHIE-S questionnaire and the Self-Test Audiometry had a significantly better “overall performance” for the oldest age group and the groups with the lowest E-Score. The DDT show significant manipulation problems and a lower rating for overall performance for the oldest age group and the group with the lowest E-score, compared to the self-test Audiometry and HHIE-S.
Conclusions:
The E-profile questionnaire for audiology practice is a good predictor of overall performance on the self-test questionnaires and audiologic tests we evaluated in this study.
The low overall performance rating for the Digit Triplet Test for the oldest age group and for the subjects with a low E-score is concerning and requires more research in the future.

AUDITORY PROCESSING DISORDERS

150 - Affordable, accessible, community-delivered hearing care among individuals with cognitive impairment: A subgroup analysis from the HEARS RCT

Carrie Nieman [(1)] - Joshua Betz [(2)] - Emmanuel Garcia Morales [(3)] - Jonathan Suen [(1)] - Jami Trumbo [(4)] - Nicole Marrone [(5)] - Hae-Ra Han [(6)] - Sarah Szanton [(6)] - Frank Lin [(1)] - Esther Oh [(7)]
Johns Hopkins University School of Medicine, Otolaryngology-Head & Neck Surgery, Baltimore, United States [(1)] - Johns Hopkins Bloomberg School of Public Health, Biostatistics, Baltimore, United States [(2)] - Johns Hopkins Bloomberg School of Public Health, Epidemiology, Baltimore, United States [(3)] - Johns Hopkins Bloomberg School of Public Health, Epidemiology, Tucson, United States [(4)] - University of Arizona, Speech, Language, and Hearing Sciences, Tucson, United States [(5)] - Johns Hopkins School of Nursing, Nursing, Baltimore, United States [(6)] - Johns Hopkins University School of Medicine, Geriatrics, Baltimore, United States [(7)]

Objectives: Sensory health and cognitive impairment, including dementia, stand at the intersection of two major public health challenges. Sensory impairments are among the most common and disabling comorbidities among individuals aging with cognitive impairment yet frequently go unrecognized and unaddressed. Among sensory impairments, hearing loss is one of the most common comorbidities among persons with cognitive impairment. Prevalence estimates, based on audiometric data, range from 60 to over 90% in specialized memory clinics and approximately 70-80% among community-dwelling cohorts of older adults. As age-related conditions, the prevalence of hearing loss increases with age and is higher among those with greater severity of cognitive impairment. Sensory impairment among individuals with cognitive impairment is associated with increased neuropsychiatric symptoms, yet persons with cognitive impairment have low rates of hearing aid use, around 20%, and face barriers to traditional clinic-based hearing care. The incorporation of community health worker (CHW)-partnered models may increase access and reduce disparities.
The HEARS (Hearing health Equity through Accessible Research & Solutions) intervention was designed as a structured hearing care program delivered by CHWs in a community setting that incorporates provision of a low-cost amplification device with education and counseling on age-related hearing loss. To assess the efficacy of CHW-delivered hearing care provided to community-dwelling older adults, including those with cognitive impairment, a randomized clinical trial was conducted.
Design**:** An open label randomized clinical trial took place in 13 community sites in Baltimore, Maryland. 348 older adults were screened and 151 participants with hearing loss were randomized to receive a CHW-delivered hearing care intervention versus 3-month waitlist control.
The primary outcome was change in communication function (Hearing Handicap Inventory for the Elderly-Screening [HHIE-S]) from baseline to 3-months post-randomization. The average treatment effect was estimated using the doubly-robust weighted least squares estimator. This pre-specified subgroup analysis was stratified by cognitive status using the total Montreal Cognitive Assessment (MoCA) score (≤25: cognitive impairment; post hoc sensitivity analysis using ≤22).
Results**:** Among 149 randomized participants with MoCA data, 100 individuals were cognitively impaired (Mean adjusted MoCA: 21(SD 3.5; 52% African American; 70% low-income). At 3-months post-intervention, 66% with cognitive impairment reported daily device use versus 76% for those without cognitive impairment. Communication function significantly improved among individuals with cognitive impairment compared with the control, with an estimated average treatment effect of -13.92 HHIE-S change (95% CI:-16.84,-10.86), comparable to those without cognitive impairment (-11.47; 95% CI:-18.04,-4.17). Post hoc sensitivity analysis using a ≤22 MoCA cut-off for cognitive impairment yielded similar findings.
Conclusions: Among individuals with cognitive impairment, a CHW-delivered low-cost amplification device intervention, compared with a waitlist control, significantly improved communication function. The improvements were comparable to participants without cognitive impairment and similar in magnitude to improvements documented for older adults who received conventional clinic-based hearing care with hearing aids fit by audiologists. To the authors' knowledge, this trial was one of the largest trials to date of a hearing care intervention in the U.S. to include African American older adults and low-income older adults with hearing loss and cognitive impairment.

Keywords: Cognitive impairment, hearing health equity, community health workers, older adults, over-the-counter hearing technology

152 - Addressing the Unmet Hearing Care Needs of Persons Living with Cognitive Impairment: A Qualitative Study of End-Users, Care Partners, and Experts

Carrie Nieman [(1)] - Marcela Blinka [(2)] - Peter Hope [(2)] - Paul Lee [(2)] - Bella Tu [(2)] - Natalie Wang [(2)] - Sevil Yasar [(2)] - Esther Oh [(2)]

Johns Hopkins University School of Medicine, Otolaryngology-Head & Neck Surgery, Baltimore, United States [(1)] - Johns Hopkins University School of Medicine, Geriatric Medicine, Baltimore, United States [(2)]

Objectives**:** Hearing health and cognitive impairment represent two major public health challenges facing an aging global population. Sensory impairments are among the most common and disabling comorbidities among individuals at risk for cognitive impairment and those already aging with cognitive impairment. Although prevalent, sensory impairments frequently go unrecognized and unaddressed. Optimizing sensory function may be an important yet overlooked approach to reducing the risk of cognitive decline as well as providing potential nonpharmacological interventions to aid in the management of neuropsychiatric symptoms, improve quality of life for persons living with dementia, and reduce burden for care partners.

Among sensory impairments, hearing loss is highly prevalent and can have significant consequences for older adults aging with cognitive impairment. However, few older adults use hearing aids and disparities in care exist by race, ethnicity, and socioeconomic position.

To understand the intersection of hearing loss and cognitive impairment with the ultimate goal of developing an affordable, accessible hearing care intervention responsive to the needs of end-users, a series of semi-structured interviews was conducted.

Design**:** We conducted 20 semi-structured interviews with 10 participants with mild cognitive impairment (end-users) and their 10 care partners and 9 experts. End-users were recruited from the Johns Hopkins Memory and Alzheimer's Treatment Center. Experts were identified professionals with expertise in dementia, hearing, neuropsychiatric symptoms, healthcare delivery, intervention development, and program implementation and dissemination. We used a heterogeneous purposive sampling to recruit participants from diverse race/ethnicities, education, and income levels. Qualitative content analysis was used to identify themes related to the impact of hearing loss on work, relationships, family life, and neuropsychiatric symptoms along with considerations for the development of a hearing care intervention.

Results**:** Among end-users and care partners, 30% self-identified as African American, 45% as male, and 40% reported less than a college degree. Among end-users, the median better ear pure tone average (500, 1k, 2k, 4k Hz) was 35 dB HL (IQR 30.3, 40.6) and 40% are not currently using hearing aids. Among care partners, the median better ear pure tone average (500, 1k, 2k, 4k Hz) was 28.1 dB HL (IQR 26.6, 35) and 60% are not currently using hearing aids.

End-users and care partners identified barriers to accessing hearing care, including the stigma associated with hearing loss, the cost of hearing aids, the lack of availability of hearing care, and the participants' denial of hearing difficulties. Suggested facilitators for improving access to hearing care include more affordable hearing aids and incorporating hearing screenings into routine medical care. The participants' desire to improve communication and care partner support motivate accessing hearing care. Measures of hearing intervention success include strengthened social connections, reduced tension with care partners, and increased social activity. Experts emphasize the importance of education on hearing and dementia, the role of care partners, minimizing burden, and reliance on practical, affordable technology.

Conclusions**:** In a diverse sample of persons living with cognitive impairment, their care partners, and experts, participants identified unique barriers, facilitators, motivators, and measures of success to guide the development of an affordable, accessible hearing care intervention. Understanding and addressing hearing loss among individuals with cognitive impairment is critical and, given existing barriers to care, it is essential to optimize interventions by learning directly from individuals aging with cognitive impairment and their care partners.

Keywords: Cognitive impairment, hearing care, older adults, qualitative research

200 - Screening for Auditory Processing Disorder in French: Initiating the development of a tool for school-aged children

Fauve Duquette-Laplante [(1)] - Jérémie Duval [(2)] - Marie-Pier Pelletier [(2)] - Patricia Darche [(3)] - Adrian Fuente [(1)] - Benoît Jutras [(1)]
Université de Montréal, École d'orthophonie et d'audiologie, Montréal, Canada [(1)] - CHU Sainte-Justine, Audiology, Montréal, Canada [(2)] - CHU Sainte-Justine, Research Center, Montréal, Canada [(3)]

Introduction**:** Auditory difficulties without the presence of peripheral hearing loss is the general overarching definition of Auditory Processing Disorder (APD). As multiple disorders, such as Specific Language Impairment or Attention Deficit/Hyperactivity, can present with similar symptomology, this large and unspecific definition can lead to an increase in the number of referrals and evaluations. Such an influx of referrals and assessments can delay early diagnosis and treatment of APD. Screening tools are generally utilized in these situations to help in the reduction of such an input. Unfortunately, all currently available screening tools are in English and cannot be used with children who do not have English as a first language. Developing an efficient, accessible, and easy-to-use screening tool for APD diagnosis in French could help solve such a problem.
Objectives**:** The current pilot study aimed to develop and assess the psychometric properties of a French APD screening test battery for identifying children at risk of APD.
Methods**:** Children (9.2 ± 1.3 years) referred for a first APD evaluation were recruited from the audiology service at the CHU Sainte-Justine and the speech-language pathology and audiology clinic at the University of Montreal. Fifty-three school-aged children participated in the current study. Children were assessed with the APD screening tool (fifteen to twenty minutes total) before being evaluated with the full APD test battery (two to three hours total). The APD screening tool was comprised of two main elements: auditory behavioural subtests (Pitch Pattern Sequence Test (PPST) and French versions of Musiek's Dichotic Digits test (DD_{fv}), a word in noise test (WIN_{fv}) and the Forward Digit Span test (FDS_{fv})) and two questionnaires – one for the parent and one for the teacher.
Results**:** Forty-five participants were eligible for analysis, and four children were identified with APD. Direct logistic regression was used to measure the questionnaires' predictive value for the diagnosis of APD. Six themes (Reading and Writing, Oral Expression, Math, Other, Listening Skills and Comprehension, Concentration and Organization) were extracted from both questionnaires, and there were no significant contributions to either model. The sensitivity, specificity, positive and negative predictive values (PPV and NPV), and efficiency were calculated with the behavioural subtests. Two subtests were failed by all four participants diagnosed with APD: the FDS_{fv} and the DD_{fv}. The subtests were subsequently extracted and combined, yielding 100% NPV, 36% PPV, and 84% efficiency with the highest sensitivity (100%) and specificity (80%).
Discussion**:** The results obtained in the current pilot study are promising. The excellent NPV (100%) suggested that combining DDfv and FDSfv could correctly identify children with APD. Even with a higher referral rate (PPV at 36%), the refinement of the subtests incorporated in this screening tool has the potential to minimize further unnecessary referrals and assessments by focusing on children at elevated risk of APD. Such a reduction could, therefore, allow early diagnosis in children with APD and increase their chances of receiving timely and adequate rehabilitation or intervention, enhancing their communication and academic performance. In its final form, this screening tool could play a vital role in identifying school-age children at risk of APD, as it could be easily administered in schools under controlled noise conditions by audiologists or various healthcare and education professionals.

Keywords: Auditory Processing Disorder, screening, school-aged children,

154 - Central auditory processing disorders in children with congenital cytomegalovirus infection
Sofya Vikhnina [(1)] - Ekaterina Garbaruk [(1)] - Maria Boboshko [(1)]
Pavlov First St. Petersburg State Medical University, Laboratory of hearing and speech, Saint-Petersburg, Russian Federation [(1)]

Background**:** Congenital cytomegalovirus (cCMV) infection is a common congenital infection with an incidence rate ranging from 0.5 to 2% of all live births [Kim B.J. et al., 2018]. It is a leading cause of non-genetic sensorineural hearing loss (SNHL) and developmental delay [Cushing S. et al., 2022; Kassis I. et al., 2023; Natale F. et al., 2020.]. It is reported that 21% of children asymptomatic at birth and 33% of those symptomatic at birth developed hearing loss. Despite advancements in the field, it remains unclear which newborns are at risk of SNHL, especially in regard to late development [Palma S. et al., 2023]. As well as it is still a lack of data about the cCMV effect on the central auditory nervous system. Rare publications concern auditory processing disorders (APD) development in patients with cCMV. Despite it is reported that cCMV has no significant impact on central conduction along the auditory pathways in the brainstem and that cCMV does not universally affect central nervous system maturation [Kassis I. et al., 2023] nevertheless the poorer cochlear implantation (CI) outcomes could consider central auditory pathways involvement. Some researchers reported that children with cCMV-related hearing loss show poorer speech production than other CI children, despite early implantation [Courtois C. et al., 2021]. Poorer CI outcomes in cCMV children implantation could be due to APD.
The aim is to assess central auditory pathways in children with cCMV.
Materials and methods: 20 children aged from 4 to 10 years old underwent comprehensive audiological assessment: 10 children with cCMV (the main group) and 10 ones without cCMV (the control group). The evaluation included standard tests such as acoustic impedance measurement (tympanogram and stapedius reflex), otoacoustic emissions recording (TEOAE and DPOAE), click-auditory brainstem registration, pure-tone audiometry as well as tests for auditory processing disorders: speech audiometry in quiet and noise, dichotic digital test, random gap detection test, binaural fusion test and cortical auditory evoked potentials registration (P1-N1-P2-N2).
Results: All children showed normal results in all tests for peripheral auditory system evaluation with normal pure-tone thresholds. 7 children of 10 in the main group and only 1 child of 10 in the control one failed APD tests, thereby APD were suspected significantly more frequently in group of children with cCMV, than in control one (70% and 10% respectively). The results obtained definitely requires higher attention to these children, regular sessions with speech therapist, special auditory training in order to improve speech intelligibility.
Conclusion: Due to higher APD occurrence in children with cCMV, APD evaluation is kindly advisable along with a usual peripheral hearing follow-up. In children older than 4 years old, audiological examination should include tests in order to assess the central auditory pathways function. Methods of speech audiometry, including the examination of speech in ipsilateral background noise, the binaural fusion test, and the dichotic digits test could be used for the APD testing in preschool children from the age of 4 years old.

Keywords: congenital CMV, hearing loss, children, auditory processing disorders.

213 - Listening difficulties in children referred with concerns about language development using the Evaluation of Children's Listening and Processing Skills questionnaire

Loes Desmedt [(1)] - Sam Denys [(1)] - Ann Goeleven [(1)] - Astrid van Wieringen [(2)] - Nicolas Verhaert [(1)]
UZ/KU Leuven, Otorhinolaryngology - Head and Neck Surgery / Neurosciences - ExpORL, Leuven, Belgium [(1)] - KU Leuven, Neurosciences - ExpORL, Leuven, Belgium [(2)]

Listening difficulties (LiD) are a core symptom of many developmental disorders, such as language disorders. In the absence of targeted behavioral tests, the range and nature of these difficulties are believed to be better captured using robust qualitative measures. Children referred with concerns related to language development typically undergo an Ear-Nose-Throat evaluation with audiological assessment, and intelligence- and language testing. Based on clinical observations, the test battery can be supplemented with tests assessing reading and spelling, psychomotor abilities, attentional skills and memory, and evaluations of social-emotional functioning. Weaknesses in any of these domains can be contributing to experienced or observed LiD. The Evaluation of Children's Listening and Processing Skills (ECLiPS) questionnaire aims to profile strengths and weaknesses in abilities related to listening, and might be a valuable instrument to support clinical decision making.

This prospective observational study aimed to (1) quantify the prevalence of LiD in a group of children referred with concerns about language development, (2) investigate intra- and interrater reliability, and (3) explore the agreement of ECLiPS profiles with clinical observations.

Caregivers of children aged 6-14 years (N = 18, 8 girls, 10 boys) referred to the Multidisciplinary University Center for Speech-Language Pathology and Audiology of the University Hospital of Leuven with language-related concerns were asked to complete an online version of the ECLiPS questionnaire at three distinct events (1) after intake, (2) before advice and (3) one year after diagnosis. Diagnostic test results and developmental diagnoses were retrieved from the children's electronic patient files.

Two completions from the same respondent were obtained for every child. Intraclass correlation coefficients (ICC), quantifying test-retest or intra-rater agreement, varied between 0.67 and 0.82 among ECLiPS factors. With respect to agreement between caregivers (interrater agreement), ICC values between 0.58 and 0.79 were obtained. Overall, these values point to a moderate-good reliability of the ECLiPS questionnaire in the current study sample.

Taking into account reference data from typically developing children (percentile 10 scores), LiD were found in 16/18 children (81%; 7 girls, 9 boys). Most frequently (12/16), and as could be expected, the poorest score was found for LLL, the language factor of the questionnaire. Noteworthy, only one child failed this factor in isolation. Most of the children were observed to have deviating scores for multiple factors. On the contrary, two children referred for a multidisciplinary assessment obtained scores within typical ranges for all ECLiPS factors. Overall, diagnostic observations (e.g., poor language skills, weak auditory short-term memory, concentration, and social interactions) and diagnostic test results seem to be in line with ECLiPS profiles, pointing towards a high validity of the questionnaire.

Data collection is ongoing at the time of abstract submission and results are preliminary at this stage. This is the first study looking at cognitive profiles using the ECLiPS questionnaire in a sample of children with language disorders. Children diagnosed with other developmental disorders will be the topic of future studies.

Keywords: ECLiPS, listening difficulties, language disorders

32 - Normative values of tests assessing auditory processing disorder (APD) for children aged 6 to 12

Piotr H. Skarżyński [(1)] - Natalia Czajka [(2)] - Rita Zdanowicz [(2)] - Aleksandra Kołodziejak [(3)] - Ewelina Bukato [(2)] - Małgorzata Talarek [(2)] - Zuzanna Pankowska [(2)] - Henryk Skarżyński [(4)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(3)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(4)]

Background**:** Auditory processing disorder can significantly affect the daily functioning of patients and a proper diagnosis is the first step in determining the further procedures of the rehabilitation process. Various guidelines are published in the literature regarding the diagnosis and normative values of psychoacoustic tests assessing auditory processing. Many centers implement them in accordance with internal procedures. The material presented in the paper is the largest collection to date in the world. The studied group includes more than 1,000 children who meet the inclusion criteria.
Material and methods**:** The research material contains the test results of 1,037 children aged 6 to 12, attending primary schools and
grades “0”, conducted in schools and kindergartens. The criterium for inclusion of children in the study were children with a normal audiogram result, intellectual norm, without any development problems and without difficulties in auditory processing. All children involved in the study made selected tests on the Sensory Examination Platform evaluating auditory processings: frequency pattern test (FPT), duration pattern test (DPT) and dichotic digit test (DDT).
Results**:** The results obtained from over 1,000 children allowed to determine the normative values for the FPT, DPT and DDT tests. Different methods of determining normative values, based on classical and positional statistical measures, are presented. The obtained results were confronted with the standards proposed so far in the literature of the subject. The paper proposes quantile-based norms. Three categories (average score, below, and above average scores) allow for a broader interpretation than previously used.
Conclusions**:** The normative values determined on the largest research group, published so far, and on the tool, which is the Senses Examination Platform (intended for general use), can become the basis for unifying the standards of conduct of entities dealing with the subject matter.

Key words: normative values • DPT • FPT • DDT • auditory processing disorder • APD

37 - Symptoms of auditory processing disorders (APD) in children with tinnitus

Piotr H. Skarżyński [(1)] - Danuta Raj-Koziak [(2)] - Elżbieta Gos [(3)] - Maria Bendykowska [(4)] - Natalia Brzozowska [(4)] - Alicja Cyrzan [(4)] - Natalia Czajka [(3)] - Henryk Skarżyński [(5)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Tinnitus Department, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(3)] - Faculty of Medicine, Interdisciplinary Student's Scientific Society at the World Hearing Center, Collegium Medicum, Cardinal Stefan Wyszynski University, Warsaw/Kajetany, Poland [(4)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(5)]

Introduction: Children rarely self-report having tinnitus and so there is limited understanding of the problems they face and how tinnitus affects their daily lives. In situations where peripheral hearing is normal and the patient reports difficulty understanding speech, one may consider the co-occurrence of other causes, such as auditory processing disorders (APD). The aim of the study was to assess the presence of APD symptoms in children with tinnitus.
Material and methods: The study group consisted of 10,582 children 13 years old. The study material included questions about tinnitus experience, screening pure tone audiometry, and the results of the Scale of Auditory Behaviors (SAB), in its Polish adaptation, which was used to assess whether they may have APD.
Results: In children with tinnitus, symptoms that may indicate APD were observed. In 2849 children, an SAB total score of less than 46 was obtained, an indication for an extended diagnosis. Among these same children 33.7% experienced tinnitus. The more frequently a child experienced tinnitus, the lower the mean overall SAB score.
Conclusions: Children reporting tinnitus should receive additional diagnostic tests for APD. The diagnosis should be multispecialty and, in addition to hearing tests, include an in-depth interview, psychological and pedagogical evaluation, and psychoacoustic tests.

Key words: questionnaire • children • tinnitus • APD • SAB

EARLY IDENTIFICATION – TECHNIQUES AND METHODS (1)

219 - Evolution of Newborn Hearing Screening Practices Through Incorporation of Wideband Absorbance: Methods for implementation

Hammam AlMakadma [(1)] - Caitlin Greer [(1)]
University of Louisville, Otolaryngology-HNS & Communicative Disorders, Louisville, United States [(1)]

Universal newborn hearing screening (NHS) is currently implemented as the standard of care for early identification of congenital hearing loss. Early intervention for hearing loss has been shown to prevent developmental delays. Therefore, the Joint Commission on Infant Hearing (JCIH) guidelines recommend identification by 1 month of age, diagnosis by 3 months of age, and intervention by 6 months of age. Nevertheless, in the United States, a considerable 32.7% of infants identified with hearing loss are late to receive diagnosis and interventions.
Screening tests routinely include otoacoustic emission (OAE) and/or automated auditory brainstem response (AABR). While OAE screens for normal outer hair cell function, and AABR for normal neural response, the test stimuli for both tests are presented in the ear canal and conducted through the middle ear. Therefore, a normal response on OAE or AABR requires a normal 'sound conduction pathway'. In newborns, naturally occurring conductive pathway obstructions, including ear canal vernix and middle ear mesenchyme, are associated with false-positive rates of 76-94%. Although, such obstructions in conductive pathway are temporary, they severely impact hospital-based screening. Since current NHS test protocols lack means for determining whether a "fail" outcome is due to a temporary conductive dysfunction or true sensory-neural hearing loss, repeat inpatient and follow-up outpatient screens are administered to all newborns who fail their screening. Such indiscriminate administration of repeat tests is costly and inefficient. Furthermore, due to high rates of loss-to-follow up, there is a compound risk of delayed interventions for infants with permanent congenital hearing loss.
Incorporating a test of the sound conduction pathway, called wideband acoustic immittance (WAI) test, to NHS protocols can lead to more conclusive interpretations of OAE and AABR outcomes, as well as a more intentional referral paradigm. For example, if an infant fails an OAE/AABR screening and has normal WAI test findings, the infant is at an elevated risk for sensory-neural hearing loss. Subsequently, prioritized referral for diagnostic evaluation can be made without additional need for repeat screenings. Furthermore, WAI testing is a more appropriate test compared to tympanometry. This is because the immature cartilaginous ear canal walls of newborns/infants are compliant to tympanometry pressure, thereby violating the assumption underlying traditional tympanometry. By comparison, conducting a WAI test does not require pressurization of the ear canals. WAI recordings are measured using OAE-type ear-canal probes using commercially available instruments.
Wideband absorbance (WBA) has been investigated, as the WAI measure of choice, with growing evidence of its effectiveness for implementation in newborn screening programs. In this presentation, we will discuss practical considerations and make recommendations for augmentation of current OAE- and/or AABR-based screening protocols with WBA measurements. This will be discussed in light of the authors' recent research findings. Specifically, (1) to report on a new method for assessment and identification of normal and abnormal WBA using the 'Absorbance Peak Template'. (2) To outline updated NHS protocols that incorporate WBA testing alongside OAE/AABR tests. (3) Finally, to describe referral paradigms using combined outcomes from WBA and OAE/AABR.

Keywords: Newborn, Wideband absorbance, Early Detection & Intervention

43 - Outcomes of a pilot hearing surveillance program for young children (1-7 years old) with speech delay: A retrospective study

Jenny Loo [1] - Manjia Fu [1] - Maureen Ding [1] - Tze Ling Kek [2] - Magdalene Lim [2]
National University of Singapore, ENT, Head & Neck Surgery (Audiology), Singapore, Singapore [1] - National University Hospital, ENT, Head & Neck Surgery (Audiology), SINGAPORE, Singapore [2]

Purpose: Although universal newborn hearing screening (UNHS) program has been implemented in most countries, there is no recommendation on hearing surveillance for children at risk for late onset hearing loss. This study aimed to evaluate the outcome of a pilot hearing surveillance program for children aged 7 years and below, who passed UNHS but present with speech delay and other developmental disorders.
Method: This retrospective study analyzed the hearing results of 59 children (aged 1-7 years old) who underwent an on-site hearing surveillance at the pediatrician clinic (Child Development Unit). The testing protocol consisted of a self-developed questionnaire, otoscopy examination, tympanometry, and transient-evoked otoacoustic emissions (TEOAE).
Results: 53 (90%) reported no parental concern in terms of hearing loss in their children. 54 children (92%) tolerated the otoscopy examination, while 56 children (95%) completed tympanometry test, of which 16% (n = 9) had abnormal results that warrant immediate medical doctor's treatment. Only 36 children (61%) cooperated for TEOAE testing, with 22 passed TEOAE while the rest (39%) had a refer result that required further audiological diagnostic assessment. Of the 23 children who did not cooperate for TEOAE testing, 61% of them had a provisional diagnosis of autism spectrum disorder (ASD).
Conclusions: Parental questionnaire may not be a reliable hearing surveillance tool. Otoscopy, tympanometry, and TEOAE are deemed feasible and acceptable by most of the young children. Such an objective hearing surveillance protocol should be implemented as part of the routine developmental check by pediatricians for children with speech delay.

Keywords: Hearing surveillance, late onset hearing loss, children

68 - High frequency bone conduction thresholds up to 16 kHz in individuals with high-frequency hearing loss

Lieke Luiken [(1)] - Hiske Helleman [(1)] - Koen Rhebergen [(1)]
UMC Utrecht, ENT Department, Utrecht, Netherlands [(1)]

Background: Early detection of potential hearing damage in children undergoing chemotherapy is crucial. Chemotherapy-related hearing loss often initiates in the high frequencies within the cochlea. To monitor ototoxicity, air conduction (AC) extended high frequency thresholds can be measured up to 16 kHz. However, middle ear problems (conductive hearing loss) affect AC thresholds, and thus hamper the determination of high-frequency cochlear loss. Regular diagnostic audiometry includes bone conduction (BC) threshold measurements which is limited to frequencies up to 4 kHz. Measuring BC thresholds at higher frequencies (up to 16 kHz) in individuals with high-frequency hearing loss would be a relevant addition to reliably detect cochlear damage. A study by Rhebergen (2023) showed that BC thresholds at higher frequencies could reliably be measured in normal hearing subjects. How well the BC thresholds could be measured in subjects with a (mixed) extended high frequency hearing loss is the aim of this study.

Material and Methods: Hearing thresholds will be measured on 100 ears of 50 subjects aged 18 to 65 years. In the first part of the study, we intend to measure 25 subjects with some age-related sensorineural hearing loss (in high frequencies). In the second part, we intend to measure 25 subjects with middle ear problems and age-related hearing loss.

Standard diagnostic audiometric tests are performed; hearing thresholds are obtained from 125 Hz to 8 kHz using AC transducer (Telephonics THD-39) and from 250 Hz to 4 kHz using BC transducer (Radioear B81). High frequency hearing threshold will be obtained from 8 to 16 kHz using the AC transducer (Sennheiser HDA200) and from 8 kHz to 16 kHz with the high frequency BC transducer (Westra KLH96). The obtained AC and BC hearing thresholds will be compared. The BC measurements will be repeated to assess the effect of the placement of the transducer.

Results: Subject inclusion and data collection are ongoing, and we anticipate presenting substantial results of part one at the time of the conference. Furthermore, we aim to present the preliminary results of part two. At this point the data collection is premature, and no conclusion can be drawn yet.

Conclusion

In this study we measured the high frequency hearing thresholds using air and bone conduction transducers. While the results so far are promising, no conclusions can be drawn at this time. Nonetheless, the findings mark a significant step toward the further implementation of high frequency bone conduction.

Keywords: High frequent bone conduction audiometry

94 - Early communication profiles and predicting risk of Autism Spectrum Disorder in deaf or hard of hearing children

Libby Smith [1] - Katherine Wilkins [2] - Jessica Xu [3] - Daisy Shepherd [4] - Valerie Sung [5]
Murdoch Children's Research Institute, Population Health, Parkville, Australia [1] - Barown Health, Paediatrics, Geelong, Australia [2] - University of Melbourne, Statistics, Parkville, Australia [3] - Murdoch Children's Research Institute, Clinical Epidemiology and Biostatistics Unit (CEBU), Parkville, Australia [4] - Royal Children's Hospital, Centre for Community Child Health, Parkville, Australia [5]

Background: Deaf or hard of hearing (DHH) children often experience symptoms of Autism Spectrum Disorder (ASD) which may be a result of their hearing loss or co-existing ASD. This overlap of symptoms can mean professionals conclude a child's difficulties are due to hearing impairment alone. Therefore, DHH children are diagnosed with ASD at an older age compared to the general population. (1) This later diagnosis causes a delay in access to appropriate early intervention. Early communication profiles of DHH children may predict risk of ASD and direct early intervention.
Aims: We aimed to describe early communication profiles in DHH children and determine whether the Communication and Symbolic Behaviour Scale (CSBS) can be used to identify DHH children at risk of ASD.
Methods: Data was drawn from the Victorian Childhood Hearing Longitudinal Databank (VicCHILD), a population-based databank of children with permanent hearing loss in the state of Victoria, Australia. Research is directed by the VicCHILD Advisory Group, composed of child-hearing health stakeholders, who meet annually to discuss research directions, and by parent stakeholders, who are consulted on research priorities. Communication profiles of DHH children aged 6 to 24 months were measured using the CSBS Infant Toddler Checklist. We used Chi-square tests to identify associations between child/family characteristics and CSBS scores, and logistic regression to analyse the relationship between CSBS scores and subsequent ASD diagnosis.
Results: Of 288 caregivers (81%) who completed the checklist, 87 (30%) of CSBS Total scores were in the 'concern' range. Children with bilateral hearing loss, hearing amplification, prematurity and language other than English were more likely to have CSBS scores in the 'concern' range.
Of 147 caregivers who later reported on additional medical diagnoses, 17 (11.5%) reported their child had ASD. Children with Total CSBS scores in the 'concern' range were 6.6 times more likely than those with scores in the 'no concern' range to have a subsequent ASD diagnosis (95% CI [2.2, 20.9]). Children with Social Communication subscale scores in the 'concern' range were 11.0 times more likely (95% CI [3.5, 34.1], and those with Symbolic Play subscale scores in the 'concern' range were 12.9 time more likely (95% CI [3.5, 47.7] than those with scores in the 'no concern' range to have a subsequent ASD diagnosis. However, having an Expressive Speech subscale score in the 'concern' range did not increase the likelihood of later ASD diagnosis (95% CI (0.6, 4.7).
Conclusions: This study suggests the CSBS Infant Toddler Checklist may be able to identify DHH children at risk of ASD. The findings have implications for screening and early intervention in young DHH children.

Keywords: child hearing loss, early communication, screening, Autism Spectrum Disorder

231 - Effects of age and screening device on percentage of false positive results at first hearing screening by Child Health Service

Kitty Van der Ploeg [(1)] - Noëlle Uilenburg [(2)] - Olmo Van der Mast [(1)] - Lion Van den Bosch [(3)] - Paul Verkerk [(1)]
TNO, Child Health, Leiden, Netherlands [(1)] - Dutch Foundation for the Deaf and Hard of Hearing Child, R&D Early identification of hearing loss - NHS, Amsterdam, Netherlands [(2)] - National Institute for Public Health and the Environment, NHS, Bilthoven, Netherlands [(3)]

Introduction. For parents, children and efficiency considerations the number of false positive screening results needs to be as low as possible. We analysed the effect of age and type of screening device (Echoscreen I/II versus III) on the percentage of false positive results at the first hearing screening by Child Health Service in the Netherlands.
Methods. Results from the first hearing screening test of newborns screened from 2013 to 2022 were analysed. The dataset contained the OAE (otoacoustic emission) results for the left and right ear separately (pass, refer, failed measurement or missing), day of 1st screening (with day of birth=day 0), year of birth, type of screening device (Echoscreen I/II (together) or III) and preterm birth. Because preterm infants are a special group who are often not screened until older ages, preterm infants were excluded from further analyses. Since 2020, the percentage of children screened with the Echoscreen III has increased from 25.2% to 41.8% in 2022. Therefore, for the effect of type of screening device only data from 2020 to 2022 were considered. The results of left and right ear were combined into one result. Only children who had a pass result on both ears were considered as 'no second test needed'. All other combinations of results were given 'positive at first test' as outcome. The percentage with a 'positive at first test' was calculated by age at screening. Only results from children who eventually -after one to three screening rounds- achieved a bilateral pass screening result were included (±0,3% excluded). This was done to exclude true-positive children, i.e. with a hearing loss ≥40 dB on one or both ears. Thus, the outcome 'positive at first test' was considered as 'false-positive at first test'.
Results. The dataset contained data from 1,663,646 children. Of these, 12,863 preterms (0.8%) were excluded. Age at screening. The relationship between age at first hearing test with the Echoscreen I/II/III and the percentage with 'false-positive at first test' for all years combined showed the lowest percentages between day 6 to 12 (3.31-3.68%). An increase is visible toward younger ages (6.3% on day 3, 4.7% on day 4, 3.8% on day 5). An increase is also visible after day 12 to 5.8% on day 20, 6.3% at week 3, 6.6% at week 4 and then an unexpected decrease to 5.6% at week 5 and 5.4% at the rest of the 2nd month.
Screening device: Echoscreen I/II versus Echoscreen III. In 2020 to 2022, the Echoscreen I/II and III had an average percentage of 'false-positive at first test' of respectively 3.9% and 5.4% (difference 1.5%; 95% confidence interval 1.4 to 1.7%). At all ages, the Echoscreen III has a higher percentage of 'false-positive at first test' than the Echoscreen I/II.
Conclusions. To prevent false-positive screening results at the first hearing screening, the Echoscreen tests can best be performed between day 6 to 12 after birth. In the Netherlands, hearing screening and newborn blood spot screening are often performed simultaneously. From the perspective of newborn blood spot screening, screening as soon as possible from day 3 is preferable to screening at an older age. The pros and cons of early screening for both screening programmes need to be balanced to choose the optimal day of screening. Currently, screening as soon as possible from day 4 after birth is recommended if both screenings are performed simultaneously. Changes in screening devices also affect the test results. The Echoscreen III gives more false-positive results at the first test than the Echoscreen I/II. It is recommended to monitor the performance of screening devices before and while introducing them in national screening programmes.
Limitation of our study. Children were assumed to have a false positive first test result if both ears got a 'pass' at the second or third screening. However, as they were not referred to an audiological center, the false-positive outcome was not confirmed by diagnostic tests. This limitation holds for all age groups and for Echoscreen I/II as well as Echoscreen III. Therefore, we do not expect this to affect the conclusions.

Keywords: Hearing screening, Neonatal screening, Otoacoustic emission, OAE, Age, Screening device, false positive

248 - Agreement between electrophysiological measures of hearing in young children

Snezana Andric Filipovic [1]
Mater Dei Hospital Malta, ENT, Msida, Malta [1]

Objective hearing tests are sometimes the only possible tools capable of defining hearing thresholds in young children. However, electrophysiological tests differ between each other and between two consecutive tests in the same child. Some of these variabilities can be explained by diseases parameters, but some depend on other factors, like frequency, test conditions, interference. Application of the widely acceptable correction factors does not change these pictures.
Aim of this presentation is to analyse different qualitative and quantitative measures capable of addressing hearing thresholds differences between two electrophysiological tests (ABR and ASSR), and between the same test mode in different time intervals.
Two electrophysiological measures, ABR and ASSRs, differ significantly ($p<0.001$) in both ears. These differences can be explained by age, health issues related to NPICU stay, malformations, hereditary factors ($R2=.628$, $p<0.001$). These patterns are partly similar to changes observed in the same test mode in different time intervals.
Hearing thresholds obtained using the ABR tests are generally higher than those of the ASSR, but differences are not uniformly presented and stable. Their oscillations depend on age, child health history, family history etc. Correction factors for the behavioural hearing thresholds estimation should be adjusted according to these factors.

117 - Auditory assessment for train drivers: evaluating the reliability and relevance of a profession-specific warning signal detection test

Kelly Haaijer [(1)] - Femke Theelen [(1)] - Cas Smits [(1)]
Amsterdam UMC, Department of Otolaryngology - Head and Neck Surgery, section Ear & Hearing, Amsterdam Public Health research institute, Amsterdam, Netherlands [(1)]

Background: For safety reasons, Dutch train drivers must be able to detect auditory warning signals in noisy cabins. Therefore, a profession-specific warning signal test is used in our clinic. The current test, however, is partially obsolete due to new trains and new warning signals. The test estimates SNR50: the signal-to-noise ratio at which 50% of signals are correctly detected. A train driver is deemed 'safety-qualified' for warning signal detection if their SNR50 is at least 15 dB lower (more favorable) than the true SNR in cabins of a train driving at maximum speed. This criterion, however, has not been validated for listeners with hearing loss.
Aims: This study aims to improve the current profession-specific warning signal test in three ways. The first improvement is to add sound recordings from new trains and warning signals to make the test more representative for current working conditions. Secondly, the test-retest reliability for listeners with hearing loss is measured to estimate the precision of test results. Thirdly, the entire psychometric function for signal detection for individuals with normal hearing and hearing loss is measured to validate the 15 dB criterion in both populations. These improvements will lead to a more robust criterion for assessing auditory competence. Additionally, the influence of visual distraction on signal detection will be tested to indicate if the safety-qualification criterion should be corrected for this effect.
Methods: The test has been augmented with long-term average spectrum noise determined from recordings in the 'Intercity Nieuwe Generatie (ICNG)' train. The warning signal from the new European Train Control System (ETCS) was included, as well as the Automatic Train Protection (ATP) signal, which is the warning signal in most train types in the Netherlands. First, SNR50 was measured using an adaptive procedure. Second, percentage correct scores were measured at fixed SNRs around SNR50 to determine the psychometric function for signal detection. Signal detection was also measured while listeners watched a video from the cabin. Listeners with hearing aids were tested aided and unaided.
Study sample: Listeners with normal hearing and listeners with hearing loss, aged between 35 to 75 years old.
Results and conclusion: To date, 19 individuals (15 hearing impaired, 4 normal hearing) were enrolled in the study. Currently, data collection is still ongoing. Relationships between SNR50, slope of the psychometric function, hearing aid usage, and pure-tone thresholds will be examined. The findings will contribute valuable insights for refining safety qualification criteria and addressing the influence of distractions on auditory assessment. The results will be presented in the talk.

Keywords: signal detection, train drivers, warning signals, hearing loss, hearing aids

Special Session

Listening effort and affective responses: Exploring the multidimensional aspects of hearing

Session Coordinators: Alessia Paglialonga and Edoardo Maria Polo

258 - Listening effort and affective responses: Exploring the multidimensional aspects of hearing

Alessia Paglialonga [(1)] - Edoardo Maria Polo [(2)]
Consiglio Nazionale delle Ricerche (CNR), Milan, Italy [(1)] - Politecnico di Milano, Italy [(2)]

Listening effort, the mental exertion required to navigate challenges in auditory processing, is a pivotal aspect of the listening experience. While commonly perceived as effortful and stressful, clinical measures of listening effort in audiology are not widespread.

Self-report measures, often in the form of closed-set questionnaires or rating scales, are the conventional means to gauge listening effort. However, relying solely on self-reports may not offer a comprehensive reflection of the cognitive demands associated with comprehending auditory messages. To address this, the scientific community is exploring variables and physiological indices as potential biomarkers for this cognitive effort. In this Special Session, we will discuss recent findings in the area of listening effort and behavioral and physiological measures.

Moreover, listening effort, akin to an emotion itself, elicits a spectrum of feelings during the listening process, including frustration, confusion, and enjoyment. Noticeably, individuals perceiving a high level of listening effort are more likely to report negative emotions such as boredom or annoyance. Surprisingly, in the literature the relationship between hearing and emotions is comparatively understudied, compared for example to the extensive analysis of visual stimuli. While the role of auditory stimuli in eliciting emotions has been minimally explored, determining the comparative effectiveness of different stimulation types—audio, visual, or audio-visual—remains a challenge.

This Special Session aims to bridge this gap and stimulate discussion by exploring the less-investigated connections from auditory stimuli to listening effort and emotions. This exploration extends to the monitoring of physiological signals and machine learning methods to investigate the efficacy of various stimulation approaches.

261 - Investigating the Impact of Auditory Stimulation on Emotion Processing: Insights from Physiological and Machine Learning Perspectives

Edoardo Maria Polo [(1)] - Andrea Farabbi [(1)] - Maximiliano Mollura [(1)] - Alessia Paglialonga [(2)] - Riccardo Barbieri [(1)]
Politecnico di Milano, DEIB, Milano, Italy [(1)] - Cnr-Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni (CNR-IEIIT), DEIB, Milano, Italy [(2)]

Background:
The growing fascination with emotions has sparked a demand for innovative methodologies to provoke and assess emotional reactions. In traditional examinations of emotions, visual stimuli take precedence, yet the endeavor to exclusively discern emotional content through sight or sound poses a formidable challenge, particularly as auditory stimuli are less frequently utilized in the literature. To address this challenge, our research endeavors to investigate the intricate physiological reactions elicited by various modalities of stimuli by incorporating both auditory and visual cues. Leveraging well-established databases like the International Affective Pictures System and International Affective Digital Sounds, we are developing a comprehensive experimental protocol to deepen our understanding in this domain.
Methods:
Our experimental protocol involves eliciting emotions through auditory, visual, and combined auditory/visual stimuli. Twenty-one healthy young adults with normal hearing participated in the study, during which we recorded several physiological signals, including galvanic skin response, electrocardiogram, blood volume pulse, pupillary signal, and electroencephalogram. To assess the autonomic and central nervous system responses, we analysed these signals in relation to the three types of stimulation. Additionally, we applied an interpretable feature selection technique and basic machine learning classifiers to discern emotional states and identify the most effective stimuli for classification.
Results:
The data analysis revealed that auditory stimuli elicited the most pronounced responses, both peripherally and centrally. Physiologically, subjects exhibited elevated galvanic skin response, deceleration of heart rate, and heightened attention, as indicated by electroencephalographic signals during auditory stimulation compared to visual stimuli. Additionally, in terms of machine learning analysis, auditory stimuli demonstrated superior predictive capabilities for emotional states and induced distinct physiological patterns compared to visual stimuli. This underscores the significance of auditory cues in both physiological arousal and machine learning-based emotion prediction.
Conclusion:
In conclusion, our study underscores the pivotal role of auditory stimuli in eliciting and modulating emotional responses, particularly within the context of hearing. The heightened galvanic skin response and increased attention observed during auditory stimulation highlight the profound impact of auditory cues on emotional processing. This emphasizes the importance of incorporating auditory components in emotion recognition studies, aligning with the focus of our hearing-centric research.
Furthermore, our interdisciplinary approach extends beyond physiological analysis to encompass machine learning techniques for emotion classification. Notably, our findings demonstrate that auditory features emerge as significantly more effective in discerning emotional states compared to visual stimuli. This highlights the potential of auditory-based interventions and underscores the need for further exploration in leveraging sound-based modalities for emotion recognition and prediction.

Keywords: Emotions, Signal processing, audio stimuli, visual stimuli

239 - Assessment of listening effort in clinical settings using manual response time and self-ratings

Chiara Visentin [(1)] - Chiara Bonora [(2)] - Nicola Brunelli [(3)] - Andrea Migliorelli [(3)] - Laura Negossi [(3)] - Pietro Scimemi [(2)] - Rosamaria Santarelli [(2)] - Andrea Ciorba [(3)] - Nicola Prodi [(1)]
University of Ferrara, Department of Engineering, Ferrara, Italy [(1)] - University of Padova, Department of Neuroscience, Padova, Italy [(2)] - University of Ferrara, Department of Neuroscience and Rehabilitation, Ferrara, Italy [(3)]

This study aimed to compare the use of manual response time (RT) and self-ratings as measures of listening effort in clinical settings. This comparison was conducted during speech-in-noise evaluations using adaptive procedures across varied background noise and reverberation conditions.
Sixty participants were included which were categorized into three groups based on age and hearing threshold: young listeners with normal hearing (YL_NH: n = 36, age: 27.4 ± 3.4 yrs, mean PTA: 3.5 dB nHL), older listeners with normal hearing (OL_NH: n = 14, age: 66.7 ± 4.7 yrs, mean PTA: 14.0 dB nHL), and listeners wearing hearing aids (HA: n = 11, age: 59.3 ± 20.2 yrs, mean PTA: 49.0 dB nHL). Speech-in-noise tests were administered in clinical settings, using an adaptive staircase procedure and a closed-set format. Target speech and background noise were played back with two loudspeakers positioned in front of the listener with an angular span of 45°; a cross-talk cancelling was implemented. The playback system allowed to create virtual sound sources with spatial attributes, either placed at arbitrary locations or spatially diffuse. Sequences of four disyllabic words without any syntactic link were presented in four listening conditions: two reverberation conditions (anechoic, reverberant with mid-frequency reverberation time of 0.56 s) and two background noise types (stationary noise and fluctuating noise, with the spectrum of a female talker).
Speech reception thresholds for 80% correct word identification (SRT_{80}) were determined in each condition. Manual response time (i.e., time elapsed between the audio offset and the selection of the first word on the base-matrix displayed on a tablet) was recorded for each trial; the median value of the last 10 trails out of 20 was taken as the RT of a given listening condition. Following the completion of each block, participants reported how much effort it took to understand the words ("*How hard did you have to work to understand the previous sentences?")* by using a ten-point visual analog scale.
Statistical analyses of SRT_{80}, RT and self-ratings of effort revealed effects of both population and listening condition. While main effects were revealed for SRT_{80} and self-ratings, significant two-way interactions between the two predictors were found for RT. Specifically regarding the population predictor, analysis of SRT_{80} indicated that OL_NH had higher SRT_{80} compared to the other groups. No difference was found between YL_NH and HA, suggesting favourable outcomes of the hearing-aiding intervention. Conversely, the analysis of self-rated effort indicated a significant main effect of population, with the HA group consistently reporting higher perceived effort compared to YL_NH. No difference was observed between the two groups and OL_NH. Analysis of RTs revealed a significant two-way interaction between listening conditions and population. Notably, RTs were significantly longer for HA compared to YL_NH, but only in reverberant conditions and in the presence of fluctuating noise. Finally, a significant positive correlation between RTs and self-rated effort was only found within the HA group.
These results suggest that achieving equivalent levels of intelligibility and SRT_{80} between young listeners with normal hearing and those using hearing aids does not guarantee comparable listening effort, as assessed either subjectively or behaviourally. Moreover, at high levels of performance, RT proves to be sensitive to changes in the auditory environment, disclosing interactions between listening conditions and population that remain uncovered when relying solely on self-ratings of effort. The practical implications of the study concern the utility of including RT measurements in clinical settings and the development of new protocols for the best fitting of hearing aids in ecological conditions.

Keywords: response times, self-ratings, listening effort, speech-in-noise assessment, hearing aids

262 - Effect of task demand on physiological responses during an adaptive speech-in-noise test

Davide Simeone [(1)] - Edoardo Polo [(2)] - Andrea Farabbi [(2)] - Maximiliano Mollura [(2)] - Riccardo Barbieri [(2)] - Alessia Paglialonga [(1)]
National Research Council of Italy, Institute of Electronics, Information Engineering and Telecommunications, Milan, Italy [(1)] - Politecnico di Milano, Department of Electronic, Information and Bioengineering, Milan, Italy [(2)]

The cognitive resources involved during a conversation depend on different factors, such as the amount of listening demand and success importance required for exerting a given amount of listening effort. While the elements affecting task demand, such as acoustic degradation, are known, there is a lack of standardized techniques for evaluating the cognitive engagement of listeners. This raises questions about the optimal methods for defining various task demand conditions to evaluate the physiological and behavioral responses of subjects exposed to auditory stimuli. Furthermore, achieving a comprehensive understanding of listening effort is challenging as various measures frequently highlight distinct aspects of the issue at hand.
In this contribution, results related to the behavioral, physiological and cognitive responses of 21 healthy normal hearing subjects are shown. Building upon an adaptive speech-in-noise test that implements vowel-consonant-vowel (VCV) stimuli in stationary speech-shaped noise, two listening demand conditions (high/low demand, corresponding to low/high signal-to-noise ratio (SNR), respectively) comprising several trials were determined by using the speech reception threshold (SRT) as a relative reference to discriminate the two conditions. Cardiac, physiological, neural, and behavioral characteristics (e.g. power spectral density, heart rate variability…) were extracted during a baseline condition and during the two task demand conditions, then subsequently compared based on the most relevant features extracted from the signal recordings. Additionally, a detailed trial-by-trial analysis of the EEG signal was conducted, employing time-frequency analysis (spectrograms) and spatial distribution analysis (EEG field topographic map) widely-used techniques usually applied for short auditory stimuli. Results indicated a substantial rise in sympathetic activation during the most demanding phase of the test, especially in terms of cardiovascular and respiratory features. Heartbeat, arterial blood pressure and breath amplitude showed a statistically significant increase during the high demand phase compared to the low demand phase, coherently with the commonly known correlation between higher task demand and higher levels of activation in the sympathetic nervous system.
These findings suggest the potential benefits of incorporating undervalued signals, such as those related to respiratory and cardiac activity, in evaluating listening effort. This approach could prompt further experimentation under more natural, real-world conditions outside of traditional laboratory settings.

Acknowledgment: This work was supported in part by the Italian Ministry of Research, under the complementary actions to the NRRP "Fit4MedRob - Fit for Medical Robotics" Grant (# PNC0000007) and in part by the Capita Foundation through Project WHISPER, Widespread Hearing Impairment Screening and PrEvention of Risk (2022 and 2020 Capita Foundation Auditory Research Grants).

Keywords: Listening effort, task demand, speech-in-noise, cardiac, respiratory

263 - Electromyographic Signals from Auricular Muscles Show Distinct Patterns During Effortful Listening and Different Modes of Auditory Attention

Andreas Schroeer [(1)] - Farah I. Corona-Strauss [(1)] - Ronny Hannemann [(2)] - Steven A. Hackley [(3)] - Daniel J. Strauss [(1)]

Saarland University, Faculty of Medicine, Homburg, Germany [(1)] – WS Audiology, Scientific Audiology, Erlangen, Germany [(2)] - University of Missouri, Department of Psychological Science, Columbia, Missouri, United States [(3)]

This work summarizes the results from three studies, which investigate the potential of electromyographic (EMG) signals from the auricular muscles as a novel approach to decode the direction of spatial auditory attention and in the context of effortful listening. Auricular muscles, integral to external ear orientation in animals, but assumed to be vestigial in humans, are hypothesized to exhibit distinct EMG patterns corresponding to changes in spatial auditory focus, as well as during increasingly challenging listening conditions.

In study I, participants engaged in two experiments requiring voluntary, endogenous (n = 21 participants) and reflexive, exogenous (n = 28 participants) auditory spatial attention. Both younger (≈24 years old) and older (≈62 years old) participants were represented in both experiments. Results showed a significant increase in sustained ipsilateral EMG activity of several auricular muscles during the endogenous attention experiment, indicating the direction of spatial auditory attention. Similarly, results of the exogenous attention experiment showed a transient increase of auricular EMG activity in response to lateralized, transient sounds, which were also significantly larger depending on the direction of the aforementioned transient stimuli.

In study II, 10 participants (≈26 years old) engaged in a replication of the exogenous attention experiment from study I, but also a modified version of this experiment in which participants were engaged in an active listening task, and personalized stimuli (the participants' first names) were employed as transient stimuli to generate an interactive, ecologically more valid experiment. Additionally, participants were fitted with personalized earpieces, which contained six dry-contact electrodes per ear. In both experiments, using electrodes placed at the postauricular muscle (PAM), and also from electrodes in the earpieces, we found that EMG activity was significantly larger on the side of the lateralized stimuli. In contrast to this, we found evidence that activity of the superior auricular muscles (SAM) is briefly suppressed, indicating an antagonistic relationship between some auricular muscles, and suggesting a complex pinna-orienting system in response to transient stimuli. Results were reproducible when participants repeated the experiments after several weeks.

In study III, 20 participants (≈28 years old), engaged in an auditory tasks requiring varying degrees of listening demand. Increased activity of both left and right SAMs were observed in relation to increased listening demand as well as self-reported listening effort metrics, providing insights into the potential of auricular muscle activity as an indicator for cognitive load during auditory tasks.

The implications of this research extend to applications in human-machine interaction, hearing aid technology, and cognitive neuroscience. Utilizing auricular muscle EMG signals as a measure of spatial auditory attention and effortful listening could enhance the development of adaptive technologies, optimizing user experience and addressing challenges associated with multitasking in auditory environments. Further investigations are warranted to refine decoding algorithms, explore individual differences, and validate the robustness of this innovative approach across diverse populations and real-world scenarios.

Keywords: auricular muscles – EMG – auditory attention – effortful listening

242 - Psychometric relation between pupillary response and speech performance in CI users: impact of SNR, peripheral auditory sensitivity, and central cognitive profile

Yue Zhang [(1)] - Amparo Callejón-Leblic [(2)] - Ana Picazo-Reina [(2)] - Sergio Blanco-Trejo [(2)] - Serafín Sánchez-Gómez [(2)]
Oticon Medical, Research and Technology Department, Vallauris, France [(1)] - Virgen Macarena University Hospital, ENT, Seville, Spain [(2)]

Cochlear implant (CI) users typically report high and elevated listening effort especially under challenging noisy conditions. Pupillometry is one of the most used physiological measures to quantify listening effort. Previous studies with normally hearing (NH) and hearing-impaired (HI) listeners have shown that the relation between speech performance in noise and listening effort (as measured by peak pupil dilation) exhibits an inverted-U shape. However, it is unclear whether the same psychometric relation exists in CI users, and how much individual differences in auditory sensitivity and central cognitive capacity affect this relation. We recruited 17 post-lingually deaf CI adults to perform speech-in-noise tasks from 0 to 20 dB SNR with a 4 dB step size. Simultaneously, their pupillary responses and self-reported subjective effort were recorded. To characterize top-down and bottom-up individual variabilities, we measured CI users' spectro-temporal modulation performance and a set of cognitive abilities (i.e., Stroop task, progressive matrices task, N-back). CI users' clinical word recognition in quiet and Quality of Life (QoL) were also collected. Results showed that at a group level, an inverted-U shape psychometric curve between task difficulty (SNR) and peak pupil dilation (PPD) was not observed as in the case of NH and HI listeners. Individual shape of the psychometric curve was significantly associated with some individual factors: CI users with higher clinical word and speech-in-noise recognition showed a quadratic decrease of PPD over increasing SNRs; CI users with better non-verbal intelligence and lower QoL showed smaller average PPD. To summarize, individual differences in CI users had a significant impact on the psychometric relation between pupillary response and task difficulty, hence affecting the interpretation of pupillary response as listening effort (or engagement) at different task difficulty levels. Future research and clinical applications should further characterize the possible effects of individual factors (such as motivation or engagement) in modulating CI users' occurrence of 'tipping point' on their psychometric functions and develop an individualized method for reliably quantifying listening effort using pupillometry.

Keywords: Listening effort, cochlear implant, cognitive capacity, speech perception

155 - Audiovisual prosody perception in cochlear implant recipients

Hartmut Meister [(1)] - Isa Samira Winter [(1)] - Moritz Wächtler [(1)] - Khaled Abdelatif [(1)]
University of Cologne, ENT-Department, Jean Uhrmacher Institute, Cologne, Germany [(1)]

Linguistic prosody plays a vital role in verbal communication. Amongst others, it carries information on sentence stress or the distinction between questions and statements. Cochlear Implant (CI) recipients are restricted in the use of acoustic prosody cues, especially in terms of the voice fundamental frequency (F0). However, prosody is also perceived visually, as head and facial movements accompany the vocal expression. To date, few studies have addressed multimodal prosody perception in CI recipients.

Controlled manipulations of acoustic cues are a valuable method to examine and quantify prosody perception. It could be shown that CI recipients had about four times higher F0-detection thresholds and shallower psychometric functions than normal-hearing listeners. For visual prosody, however, such a technique is more demanding. Here, a novel approach based on animations via virtual humans is used. Such a method has the advantage that – in parallel to acoustic manipulations – head and facial movements can be parametrized.

Based on this method a study is shown that examines audiovisual prosody perception in CI recipients. Besides behavioral measures, eye-tracking and pupillometry data are collected to assess selective attention and cognitive load of the participants. Results from postlingually deafened CI recipients are compared with a control group of normal-hearing listeners. The results are discussed in terms of multimodal speech perception, audiovisual integration, and processing effort.

Supported by Deutsche Forschungsgemeinschaft, grant ME 2751-4.1 to HM

Keywords: prosody perception, audiovisual, cochlear implant, virtual reality, pupillometry

LISTENING EFFORT

54 - Dual-task interference in a listening effort dual-task paradigm: results of normal-hearing adults, cochlear implant users and hearing aid users

Dorien Ceuleers [(1)] - Sofie Degeest [(2)] - Freya Swinnen [(3)] - Nele Baudonck [(3)] - Katrien Kestens [(2)] - Ingeborg Dhooge [(1)] - Hannah Keppler [(2)]
Ghent University, Department of Head and Skin, Ghent, Belgium [(1)] - Ghent University, Department of Rehabilitation Sciences, Ghent, Belgium [(2)] - Ghent University Hospital, Department of Otorhinolaryngology, Ghent, Belgium [(3)]

Introduction: Individuals with hearing loss experience an increased effort during listening activities. To measure this listening effort behaviorally, a dual-task paradigm can be used whereby a primary speech understanding task and a concurring secondary task are presented separately (i.e. baseline condition) and simultaneously (i.e. dual-task condition). The change in performance of the secondary task between baseline and dual-task condition is typically used to measure listening effort, assuming similar performance in the primary task. However, recent research suggests evaluating changes between the dual-task and baseline condition for both the primary and the secondary task to identify the used attention allocation strategy (i.e. dual-task interference) (Gagne et al., 2017; Plummer & Eskes, 2015). Therefore, the purpose of the current study was to assess this dual-task interference in normal-hearing (NH) adults, hearing aid (HA) users, and cochlear implant (CI) users.
Material and methods: Three matched groups of 31 participants were included: (1) NH adults, (2) adult HA users with a moderate to severe hearing loss, and (3) adult CI users with a severe to profound hearing loss. The dual-task paradigm consisted of a primary speech understanding task in which monosyllabic digits were presented in three different listening conditions (i.e. silence, favorable and unfavorable noise conditions) (Degeest et al., 2022). The secondary task was a visual memory task whereby participants had to memorize the position of five appearing blue circles in a raster (Degeest et al., 2022). Dual-task interference was calculated, and participants were classified using the different patterns of interference based on the framework presented by Plummer and Eskes (2015). Descriptive analyses were established and differences between the three groups were examined using a one-way analysis of variance or Kruskal-Wallis test for scores for the primary and secondary task and for the dual-task interference, and a Fisher's exact test for the patterns of dual-task interference.
Results & discussion: NH adults scored significantly better than HA and CI users in the favorable and unfavorable noise conditions for the primary speech understanding task, both in baseline and dual-task conditions. No significant differences across groups were found for the secondary task. Descriptive results showed that the patterns of dual-task interference varied among the three listening conditions for all participants. The majority of participants did not demonstrate stable performance for the primary task in both baseline- and dual-task conditions, indicating that the traditional approach of measuring listening effort may be insufficient. A large number of participants showed the pattern of visual memory interference (i.e. worse results for the secondary task in the dual-task condition, and no difference for the primary task) in the silent condition, whereas the pattern of speech understanding priority trade-off (i.e. worse results for the secondary task in the dual-task condition, and better results for the primary task) was most prominent in the unfavorable noise condition. This finding suggests that participants may allocate more resources and make extra effort to understand the speech stimuli in difficult listening conditions. However, the causes and implications of this trend need to be explored further. Particularly in HA and CI users this shift was seen. However, the patterns of dual-task interference were not statistically different between the three groups for all listening conditions.
Conclusion: Results of this study may provide additional insight into the interpretation of dual-task paradigms for measuring listening effort in different groups of participants. It highlights the importance of considering both the primary and secondary tasks for accurate interpretation of results in future research.

Key words: listening effort, dual-task paradigm, attention allocation, dual-task interference

Financial disclosures/conflicts of interest: This research was supported by a grant provided by Cochlear Research & Development Ltd (ref # IIR-2321). The funding organizations had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the decision to submit the abstract for presentation.

3 - The Impact of Perceived Stress and Anxiety on Hearing Sensitivity: An In-Depth Examination

Aaron Roman [(1)]
Salus University, Osborne College of Audiology, Elkins Park, United States [(1)]

The purpose of this presentation is to detail comprehensive study that delves into the often-overlooked relationship between perceived stress, anxiety, and hearing sensitivity. In the United States, hearing loss affects a substantial portion of the population, with approximately 27.7 million adults, or 31.1% of the overall population, experiencing some form of hearing impairment[1]. Yet, despite this high incidence, only a fraction of those affected, approximately 3.8 million individuals, or roughly 14% of those with hearing loss, utilize hearing aids as a means of addressing their condition[2].

Numerous factors have been extensively studied to understand their role in hearing aid uptake. These factors range from pre-fitting expectations and the acceptance of hearing impairment[3] to the literacy levels of materials provided and various demographic characteristics[4]. However, one crucial aspect that has received relatively limited attention in the literature is the impact of perceived stress and anxiety on the willingness of individuals to seek and utilize hearing aids.

This presentation aims to bridge this gap by investigating the correlation between perceived stress and anxiety levels and hearing sensitivity thresholds. We believe that understanding this relationship is crucial not only for improving our understanding of the psychological factors influencing hearing aid adoption but also for enhancing the quality of care and support provided to individuals with hearing loss.

As part of the intake process for new patients, three key assessments to gather data for this investigation were administered:

1. **Perceived Stress Scale (PSS)**: The PSS is a widely recognized tool for assessing an individual's perceived stress levels. By quantifying an individual's subjective perception of stress, one can gain insight into how stress may impact their overall well-being and decision-making processes.
2. **Generalized Anxiety Disorder Screening (GAD-7**): The GAD-7 is a reliable questionnaire designed to identify symptoms of generalized anxiety disorder. It provides valuable information about an individual's anxiety levels, shedding light on how anxiety may be influencing their behavior and choices.
3. **Modified Hearing Handicap Index (RHHI-M):** This modified version of the Hearing Handicap Inventory for Adults (HHIA) specifically examines how hearing loss affects communication, social interactions, and emotional well-being.

This presentation will focus on exploring the intricate relationship between these psychological measurements (PSS and GAD-7) and objective hearing-related assessments, including measured auditory thresholds and speech understanding measures. By analyzing these data points, we aim to achieve several critical objectives:

1. **Identify Patterns and Correlations**: We will examine whether there are discernible patterns or correlations between perceived stress, anxiety levels, and hearing sensitivity thresholds. This analysis will help us understand whether heightened stress or anxiety may be associated with more severe hearing impairments.
2. **Uncover Mediating Factors**: In addition to direct relationships, we will explore potential mediating factors that could influence the connection between psychological stressors and hearing sensitivity. This might include variables such as age, gender, or the duration of untreated hearing loss.
3. **Inform Targeted Interventions:** By gaining insights into the complex interplay between psychological well-being and hearing health, we hope to inform the development of targeted interventions aimed at reducing stress and anxiety levels in individuals with hearing loss. These interventions could ultimately lead to increased acceptance of hearing aids and improved overall quality of life.

In conclusion, this study represents a significant step forward in understanding the multifaceted factors that influence hearing aid uptake in individuals with hearing loss. By shining a spotlight on the relationship between perceived stress, anxiety, and hearing sensitivity, we aspire to contribute valuable insights to the field of audiology and improve the quality of care provided to those in need.

198 - Using Ecological Data to Investigate Real-life Outcomes of Cochlear Implants in Ecological Situations

Yue Zhang [1] - Amparo Callejón-Leblic [2] - Ana Picazo-Reina [2] - Lelia Erscoi [3] - Manuel Segovia-Martinez [1] - Serafin Sánchez [2]
Oticon Medical, Research and Technology Department, Vallauris, France [1] - Virgen Macarena University Hospital, ENT, Seville, Spain [2] - University Paris Cite, Digital Science, Paris, France [3]

Cochlear implant (CI) can restore sensation of hearing and near perfect speech communication to many patients with severe-to-profound sensorineural hearing loss in quiet environments. However, many challenges remain. There are big individual variabilities observed in speech and quality of life outcomes following cochlear implantation. Specifically, most of the clinical assessments for patients are conducted in an isolated lab or clinic, using unrealistic sound stimuli, which are far from the real communication scenarios CI users face daily. Therefore, results generated from these tests cannot uncover fully the challenges and difficulties CI users are experiencing. This discrepancy might be able to explain the lack of association between real-life quality of life measurement and standard clinical assessment.
Ecological Momentary Assessment (EMA) introduces a new way to investigate the realistic usage of medical devices for CI users. To implement this methodology, a standalone iPhone application is set up to connect with the hearing devices via Bluetooth connection to control device-related settings (e.g., programs, sound level, data logging, acoustic scene classification). The application interacts with the user by collecting EMA questionnaires at certain intervals. The application is also connected to external devices to collect simultaneous physiological signals, such as heart rate variability.
To understand better the validity and sensitivity of this method in assessing CI users' device usage, we are designing a clinical protocol to compare the in-lab results and field data in different acoustic scenes, including, urban traffic, classroom, café, restaurant. During the in-lab session, participants will perform a series of speech-in-noise tasks in different types of background noise with simultaneous pupillometry, heart rate variability measurements and post-task subjective effort rating, to obtain CI users' speech recognition and listening effort. Then the participants will take the iPhone application back to their daily life and fill out EMA assessment on communication success and effort/fatigue level. They will be encouraged to experience different acoustic scenes and log down their assessments for different scenes during the 4 weeks. Long term heart rate variability data will be recorded to understand the construct validity of the field data and its relationship with lab data in these scenes. At the end of the test, they will return to the lab and provide subjective feedback on the usability and informativeness of the EMA method. Audiologists involved in the experiment will also assess the evidence level of this methodology. These subjective inputs will join the sensitivity and validity comparison analysis of in-lab and field data to provide a holistic overview of the methodology. We are aiming to recruit 18 CI users to finish both the in-lab and field data collection. We expect that we should have completed peer-reviewed pre-registration, received ethics approval and collected pre-liminary data by June 2024.
To summarize, EMA methodology and its implementation can serve as a next-generation tool for assessing realistic CI outcomes. In comparison to in-lab testing, EMA can provide solutions for measuring performance and effort in highly variable listening conditions. The phone application will provide access to extend the in-lab knowledge to real life. The clinical experiment will assess the construct validity and sensitivity of this method for future clinical usage of this tool.

Keywords: Ecological momentary assessment, listening effort, cochlear implant, acoustic scenes, pupillometry, heart rate variability

EARLY IDENTIFICATION – TECHNIQUES AND METHODS (2)

27 - New imaging techniques to identify site-of-lesion and degree of neural abnormality in patients with auditory neuropathy

Gary Rance [(1)] - Julien Zanin [(1)]
The University of Melbourne, Audiology & Speech Pathology, Melbourne, Australia [(1)]

Background**:** "Auditory neuropathy" (AN) is a term used to describe disorders in which afferent neural transmission through the auditory nerve and brainstem is disrupted, but cochlear (outer) hair cell function is normal. There are a range of pathologic mechanisms capable of producing the AN result pattern. In this study we explored the use of ***Diffusion Weighted Magnetic Resonance Imaging (dMRI)*** to localize and quantify auditory neural changes in patients with both pre- and post-synaptic forms of auditory neuropathy.
Methods**:** This case-control study involved seventeen adults and children with bilateral auditory neuropathy, five individuals with cochlear hearing loss and 35 normally hearing control subjects. Diffusion-weighted MRI data was collected for all subjects and the auditory pathways were evaluated using the fixel-based analysis metric of "auditory fibre density" (AFD). Auditory perception (audiometric thresholds, speech perception in noise etc.) was also evaluated in all participants.
Results**:** Different patterns of neural fibre loss were demonstrated for aetiologies known to affect different regions in the auditory pathway. Furthermore, there were significant correlations between degree of neural abnormality and the perceptual abilities of the participants.
Conclusions**:** Diffusion weighted MRI has the potential to predict functional hearing outcomes and guide management recommendations for individuals with both peripheral and central auditory pathway abnormality.

Keywords: Auditory neuropathy, diffusion MRI; site-of-lesion

274 - Innovation in diagnostics - validation results

Peter Zoth [(1)] - Matteo Manente [(2)]
Ing. Büro Zoth, Gilching, Deutschland [(1)] - Neuranix, Italia [(2)]

Achievements/Questions: The 'Admittance Response' based method is an innovative technology based upon propriety patents and as such merits the closest clinical investigation. It enables the evaluation of the functional conditions of the middle ear through graphic and numerical representation of the response characteristics of the tympanic membrane without applying variations in air pressure to the ear canal. The method adds further evolution to audiological diagnostics in the near future that goes beyond classic tympanometric screening.

Methods: The med·wave® device is based on PLAI® methodology, an acronym for 'Pressure Less Acoustic Immittance', primarily characterized by taking measurements without exerting pressure in the ear canal. It acquires the ear admittance response as a frequency of a sound varies between 100 and 3kHz. The module & phase of the admittance response recorded in the ears of subjects belongs to one of the 3 groups which will be shown during the presentation.

It presents a clear peak at a particular frequency ('resonance frequency'). A frequency above 1kHz indicates measurement error due to the incorrect probe positioning or the ear canal being occluded. Several clinical trials have been carried out on pediatric & adult subjects and trials with children aged 0-24 months are currently ongoing.

One Italian hospital deemed most appropriate for clinical investigation with a pediatric focus was the Burlo-Garofolo IRCCS/Trieste, where data on a pediatric population aged 2-17 years old was collected. The primary and first objective of study was to evaluate the capacity of the method to classify an ear in one of the following conditions or groups:

1. Healthy ear;
2. presence of Otitis Media;
3. flacid ear or presence of perforated eardrum.

Results: The graphs of healthy subjects (children) showed that the measured admittance curves have low variability & being very compact. The mean resonance frequency was of 463Hz (standard deviation- 69Hz). The Otitis Media (OME) admittance graphs show that the measurements have low variability and are very compact. Mean resonance frequency of OME subjects was of 617Hz (Standard deviation-85Hz). Finally, the graphs of ears presenting flacid tymp. or tympanic perforation report low variability, despite the small number of subjects until how have been available.

Summary: The clinical investigation demonstrated that the objectives posed were met and that the method supports significantly a distinction of healthy subjects from those with pathology in both: paediatric&adult groups. Among the parameters proposed and calculated, the best seems to be resonance frequency, which make it possible to significantly distinguish both the healthy group from the two groups of pathologies considered.

References:

1. Thais Antonelli Diniz Hein, Advances in Clinical Audiology, Wideband Tympanometry, Intech-Open, 2017, http://dx.doi.org/10.5772/67155
2. Neuranix, European patent, EP2800514**A**

104 - Auditory Brainstem Response test strategies: maximising efficiency and accuracy

Inga Ferm [(1)]
Croydon Health Services NHS Trust, Audiology, Croydon, United Kingdom [(1)]

The Auditory Brainstem Response test (ABR) is called an objective test, because we do not have, or seek, a behavioural response from the patient. However, there is a subjective element to the test. A tester has to interpret whether a response meets response present or response absence criteria, or identity when it doesn't meet either set of criteria.
To help with this interpretation, the manufacturers of ABR systems have developed some objective quality measures, for example Fsp / Fmp, and report other measures, for example residual noise. Using these measures, the testers can adopt a more intelligent approach to their test strategies and their interpretation. The latest revision of the British Society of Audiology guidance on newborn ABR testing includes this advice.
This presentation aims to discuss these measures and provide information about how they can help make decisions, but also to describe some of the limitations.

Key words: ABR, test strategy, quality measures, efficiency

HEARING LOSS, COMMUNICATION AND QUALITY OF LIFE

268 - Associations of Hearing Loss and Dual Sensory Loss With Mortality: A Systematic Review, Meta-analysis, and Meta-regression of 26 Observational Studies With 1,213,756 Participants

Nicole Kye Wen Tan [(1)] - Benjamin Kye Jyn Tan [(2)] - Faye Yu Ci Ng [(1)] - Harris Jun Jie Muhammad Danial Song [(1)] - Li Shia Ng [(3)] - Woei Shyang Loh [(3)]
National University of Singapore, Yong Loo Lin School of Medicine, Singapore [(1)] - Singapore General Hospital, Department of Otorhinolaryngology-Head & Neck Surgery, Singapore [(2)] - National University Health System, Department of Otolaryngology-Head & Neck Surgery, Singapore [(3)]

Importance Hearing loss (HL) and dual sensory loss (DSL) are prevalent, disabling, and associated with numerous age-related health conditions, including dementia and frailty. To date, no evidence-based summary of their mortality risk is available.
Objective To clarify the epidemiological associations between HL/DSL and mortality.
Data Sources PubMed, Embase, and Cochrane Library, from inception until June 18, 2021.
Study Selection Two blinded reviewers selected observational or interventional studies, published as full-length English articles in peer-reviewed journals, that reported the presence or severity of HL or DSL (ie, comorbid HL and vision loss), whether objectively measured or self-reported, in association with any mortality estimate, among adults 18 years and older.
Data Extraction and Synthesis Two reviewers extracted data and evaluated study bias using the Newcastle-Ottawa Scale, following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)/Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines and a PROSPERO-registered protocol. The analysis pooled maximally adjusted estimates using mixed-effects models, measured heterogeneity using I^2, investigated sources of heterogeneity using meta-regression and subgroup meta-analyses, examined and adjusted for publication bias, performed influence and cumulative meta-analyses, and assessed evidence quality using the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework.
Main Outcomes and Measures Hazard ratios (HRs) for all-cause, cardiovascular, or other mortality estimates.
Results This review included 14 retrospective and 12 prospective observational studies (1 213 756 participants) from 3220 records. Risk of bias was low to moderate; exclusion of 3 high-risk studies did not alter conclusions. Hearing loss was associated with excess all-cause mortality (HR, 1.13; 95% CI, 1.07-1.19; $I^2 = 77\%$; n = 21; 95% prediction interval [PI], 0.93-1.37) and cardiovascular mortality (HR, 1.28; 95% CI, 1.10-1.50; $I^2 = 60\%$; n = 6; 95% PI, 0.84-1.96), while DSL was associated with larger excess risks (all-cause: HR, 1.40; 95% CI, 1.30-1.51; $I^2 = 34\%$; n = 10; 95% PI, 1.18-1.66; cardiovascular: HR, 1.86; 95% CI, 1.31-2.65; $I^2 = 0\%$; n = 2), after adjustment for demographics and comorbidities. Prespecified meta-regression sufficiently explained heterogeneity, with longer follow-up duration weakening the pooled association, leaving low (29%) residual heterogeneity. Meta-regression among audiometric studies showed a dose-response association (doubling of HR per 30-dB increase in HL). Self-reported and audiometric effect sizes were similar, with lower heterogeneity in the latter. Associations were robust to trim-and-fill adjustment for publication bias and single-study influence and cumulative meta-analyses. Associations with accident/injury, cancer, and stroke mortality were inconclusive, with only 1 to 3 studies. Overall evidence quality was moderate.
Conclusions and Relevance In this systematic review and meta-analysis, HL and DSL were associated with excess all-cause and cardiovascular mortality. Physicians caring for patients with HL should consider its relevance to general health and longevity.

Keywords: hearing, vision, mortality, epidemiology, dose-response effect.

22 - Do adult cochlear implant users use the intended program when fitted with multiple programs?
Cas Smits [(1)] - Feike de Graaff [(1)] - Elke Huysmans [(1)] - Paul Merkus [(1)] - Theo Goverts [(1)] - Sophia Kramer [(1)]
Amsterdam UMC, Department of Otolaryngology - Head and Neck Surgery, section Ear & Hearing, Amsterdam Public Health research institute, Amsterdam, Netherlands [(1)]

Objective: Most of the current cochlear implant (CI) devices have the option to adjust settings to different listening environments by self-selecting one of the programs in the sound processor (manual switching), or by using a setting in which the sound processor automatically switches between programs (automatic switching). Even though multiple programs or automatically switching programs are fitted on a regular basis, little is known about the need for and use of these multiple programs and automatically switching devices. Previously we performed a scoping review in which no studies were identified that concerned the use of automatically switching CI sound processors (de Graaff et al. 2018, Int J Audiol).
The aim of the current study therefore was to investigate the use of manually and automatically switching programs in everyday day life by adult CI users
Method: Participants were fitted with an automatically switching sound processor setting and 2 manual programs for 3-week study periods. They received an extensive counselling session. Datalog information was used to analyse the listening environments identified by the sound processor, the program used and the number of program switches.
Study sample: Fifteen adult Cochlear CI users. Average age 69 years (range: 57-85 years).
Results: Speech recognition in noise was significantly better with the 'noise' program than with the 'quiet' program. On average, participants correctly classified 4 out of 5 listening environments in a laboratory setting. Participants switched, on average, less than once a day between the 2 manual programs and the sound processor was in the intended program 60% of the time.
Conclusion: Adult CI users switch rarely between two manual programs and leave the sound processor often in a program not intended for the specific listening environment. A program that switches automatically between settings, therefore, seems to be a more appropriate option to optimize speech recognition performance in daily listening environments.

Keywords: cochlear implant, manual program selection, automatic switching, listening environment

182 - Exploring the Impact of Speech Perception Outcomes on CI Users and Their Communication Partners

Nikki Philpott [1] - Hugo Nijmeijer [1] - Birgit Philips [2] - Emmanuel Mylanus [1] - Wendy Huinck [1]
Radboud university medical center, Department of Otorhinolaryngology, Nijmegen, Netherlands [1] - Cochlear Ltd, R&D, Mechelen, Belgium [2]

Background & Objectives
Cochlear implants (CIs) significantly enhance speech perception in quiet for the majority of individuals with post-lingually acquired severe-to-profound sensorineural hearing loss Beyond the improvement in communication ability, CIs have demonstrated the ability to elevate the well-being and satisfaction of both users and their communication partners, particularly in terms of enhanced autonomy, a sense of normalcy, and increased social engagement in everyday life. Our study uniquely examines pre- and post-implantation quality of life (QOL) from the perspectives of both newly implanted CI users, using the Nijmegen Cochlear Implant Questionnaire (NCIQ) and their communication partners, using the HII-SOP (Hearing Impairment Impact – Significant Other Profile). The study assess the impact of CIs on self-reported QOL for both groups in relation to speech perception outcomes.
Methods
Over 200 adults with a post-lingual deafness are part of the SMILE study, a multi-center study in the Netherlands exploring the societal impact of CI. All participants are required to complete surveys, including the NCIQ, and undergo audiological testing pre-CI, as well as 1-, 2- and 3-years post-CI. Their communication partners are asked to complete the HII-SOP at these time points.
Results
To date, eighty participants have completed the NCIQ and required speech perception testing pre-CI and 1-year post-CI. Fifty-four communication partners have completed the HII-SOP at these same time points. Full results will be presented at the conference, focusing on the complex interplay between hearing-related QOL measures, speech perception outcomes, and post-CI QOL for both users and their partners.
Conclusion
Data analysis is ongoing, but preliminary results emphasize the impact of CIs on the QOL of CI users and their communication partners, particularly the complex interplay between clinical and self-reported speech perception. Further exploration into the multifactorial contributors to post-implantation QOL is essential for integrating these factors into CI care pathway as tools for counselling, expectation management and satisfaction monitoring.

Keywords: Quality of life, communication partners, cochlear implants

253 - Quality of life following cochlear implants in elderly recipients – a prospective cohort study

Melville da Cruz [(1)] - Haisam Shah [(1)] - Yuning Xue [(1)] - Hamna Rehman [(1)] - Glen Watson [(2)] - Kerry Hitos [(1)]
University of Sydney, Surgery, Sydney, Australia [(1)] - Royal Hallamshire Hospital, Department of Otolaryngology, Sheffield, United Kingdom [(2)]

Background: Deafness is a leading cause of disability worldwide. The impact of severe hearing loss is greater for higher degrees of deafness. This prospective cohort study investigates the impact of cochlear implants (CI) on self-reported quality-of-life (QoL) in post-lingually deaf Australian adults aged 50 and older.
Methodology: Self-administered 36-item World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) and Speech, Spatial, and Qualities of Hearing Scale (SSQ) questionnaires were used to investigate the impact of CI in 98 post-lingually deaf adults aged ≥ 50 years.
Results: QoL improved post-CI in the cumulative scores and scores for all domains of the SSQ ($p < 0.05$). QoL improved post-CI in domains related to 'cognition' and 'participation in society' of the WHODAS 2.0 ($p < 0.05$), but there was no significant difference in the cumulative score. Subgroup analysis showed improvement in the 'participation in society' domain only and, only in males and participants aged < 75 ($p < 0.05$).
Conclusion: CI improves QoL in post-lingually deaf adults, with greatest impact in domains related to cognition and engagment in society.

Keywords: Deafness, hearing loss, cochlear implants, quality of life

125 - Factors affecting the rehabilitation outcomes in preschool children with hearing loss

Gaziz Tufatulin [(1)] - Sergey Artyushkin [(2)]
Center of Pediatric Audiology; St Petersburg Scientific ENT Research Institute; North-Western State Medical University named after I.I.Mechnikov, ENT, St Petersburg, Russian Federation [(1)] - North-Western State Medical University named after I.I.Mechnikov, ENT, St Petersburg, Russian Federation [(2)]

Objective. The aim of the study is to identify the most significant factors influencing the audio-verbal rehabilitation outcomes in preschool children.
Materials and methods. The study included 104 children, 3–7 years of age, with hearing loss who underwent course of audio-verbal rehabilitation in audiology center: 50 children after cochlear implantation, 51 children with hearing aids, 3 children without any hearing devices. The following data was collected at the beginning of the course: gender, type and degree of hearing loss, comorbidities, method and age of initial amplification, family structure, preschool institution type. The scale of social and psychological diagnostics was filled in. The dynamics of indicators were estimated at the end of the course. The overall result was rated as “high”, “good”, “medium” or “low”. Correlations between clinical, audiological, social, psychological data and different rehabilitation outcomes were estimated.
Results. Degree and type of hearing loss, method of amplification, gender, age, and social aspects do not affect the rehabilitation outcomes. Hearing aid was fitted before 3 years of age in 67% of children, and after 3 years of age in 33% of children in the group with “high” and “good” results. Hearing aid was fitted after 3 years of age in 61% of children, and before 3 years of age in 39% of children in the group with “medium” and “low” results ($p < 0.01$). Burdened anamnesis and comorbidity was determined in 28% of children with “high/good” outcomes and in 59% of children with “medium/low” outcomes ($p < 0.01$). Children with “medium” results rarely had previous audio-verbal therapy, 43.8% of cases ($p < 0.01$). Children with “medium” and “low” outcomes have significantly worse score according to the scale of social and psychological diagnostics ($p < 0.05$ and $p < 0.01$, respectively).
Conclusion. High results of audio-verbal rehabilitation in preschool children can be predicted by the age of initial amplification (before 3 years of age), absence of comorbidities, previous audio-verbal therapy, score of the scale of social and psychological diagnostics less than 17 points.

Keywords: hearing disorders in children, audio-verbal therapy, hearing aids, cochlear implantation

148 - Impact of Hearing Rehabilitation on Mental Well-being

Paul McIlhiney [(1)] - Catherine Sucher [(1)] - Robert Eikelboom [(1)] - Dona Jayakody [(1)]
Ear Science Institute Australia, Brain and Hearing, Subiaco, Australia [(1)]

Background**:** Hearing loss was found to be the third largest contributor to years lived with disability in 2019 (Haile et al., 2021). Furthermore, those with hearing loss can suffer greater degrees of depression, anxiety, and stress that increase with more-severe hearing loss (e.g., Jayakody et al., 2018). However, it is yet unknown whether treatment of mild-to-moderately-severe hearing loss with hearing aids, or severe-to-profound hearing loss with cochlear implants, can help alleviate these mental-health issues.
Objectives**:** To assess whether treatment of mild-to-moderately-severe hearing loss with hearing aids, or severe-to-profound hearing loss with cochlear implants, helps alleviate hearing-loss-related elevations in depression, anxiety, and stress levels.
Methods**:** Middle-aged-to-older-adult participants (M_{age} = 65.56, SD_{age} = 10.24) were assigned to normal-hearing (NH) and hearing-loss (HL) groups based on their better-ear four-frequency (500Hz, 1, 2 & 4 kHz) average; subsequently, those who chose treatment with hearing aids (HA) or cochlear implants (CI) were assigned to their own treatment groups. Participants completed a standardised measure of depression, anxiety, and stress symptoms at four timepoints (baseline, 3, 6, 12 months). Linear mixed-effects modelling was used to analyse effects of hearing status and time. Analyses were run in R Studio.
Results**:** Firstly, only those in the HL group with moderate-or-worse hearing loss (mod+ HL) showed elevations in depression, anxiety, or stress scores. The NH group demonstrated lower scores on all measures at all timepoints than the mod+ HL group. Further, the HA group demonstrated generally lower and more-stable depression, anxiety, and stress scores than the mod+ HL group, and was statistically similar to the NH group. Meanwhile, the CI group showed a similar pattern to the HA group for anxiety and stress, but demonstrated
Conclusion**:** Our findings suggest that those with untreated, moderate-to-worse hearing loss are at greater risk of mental-health issues, but that treatment with hearing aids or cochlear implants is associated with these issues. Thus, mental-health screenings and counselling should be considered a vital part of audiological care and assessment. Indeed, with a greater focus on psychological well-being, it may be possible to improve client outcomes in audiology.

218 - Enhancing Quality of Life: Bilateral Hearing Solutions

Darja Pajk [(1)]
EFHOH, European Federation of Hard of Hearing People, Houten, Netherlands [(1)]

When we think about hearing loss, our usual first thought is that a person has difficulties with communication and cannot follow what is happening in their environment. Naturally, the inability to communicate effectively diminishes the quality of life. With the advancement of technology and care for individuals with hearing loss through hearing aids and implants, the quality of life has significantly improved. This applies not only to individuals with hearing loss but also to all those who interact and live directly with people experiencing hearing loss.

However, quality of life is not solely connected to successful communication and engagement in it. Quality of life means being able to listen to life around us with high-quality hearing aids and implants. It means having access to quality hearing devices. It means acquiring bilateral devices in the case of bilateral hearing loss. While obtaining bilateral hearing aids is well understood and accepted, often only one implant is provided. Why do decision - so often think that one implant is enough? Listening with two ears is an entirely different experience to listening with one.

Despite many different efforts to increase awareness of the impact of hearing loss, hearing loss is still not understood as a bigger problem. The issue is that people with hearing loss who use hearing aids and implants try to live everyday life without making clear the challenges we face daily.

Having two high-quality hearing aids or two implants does not mean something special but means the possibility of equality. To perceive sound from both directions is essential for effective communication and for quality of life.

Key words: hearing loss, bilateral, quality of life

130 - Hearing and self-reported Hearing-Related Quality of Life in Danish Adult CI users: A 2-year clinical follow-up study

Line Husted Baungaard [(1)] - Matilde Grønborg Sandvej [(1)] - Mathilde Marie Overmark [(1)] - Marianne Kyhne Hestbæk [(1)] - Louise Brasen Brændgaard [(1)] - Mie Stenner Hansen [(1)] - Per Cayé-Thomasen [(1)] - Lone Percy-Smith [(1)]

The University Hospital of Copenhagen, Copenhagen Hearing and Balance Centre, Copenhagen, Denmark [(1)]

In the last 10 years, 565 adults and 211 children have received a Cochlear Implant (CI) at the Copenhagen Hearing and Balance Centre (CHBC). CHBC is one of three CI Centres for adults in Denmark and is located at the University Hospital in Copenhagen, Rigshospitalet. Candidates and outcomes of CI users are monitored by an interdisciplinary team consisting of surgeons, medical doctors, technicians, audiological technicians and speech language and hearing pathologists. The team at CHBC provides long-term aftercare and follow-up for the CI users. New CI users also participate in an auditory training programme at their local communication centre for about 6 months after the activation of their CI.

In 2020 to 2022, participants were included in this follow-up study at CHBC. 50 adult CI users chose to participate in the study, and they were seen for two extra monitoring sessions after activation of their CI; one at one and a half year after activation and another at two years after activation. Participants' pre-implant hearing history and ability was also recorded for the study.

The test battery consisted of adaptive and non-adaptive hearing tests in quiet and noise settings (Dantale and the Hearing in Noise Test (HINT)). Patient-reported outcome measures were used to evaluate change in tinnitus and in Hearing-Related Quality of Life (HRQOL). Patients also shared information about their participation in their individual auditory training programmes.

Results from descriptive and statistical analysis comparing the CI users' hearing abilities, HRQOL and participation in auditory training will be presented in the poster session.

Keywords: CI outcome in adults; CI rehabilitation; CI adaptive test; CI quality of life

6 - Assessing the Efficacy of Preoperative Procedural Patient Education as an Intervention to Mitigate Stress and Anxiety Among Otorhinolaryngology Surgery Patients: A Randomized Controlled

Chia-Jung Busch [(1)] - Tina Brzoska [(1)] - Marcus Vollmer [(2)] - Britta Buchhold [(3)] - Ranny Assaf [(1)]
Clinic of ENT and Head and Neck Surgery University Hospital Greifswald, Greifswald, Germany [(1)] - Institute of Bioinformatics of University Hospital Greifswald, Greifswald, Germany [(2)] - Institute of Clincal Psychology of the University Hospital Greifswald, Greifs, Germany [(3)]

Patients awaiting ENT surgery typically experience significant physical and psychological stress. However, although there is evidence that preoperative education interventions can lead to positive perioperative outcomes for surgical patients in general, less is known about the effectiveness among patients undergoing ENT surgery.
Objective This study investigated whether, preoperative procedural patient education designed for ENT surgery patients, as a time- and cost-efficient intervention, can reduce patient stress and anxiety.
Design Randomized controlled trial.
Methods
We employed a randomized parallel-group design with 2 study arms to compare a procedural patient education to the standard preoperative preparation procedure. The study comprised 164 patients who underwent inpatient ENT surgery under general anesthesia. An externally validated inventory (State-Trait Operation Anxiety, STOA) was used to assess perioperative state anxiety days before (T1), on the day of (T2, T3) and a day after (T4) surgery. In addition, the perioperative stress and anxiety levels were further evaluated using the numeric rating scale for stress (NRS) as well as the vital parameters blood pressure (BP), respiratory rate (RR) and heart rate (HR). Moreover, user ratings on the usefulness of the patient education were assessed with an evaluation questionnaire. The study arms were subjected to a comparison of perioperative state anxiety through two-tailed independent samples t-tests, utilizing a 95% confidence interval. Subjective ratings were correlated with STOA values to investigate possible associations between perioperative anxiety with perceived usefulness.
Results
Of 164 participants randomized, 152 completed the trial. Participants who received preoperative education experienced a significantly lower increase in the state anxiety on the day of operation (mean difference +2,15, P=0.03) compared to those who did not receive an educational intervention (mean difference 3.09, P=0.04). Furthermore, participants who perceived a potential preoperative education as helpful (Helpfulness between 6 – 10) showed significantly lower stress increase (M=+2.80) compared to the control group (M=+4.04, P=0.05). There was no significant difference between groups regarding a change in vital parameters. Based on the results using the NRS, female patients randomized to the preoperative education group showed significantly lower stress levels postoperatively (M=-2.95) compared to female patients of the control group (M=-2.19; P=0.04). There was some evidence to suggest similar but non-significant effect for male patients (P=0.10).
Conclusions
This type of preoperative education has demonstrated its effectiveness in alleviating stress and anxiety among patients undergoing ENT surgery. Considering the existing body of evidence and prevailing international norms, it is advisable to integrate preoperative education as a standard practice, with a particular emphasis on offering it to patients who perceive the educational intervention as valuable, as our study indicates that they derive substantial benefits from it.

Key words: ENT surgery, Preoperative education, Patient stress, Patient anxiety, Randomized controlled trial, State-Trait Operation Anxiety (STOA), Numeric rating scale for stress (NRS), Vital parameters Evaluation questionnaire, Perioperative state anxiety, Educational intervention, Female patients, Male patients, Effectiveness, Standard practice, Psychological stress, Time- and cost-efficient intervention

IMPLANTABLE DEVICES: STRATEGIES AND FRAMEWORKS

279 - Understanding the influences of patient characteristics and healthcare practices on language outcomes for children with cochlear implants

Julie Hare [(1)] - Tracey Sear [(1)] - Deborah Vickers [(2)]
University College London Hospital, Auditory Implant Department, London, UK [(1)] - University of Cambridge, SOUND Lab, Cambridge, UK [(2)]

The goal was to determine how the patient profile of pediatric cochlear implant recipients changed over a 20-year period and to understand how these changes were influenced by clinical practice and changes in society. These profiles of factors were related to changes in long-term language outcomes.
We conducted a retrospective, observational cross-sectional study of children implanted between 1998 and 2019 in an inner-city clinic and related demographic factors to longitudinal language outcomes from pre-implant to five-years post-implant from all children reaching the five-year clinical review (179 children). Demographic factors of home language, onset of severe-to-profound deafness (congenital, progressive, or acquired), age at implantation, device configuration (unilateral, bimodal, bilateral) and socioeconomic status were collected for the entire sample (414 children). Chi-square, Kruskal-Wallis and ANOVAs were used to determine if demographic factors changed over time and logistic regressions were used to understand factors predicting language outcomes.
Over the 20-year period we observed a significant increase in the percentage of children from non-native English-speaking families (24% to 67%), influenced by population migration. There was a significant increase in the percentage of children with progressive onset of deafness (8% to 45%), influenced by UK National Institution of Health and Care Excellence guidance which saw a relaxation in audiometric criteria such that more children with progressive losses were eligible.
Age at implantation significantly decreased due to greater surgical confidence, increased awareness of the benefits of implanting babies under 12 months and the introduction of newborn hearing screening. There was a significant reduction in the Index of Multiple Deprivation (proxy for socio-economic status) believed to be related to recession, austerity, and population migratory trends.
Regression analyses suggested that onset of deafness, age at implantation, year of implantation, income deprivation and parental education were key predictors of five-year post implantation language abilities.
Multiple factors affect long-term speech and language outcomes for children using cochlear implants. Influential factors can alter over time due to changes in clinical practice/guidance or society (affecting cultural/linguistic distribution). If this complex and dynamically changing landscape of influential factors is well understood, appropriate interventions can be introduced for families that are most in need of them to facilitate faster rates of language acquisition.

Key words: children, cochlear implant, paediatric, language, predictors

269 - Association of Hearing Aids and Cochlear Implants with Cognitive Decline and Dementia: A Systematic Review and Meta-analysis

Benjamin Kye Jyn Tan [(1)] - Brian Sheng Yep Yeo [(2)] - Harris Jun Jie Muhammad Danial Song [(2)] - Emma Min Shuen Toh [(2)] - Li Shia Ng [(3)] - Cyrus Su Hui Ho [(4)] - Roger Ho [(4)] - Reshma Aziz Merchant [(5)] - Woei Shyang Loh [(3)]

Singapore General Hospital, Department of Otorhinolaryngology-Head & Neck Surgery, Singapore, Singapore [(1)] - National University of Singapore, Yong Loo Lin School of Medicine, Singapore, Singapore [(2)] - National University Health System, Department of Otolaryngology-Head & Neck Surgery, Singapore, Singapore [(3)] - National University of Singapore, Department of Psychological Medicine, Yong Loo Lin School of Medicine, Singapore, Singapore [(4)] - National University Hospital, Division of Geriatric Medicine, Department of Medicine, Singapore, Singapore [(5)]

Importance Hearing loss is associated with cognitive decline. However, it is unclear if hearing restorative devices may have a beneficial effect on cognition.
Objective To evaluate the associations of hearing aids and cochlear implants with cognitive decline and dementia.
Data Sources PubMed, Embase, and Cochrane databases for studies published from inception to July 23, 2021.
Study Selection Randomized clinical trials or observational studies published as full-length articles in peer-reviewed journals relating to the effect of hearing interventions on cognitive function, cognitive decline, cognitive impairment, and dementia in patients with hearing loss.
Data Extraction and Synthesis The review was conducted in accordance with Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) reporting guidelines. Two authors independently searched the PubMed, Embase, and Cochrane databases for studies relating to the effect of hearing interventions on cognitive decline and dementia in patients with hearing loss.
Main Outcomes and Measures Maximally adjusted hazard ratios (HRs) were used for dichotomous outcomes and ratio of means for continuous outcomes. Sources of heterogeneity were investigated using sensitivity and subgroup analyses, and publication bias was assessed using visual inspection, the Egger test, and trim and fill.
Results A total of 3243 studies were screened; 31 studies (25 observational studies, 6 trials) with 137 484 participants were included, of which 19 (15 observational studies, 4 trials) were included in quantitative analyses. Meta-analysis of 8 studies, which had 126 903 participants, had a follow-up duration ranging from 2 to 25 years, and studied long-term associations between hearing aid use and cognitive decline, showed significantly lower hazards of any cognitive decline among hearing aid users compared with participants with uncorrected hearing loss (HR, 0.81; 95% CI, 0.76-0.87; $I^2 = 0\%$). Additionally, meta-analysis of 11 studies with 568 participants studying the association between hearing restoration and short-term cognitive test score changes revealed a 3% improvement in short-term cognitive test scores after the use of hearing aids (ratio of means, 1.03; 95% CI, 1.02-1.04, $I^2 = 0\%$).
Conclusions and Relevance In this meta-analysis, the usage of hearing restorative devices by participants with hearing loss was associated with a 19% decrease in hazards of long-term cognitive decline. Furthermore, usage of these devices was significantly associated with a 3% improvement in cognitive test scores that assessed general cognition in the short term. A cognitive benefit of hearing restorative devices should be further investigated in randomized trials.

Keywords: hearing aids, cochlear implants, cognition, dementia, evidence synthesis

132 - Examining hearing aid use prior to cochlear implantation in children

Kathryn Wiseman [(1)] - Caitlin Sapp [(2)] - Erika Gagnon [(3)] - Lisa Park [(3)]
Boys Town National Research Hospital, Center for Hearing Research, Omaha, United States [(1)] - University of North Carolina at Chapel Hill, Pediatric Audiology, Chapel Hill, United States [(2)] - University of North Carolina at Chapel Hill, Children's Cochlear Implant Center, Chapel Hill, United States [(3)]

Many deaf children in the United States are fitted with hearing aids before receiving a cochlear implant(s), either as a trial to assess the benefit a child receives from a hearing aid or as long-term hearing aid users prior to transitioning to a cochlear implant. Hearing aid use prior to implantation may provide acoustic benefit for some children, time for newly diagnosed children to establish consistent device use prior to implantation, or an opportunity to assess potential challenges with device use before surgery. Some professionals surmise that consistent hearing aid use prior to cochlear implantation is an indicator of a family's high motivation level to pursue intervention, but little research has examined the consistency of hearing aid use prior to implantation. This study examined hearing aid use as a predictor of cochlear implant use at 6 months and 1 year after implantation. We also examined relationships between pre-implantation hearing aid use, cochlear implant use, pre-implant hearing, and sociodemographic factors.
This retrospective analysis includes 108 children with cochlear implants from the University of North Carolina -- Chapel Hill. Children were age 6 months – 17 years when receiving their first cochlear implant. All demographic and audiologic information was extracted from clinical records. Hearing aid and cochlear implant use was represented via datalogging measurements collected at cochlear implant candidacy evaluation or follow-up appointments. Models predicting device use were analyzed using multiple regression and linear mixed modeling. Results indicate that hours of hearing aid use significantly predicted cochlear implant use at 6 months and 1 year post-implantation. Datalogging indicated that, on average, children used their hearing aids 7 hours/day (range: 0-20). By 6 months after implantation, children used their cochlear implants a mean of 7 hours/day (range: 0.2-14.6) and 8 hours/day (range: 0.4-18.3) by 1 year post-implantation. Hearing aid use remained a predictor of cochlear implant use after accounting for age at assessment pre-implantation, pre-implant hearing (i.e., aided audibility), and socioeconomic position (i.e., insurance status). Older children were more likely to wear their hearing aid prior to implantation and their cochlear implant after implantation. Aided audibility was a weak significant predictor of hearing aid use, such that children with more access to speech via their hearing aids were more likely to wear their hearing aids, though this effect was not present after accounting for age.
These findings indicate that children who are consistent hearing aid users are more likely to be consistent cochlear implant users after implantation. Overall, hours of device use are likely to increase pre- and post-implantation as children age. Individuals with lower hearing aid wear time may need additional support and counseling after CI to increase hours of use. Future research should examine the benefits and drawbacks of a hearing aid trial prior to pediatric cochlear implantation.

Keywords: pediatrics, cochlear implant, hearing aid, datalogging

265 - Intracochlear Electrocochleography in Children with Auditory Neuropathy Spectrum Disorder wearing Cochlear Implants

Geeorge Tavartkiladze [(1)] - Mariia Lalayants [(1)] - Vigen Bakhsginyan [(1)]
Russian Medical Academy of Continuing Professional Education, Clinical Audiology, Moscow, Russian Federation [(1)]

Objective**:** Electrocochleography (ECochG) is a technique for recording evoked potentials from the inner ear, generally originated from hair cells and nerve fibers. It is useful for assessing inner ear function in both laboratory and clinical settings. Recently, the research focus of ECochG was shifted towards its application during cochlear implantation. ECochG using intracochlear electrodes appears to be a feasible instrument to assess the inner ear electrophysiological features in cochlear implant recipients, especially in patients with auditory neuropathy spectrum disorder (ANSD). One of the most interesting from the research and clinical point of view goal is to specify the site of lesion in these patients and differentiate the auditory synaptopathy and auditory neuropathy.
Material and methods**:** 15 children with ANSD with profound hearing loss according to age-appropriate behavioral tests were enrolled in the investigation. The etiology of ANSD in these patients included: *OTOF* gene mutation in 5 cases; cochlear nerve deficiency in 2 cases; prematurity with other perinatal risk factors in 3 cases and the etiology was unknown in 5 children. 10 patients were implanted with Cochlear CI512 or CI24RE(CA) and 5 - with Advanced Bionics HiRes 90K Advantage CI. Electrocochleography, acoustic stimulation and recording were performed using Active Insertion Monitoring systems for Advanced Bionics users and Cochlear Research Platform - for Cochlear users. ECochG was performed at least in two modes for each patient: 1. Frequency sweep mode - ECochG via most apical intracochlear electrode (by default but variable) for different frequencies from 125 Hz to 4000 Hz (depending on the system); 2. Electrode sweep mode - ECochG via every second intracochlear electrode for stimulation with 500 Hz tone burs (by default but variable). All patients were tested postoperatively and 5 patients were also tested intraoperatively. Cochlear microphonic (CM) and auditory nerve neurophonic were estimated.
Results**:** CMs were recordable in all patients with ANSD at most tested frequencies. CM thresholds were registered at some unexpected low levels - 35 dB HL at 125 Hz and 65 dB HL at 2000 Hz in some cases. The obtained ECochG parameters were different in patients with ANSD of different etiology. ECochG thresholds were not comparable with behavioral thresholds. To specify the nature of the disease (synaptopathy or true neuropathy) the ABR registration to electrical stimulation was performed. Additionally, due to preserved cochlear structures in patients with ANSD, the ECochG performed at different frequencies allows to specify the electrode location in the cochlea.
Preliminary conclusions: ECochG obtained through cochlear implant appear to be an easy performing informative tool to estimate the functional integrity of preserved cochlear structures in patients with ANSD of different etiology after cochlear implantation. ECochG findings do not correlate with audiometric tests in patients with ANSD, therefore intraoperative ECochG should not be used for estimating residual hearing level in patients with ANSD. The eABR registration along with the ECochG provides important additional information for prognosis of CI effectiveness.

Keywords: auditory neuropathy, electrocochleography, cochlear implantation, eABR

78 - Identification of potential candidates for CI in large database of hearing aids users

Bernard Fraysse [1]
Clinique Rive Gauche,Toulouse, France [1]

Cochlear Implant is one of the most successful of all protheses to date. There is still a huge underutilization < 10 %. Many factors are involved: underestimation try the patients of disability, lack of awareness, lack of referral pathways unclear cochlear implant audiological criteria of candidacy.
Our database included 169414 patients for audiological screening on which 48298 with symmetric hearing loss and all hearing aids outcomes.

1. Description of the population: we analyse the delay in access, impact of socioeconomics status and biographic data
2. Identification of potential candidates based on a routine assessment PTA in unaided as showed a low sensitivity and specificity
3. We describe the difference when we considered the audiological for candidacy using SNR with hearing aids > 9 dB (French HINT test) instead of SRT disyllabic words > 60 dB with hearing aids

53 - The evolution of auditory, visual, and cognitive abilities in adults with a severe-to-profound hearing loss after cochlear implantation

Dorien Ceuleers [(1)] - Hannah Keppler [(2)] - Nele Baudonck [(3)] - Freya Swinnen [(3)] - Katrien Kestens [(2)] - Ingeborg Dhooge [(1)]
Ghent University, Department of Head and Skin, Ghent, Belgium [(1)] - Ghent University, Department of Rehabilitation Sciences, Ghent, Belgium [(2)] - Ghent University Hospital, Department of Otorhinolaryngology, Ghent, Belgium [(3)]

Introduction: Cochlear implantation (CI) is the standard-of-care for individuals with a severe-to-profound bilateral hearing loss. However, a large variability is seen in the outcome after implantation, especially for speech understanding (Blamey et al., 2013; Holden et al., 2013; Moberly, Bates, et al., 2016). It is suggested that the variation in CI outcome may not solely be due to peripheral auditory factors. The process of speech understanding is considered a bi-modal process, whereby information from both the auditory and the visual modalities is integrated to increase speech intelligibility (Massaro & Cohen 1983; Stevenson et al. 2017; van de Rijt et al. 2019). Besides, increasing evidence exists that — next to auditory-visual bottom-up mechanisms — cognitive top-down mechanisms also contribute to speech understanding (Akeroyd 2008; Rönnberg et al. 2013; Moberly et al. 2016b). Specifically, high-level cognitive processes such as working memory, processing speed, selective attention, and cognitive flexibility and inhibition are considered important for speech understanding (Akeroyd 2008; Rönnberg et al. 2013; Dryden et al. 2017). Given this complexity of speech understanding, it is suggested to consider a broader variety of factors than only auditory factors in the follow-up of CI candidates. Therefore, the current study aimed to evaluate the auditory, visual, and cognitive abilities of adults with a severe-to-profound hearing loss before implantation and in the short- (i.e. three months and six months) and long-term (i.e. twelve months) after implantation.
Material and methods: The study sample consisted of 26 adults with a severe-to-profound hearing loss who were candidates for CI, according to the Belgian criteria for reimbursement. Participants were evaluated with an extensive test battery, including auditory, visual, and cognitive assessments, at four test moments: before implantation, and at three months, six months, and twelve months post implantation. The auditory abilities were evaluated using pure-tone audiometry, speech audiometry in quiet and in noise. For assessing the (audio-)visual speech processing abilities the Test for (Audio-)Visual Speech Perception (TAUVIS) was used (Ceuleers et al., 2021). The cognitive assessments included the Letter-number sequencing task (Wechsler, 2012), the Letter Detection Test (COTESS werkgroep, 2011), and an auditory Stroop test (Kestens et al., 2021) as measures for working memory and processing speed, selective attention, and cognitive flexibility and inhibition, respectively. Furthermore, the subjective impact of implantation on the hearing-related quality of life was investigated using the hearing-related quality of life questionnaire for Auditory-VIsual, COgnitive and Psychosocial functioning (hAVICOP) (Ceuleers et al., 2023). Descriptive parameters were established for every test moment. Linear Mixed Models were used to investigate the effect of test moment statistically.
Results: Preliminary results indicate an improvement for all auditory, visual, and cognitive abilities after implantation. The greatest improvement is seen between the test moment before implantation and three months post implantation. Furthermore, a large improvement is seen in hearing-related quality of life after implantation. Currently, data collection and data analysis is still ongoing. The final results will be presented at the at the HeAL conference in June, 2024.
Conclusion: This study aimed to investigate the evolution of auditory, visual and cognitive abilities before and after CI. As such, more insight in the different abilities contributing to speech understanding outcomes could be provided. In the future, these results could provide useful information for the counseling and rehabilitation after implantation.

Key words: cochlear implantation, outcome, speech processing, audiovisual speech understanding, auditory-cognitive functions

Financial disclosures/conflicts of interest: This research was supported by a grant provided by Cochlear Research & Development Ltd (ref # IIR-2321). The funding organizations had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the decision to submit the abstract for presentation.

144 - Cochlear implantation and uptake in Australia over 20 years: are we reaching a limit?

Robert Eikelboom [(1)] - Catherine Sucher [(1)] - Sandra Bellekom [(2)] - Marcus Atlas [(1)]
Ear Science Institute Australia, Research, Subiaco, Australia [(1)] - Ear Science Institute Australia, Corporate, Subiaco, Australia [(2)]

Background: The one millionth cochlear implant in the world occurred in 2022. Since the commercialisation in the 1980s of cochlear implants as a treatment for profound hearing loss, indications for implantation have expanded In Australia and other countries to include those with greater degrees of residual hearing or single-sided deafness. Public or medical insurance funding has adapted to candidacy changes, facilitating improved access to CIs in many countries. Despite this, uptake of cochlear implants amongst adults has been estimated at around 10% of eligible adults in Australia, and generally lower globally. However, these estimates are based on old data, and at times the method to arrive at these estimates is unclear.
This study reports on publicly available metrics on episodes of CI surgery, routinely reported by public and private hospitals in Australia since 2000/2001 by age and year. Furthermore, an estimates of CI uptake amongst Australian adults and children are reported.
Data sources and methods: (i) Australian Institute for Health and Welfare's Procedure Codes for implantation data (by age, sex and year). (ii) Australian Bureau of Statistics population data for each year since 2000/2001, to determine the rate of implantation per age group and sex. (iii) Population data of prevalence of the severity of hearing loss in Australia for estimates of implant uptake rate. Adults were defined as those over the age of 14 years. Rates of bilateral implantation in children and adults were estimated from published reports and data from individual centres. (iv) Uptake rates were estimated using (i) new instances of severe-profound hearing loss each year, and the number of implants in that year, and (ii) prevalence of severe-profound hearing loss in 2021 and the number of implants over 20 years.
Results: Overall implantations increased from 162 adult and 127 paediatric implantations in 2000/2001, to 1260 and 365 respectively in 2020/2021. The greatest growth in implantations were in those in the 75 to 84 years age group. However, there has been a plateauing in the annual number of adult implantations since 2015/2016. Furthermore, a peak of 458 paediatric implantations in 2012/2013, was followed by a noticeable steady reduction to about 365 in 2020/2021. There was a noticeable decrease in implantation around the time of COVID-19 restrictions on activities.
The 20-year uptake rate of cochlear implants by adults with severe to profound hearing loss is estimated to be between 10.1% and 20.8%, depending on two methods of estimating this. The uptake rate in children is estimated to approach 100%.
Discussion and conclusion: The annual increase in number of cochlear implants could be expected as cochlear implantation became normalised in clinical practice and as the criteria for implantation in Australia broadened over time. The plateau in numbers of adults implanted, despite the uptake rate still being low, may be due to barriers in the referral process, and funding in some states. Hospitals may still be dealing with the effects of COVID-19. The plateau and drop in number of children being implanted may be due to a reduction in children born with or developing severe to profound hearing loss.
The estimate of the uptake rate is somewhat higher than previously published estimates for Australia. This estimate is based on somewhat unreliable estimates of the population prevalence of severe to profound hearing loss. However, it appears to confirm that the cochlear implantation rate in Australia is amongst the highest in the world.

INTERVENTION AND REHABILITATION: STRATEGIES AND FRAMEWORKS

73 - New hyperacusis therapy combines psychoeducation, sound exposure and counseling

Sandrien Thieren [1] - Paula van Dommelen [2] - Michel R. Benard [1]
Pento Speech and Hearing Centers, Audiology, Apeldoorn, Netherlands [1] - The Netherlands Organization for Applied Scientific Research TNO, Child Health, Leiden, Netherlands [2]

Purpose: The aim of this study was to investigate the short- and long-term effects of a new Cognitive Sound Exposure Therapy (CSET) in patients with hyperacusis.
Method: A new therapy was developed to reduce hyperacusis using sound exposure combined with breathing and relaxation strategies from both Acceptance and Commitment Therapy, and Cognitive Behavioral Therapy. Patients referred to the Speech and Hearing Centers located in Hengelo and Zwolle in the Netherlands and aged >=18 years with hyperacusis as main complaint and no or mild hearing loss, were included in this study. Patients were seen for CSET between June 2020 and August 2022 by a clinical audiologist and a social worker experienced in tinnitus and hyperacusis. Additionally, the social worker has received training in cognitive behavioral therapy. The sessions took place bi-weekly. Sessions ended when exposure reached a healthy level with a maximum of 70 to 80 dB Sound Pressure Level (SPL). Short-term effects between the start and the end of therapy were based on tolerable level of sound exposure (dB SPL), subjective level hinderance (emotional and psychological impact of sounds) of hyperacusis and sensitivity to sound using the Hyperacusis Questionnaire (HQ). The long-term effect was based on HQ six months after the end of therapy. Linear mixed effects and regression models were applied to study outcomes over time.
Results: In total, 30 patients, 15 males and 15 females, aged between 24 and 76 years were included in this study. The mean number of sessions during therapy was six and ranged between four and eight. The duration of the hyperacusis complaints at therapy start varied from six months to 20 years. Results showed an increase of exposure level (mean change was +23.7 dB with a standard deviation (SD) of 7.9, $p<0.001$), a decrease in sensitivity to daily sounds (mean (SD) change was -1.6 (2.1), $p<0.001$), and a decrease in HQ (mean (SD) change was -9.8 (4.9), $p<0.001$) between the start and the end of therapy. There was no significant change in HQ after the end of therapy and 6 months later (mean (SD) change was 0.2 (4.3) $p=0.81$).
Conclusion: Our pre-post study showed that CSET decreased short- and long-term sensitivity to sound in patients with hyperacusis. CSET had a positive impact on the daily life of patients with hyperacusis by reducing auditory sensitivity, not only for the sounds used in the therapy sessions, but also a transfer to daily sounds, therefore making CSET an effective therapy. These results are promising and warrants further evaluation.

Keywords: Hyperacusis; sound exposure; therapy

159 - Outcome of questionnaires on music perception by hearing-impaired subjects

Jan A.P.M. de Laat [(1)] - Nouri Khalass [(2)] - Berend Glazenburg [(2)] - Evert Rijntjes [(2)] - Marc Stotijn [(3)] - Huinck Wendy J. [(4)]

Leiden University Medical Centre, Dept. Audiology, Leiden, Netherlands [(1)] - Golden Hearing, C-level, Amsterdam, Netherlands [(2)] - Golden Hearing, Research, Amsterdam, Netherlands [(3)] - ENT Department, Radboud University Medical Center, Nijmegen, The Netherlands [(4)]

Improving speech understanding through the use of hearing aids has been the subject of research for years and has since paid off. For hearing-impaired people who love music, the use of hearing aids is far from optimal: the quality of the music experience still leaves much to be desired. In the “Golden Hearing” project we want to a) test music perception with components such as pitch, volume, rhythm, timbre, amplitude and frequency modulation, but also melody and instrument recognition, b) map it out through questionnaires, c) improve it by apply smart sound processing algorithms in hearing aids. In this presentation we show the results of the questionnaires.

By analogy with Kramer's questionnaire study (ref.), we have developed a music questionnaire with a comparable number of questions about the music experience of hearing-impaired people, with the intention of applying a PRÉ version: before the fitting and use of new hearing aids. and a POST version: to evaluate the use of new hearing aids in the so-called trial period. We validate the questionnaire that we prepared by having approximately 200 hearing-impaired people, a second group of 50 normal-hearing musicians people,and a third group of 50 normal-hearing people.

The music questionnaire examines personal data, such as the degree of hearing loss, musical preference and involvement, and the perception of music, such as enjoying music, for example in terms of timbre, in different acoustic conditions, with dynamic, spectral and polyphonic differences. distinguishing melodies and instruments, etc. The correlations between the different parameters are discussed, but also the differences between the three groups of subjects that can or cannot be explained or that can cause surprises.

In a follow-up study, we want to compare the results of Golden Hearing's music perception tests with the results of the music questionnaires. This should help us further with the third point of attention: improving the music perception by the hearing impaired.

Reference

Kramer, S. E., Goverts, S. T., Dreschler, W. A., Boymans, M., & Festen, J. M. (2002). International Outcome Inventory for Hearing Aids (IOI-HA): Reults from the Netherlands. International Journal of Audiology, 41(1), 36-41. https://doi.org/10.3109/14992020209101310

108 - A new array of age confounds for research into hearing problems in older adults

Graham Naylor [(1)]
University of Nottingham, School of Medicine, Hearing Sciences, Glasgow, United Kingdom [(1)]

The field of hearing research has historically been aware of certain confounds related to participant age, that have to be accounted for when designing and interpreting research studies. As the research 'front' evolves, the types of questions, phenomena and experimental techniques involved change character. It is therefore important to consider whether some previously overlooked age-related factors might come to confound our studies in the near future. First we briefly consider domains of hearing research in which age confounds are recognized and taken into account.

Studies of auditory physiology and peripheral processing are relatively well conditioned to separate effects of aging per se and hearing loss. In many studies, the structures and processes of interest are sufficiently low-level that issues of age-related declines in memory or attention are avoided. Also, in animal studies, it is possible to control lifetime exposure to noise, and to use genetically controlled animals that reliably exhibit (for example) early-onset hearing loss as a contrast to reference animals showing typical longitudinal decline. By such means, the effects of mechanisms specific to hearing loss can be somewhat separated from those arising from generic aging processes.

In the human domain, some of the above approaches are not available, and a persistent quandary here is the definition of 'normal hearing'.

Moving into higher-level processing and complex (meaningful) stimuli, cognition inevitably enters the game, and complicates matters. Here, there is appropriate recognition that confounds arising from normal (or abnormal) age-related changes in essential cognitive processes may be in play. Furthermore, the cause vs. effect conundrum arises, as sensory deprivation may lead to cognitive deficit, and cognitive deficit (typically most associated with aging) may hinder efficient processing of incoming sensory information, or potentially even lead to chronically degraded peripheral processing. A healthy debate is ongoing in this arena, and studies which contrast 'young normal-hearing' vs. 'older hearing-impaired' groups are routinely cautious in their conclusions. There is now renewed interest in understanding the effects of hearing loss and hearing interventions on everyday behaviour, which primarily means conversation behaviour – this being the situation posing the most complex challenges in everyday use of our hearing. Of course the main population of interest is older adults with acquired hearing loss.

It is worthwhile to consider how age effects in the broadest sense ('being older', as opposed to aging effects on body systems) may intersect with conversation behaviour, in order to identify potential dimensions along which novel age confounds might intrude in conversation experiments. A number of potential confounds may arise inadvertently from study design choices concerning the age sample(s) to include, especially since a conversation must involve at least two people. Recruitment challenges and/or convenience may induce researchers to include young (Y) participants, either as conversation partners to older (O) target participants, or as a control group. In this talk we argue that both of these approaches are problematic, and describe multiple component aspects of the following primary issues:

- Everyday conversations involving only Y interlocutors exhibit properties different from conversations involving only O interlocutors, and a conversation involving a mix of O and Y resembles neither Y-only nor O-only.
- Y and O participants may react differently to the implied social norms of an experimental setting that involves other participants besides themselves.

A further philosophical question is, what is a 'normal' conversation? And hence, is there an identifiable target for rehabilitation outcomes?

Keywords: Age, Conversation, Confound

65 - 'The burden is very much on yourself': A qualitative study to understand the illness and treatment burden of hearing loss across the life course

Sian Smith [(1)] - Helen Pryce [(1)] - Georgina Burns-O'Connell [(1)] - Saira Hussain [(1)] - Rachel Shaw [(2)] - Jean Straus [(1)]
Aston University, College of Health & Life Sciences, School of Optometry, Department of Audiology, Birmingham, United Kingdom [(1)] - Aston University, College of Health & Life Sciences, School of Psychology, Birmingham, United Kingdom [(2)]

The Hearing Loss and Patient Reported Experience study is an National Institute of Health Research Health Service and Delivery Research funded programme in the NHS in the UK (grant no NIHR 131597), sponsored by University Hospitals Bristol and Weston NHS Trust and delivered with Aston University and the University of Bristol.

Background: Hearing loss is a chronic health condition that rises sharply with age. Patients are increasingly expected to manage their chronic conditions alongside everyday life demands. The way people respond to, and cope with health conditions is influenced by their capacity (resources, skills) to perform illness and treatment-related work. It is important to understand the cumulative workload of hearing loss from the patient perspective.
Aims: We explored the characteristics of the burdens of *illness* (e.g., coping with hearing loss in daily life) and burdens of *treatment* (e.g., accessing and living with interventions) experienced by people living with hearing loss across the life course, and the *resources* they draw upon to manage the workload.
Methods: Individual, semi-structured interviews (either online or in-person) were undertaken with participants recruited from audiology services, and non-clinical services, such as lip-reading classes. We developed the project in consultation with Patient and Public Involvement Engagement (PPIE) groups recruited through Aston University and volunteer links to audiology services. The data were analysed thematically and informed by the burden of treatment theory (May et al., 2014) to understand how participants described the "work" of living with hearing loss and help-seeking and the resources they drew upon to ease the burdens. Abductive reasoning was used in this phase to critically appraise the themes identified.
Results: We interviewed 46 participants with hearing loss aged between 16 and 96 years. The illness burden involved participants working to make sense of their hearing loss, engaging in emotional work in response to changes in sound, social interactions, and identity, and coping with the daily frustrations required to communicate with others. Abandonment and uncertainty characterised the treatment burden; participants engaged in emotional work to adjust to hearing technology and deal with the uncertainty of how their hearing might progress. To ameliorate the burdens, participants drew on internal resources (psychological, health literacy, cognitive) and external resources (social support, financial, information, technology).
Conclusions: The experience of hearing loss takes significant effort, involving hidden practical, psychosocial, and relational work that is devolved to the individual. Participants drew on several internal and external resources to learn about their hearing loss, communicate with and educate others, manage devices, and cope with the residual uncertainty and feelings of disconnection inherent in the experience. It is important to be mindful of the workload and responsibility delegated to the individual and build patient capacity to ease burdens; widening approaches in audiological care (e.g., lifeworld-led care, family centred care) could help to achieve this.

Keywords: qualitative, lived experience, hearing loss, life-world led care, life course perspective, illness burden

215 - Unravelling Communication: Insights from Adults with Hearing Loss - a concept elicitation study

Katie Neal [(1)] - Isabelle Boisvert [(2)] - Jen Whiteway [(3)] - Janette Oliver [(3)] - Sarah Hughes [(4)]
Macquarie University, Linguistics, NSW, Australia [(1)] - University of Sydney, School of Health Sciences, NSW, Australia [(2)] - The Listening Lab, Clinical Research, NSW, Australia [(3)] - University of Birmingham, Centre for Patient Reported Outcome Research, Birmingham, United Kingdom [(4)]

Background: Communication is dynamic, evolving, and collaborative. In oral communication, listening is foundational to this dynamic system. Hearing loss disrupts communicative interactions, requiring individuals to adapt their behavior to achieve communicative success. The representation of this disruption within existing clinical measurement is often inadequate, as hearing and listening skills are standardly isolated from the broader context of communication. The processes and outcomes of listening for communication are contingent upon variables related to the listener, the speaker, the message, the situation, the reciprocal interactions and adaptations and the way a person reports the psychological and psychosocial impacts of their listening. Listening experience is influenced by many factors such as personality traits, cognitive biases, and heuristics. For instance, reports about experiences are prone to recall bias. Highly emotional experiences, such as feelings of exclusion, are more likely to be remembered than the mundane processes of day-to-day conversations, leading to a higher likelihood of recalling these intense emotions when reporting listening experiences. To accurately explain the concepts of listening and communication, we must consider the impact of cognitive biases and an adults' understanding of their own experiences of hearing loss and its effect on communication, as well as the contexts and perspectives of communication partners.
Despite its significance, there has been a scarcity of studies that investigate the self-experienced state of listening for communication in adults with hearing loss. Self-reporting methods may hold the key to capturing the breadth of individual and collective experiences in this domain.
Aims and objectives: This research aimed to explore the intricate disruption of oral communicative interactions associated with hearing loss to support content generation for a patient-reported outcome measure of functional listening ability. It aimed to understand the perceptions of and conceptualisations by adults with hearing loss and their communicative partners regarding the processes and components of listening for communication. Design: Qualitative, multimethod research design
Participants: This study engaged 18 adults with hearing loss (AWHL) ranging from 20 to 90 years old, with a mix of congenital and acquired bilateral hearing loss, along with five of their communication partners. The participants utilized a spectrum of hearing devices including bone conduction implants, cochlear implants, hearing aids, a combination of cochlear implants and hearing aids, or no device at all.
Data collection: Data were gathered through focus groups, semi-structured interviews, and a follow-up open-ended survey. Data were subjected to inductive line-by-line coding and grouping of codes into higher-level categories using reflexive thematic analysis. Results: Participants' accounts described in detail the emotional-psychosocial consequences of living with hearing loss. AWHL exhibited difficulty in moving past these emotional-psychosocial constructs to describe and conceptualise their perceptions of listening processes and behaviours. However, iterative development of the topic guide to include story-rich, contextually embedded questions, facilitated participants expressing the subtleties of their listening experiences beyond the emotional-psychosocial consequences. Thematic analysis yielded 17 themes (cognition, communication partner, communication repair, context, decision making, linguistic, macro constructs, motivation, participation, pragmatics, psychological, psychosocial, scaffolding communication, see-saw of responsibility, social capital, timing and universal attributes) highlighting the salient and fluid nature of communication behaviors. The study showed that adults have insight into the component skills and behaviors necessary for listening and communication and that the recognition and relevance of these aspects are most accurately expressed through the experiences and perspectives of other individuals with hearing loss. It also highlighted that a thorough understanding across the extensive spectrum of domains related to oral communication, is necessary to grasp the impact of hearing loss on communication. Conclusion: The findings underscore the complex and highly dynamic nature of communication behavior and experience and how these are shaped by hearing loss. The variability, timing challenges, and multimodal aspects of listening, render it resistant to simplistic explanations and concise behavioral categorisation. By exploring the wider linguistic, cognitive, and interactive facets of communication from firsthand perspectives, this study may represent components essential to how AWHL experience listening and communication. This exploration supports concept elicitation and thereby ensures item content validity for a new hearing-specific patient-reported outcome instrument measuring functional listening in the communication situations of everyday life.

Keywords: Lived experience, functional communication, measurement

EPIDEMIOLOGY (ADULTS)

164 - Prevalence and incidence of hearing loss: results of a large population study of middle-aged adults

Robert Eikelboom [(1)] - Adriana Smit [(2)] - Inge Stegeman [(2)] - De Wet Swanepoel [(3)] - Yinan Mao [(2)] - Michael Hunter [(4)]

Ear Science Institute Australia, Research, Subiaco, Australia [(1)] - University Medical Center Utrecht, Otorhinolaryngology, Head and Neck Surgery, Utrecht, Netherlands [(2)] - University of Pretoria, Speech Language Pathology and Audiology, Pretoria, South Africa [(3)] - Busselton Population Medical Research Institute, Busselton, Australia [(4)]

Background: Numerous cross-sectional studies have associated hearing loss with a wide range of demographic factors, physical health factors, including age, sex, cardiovascular disease, diabetes, ear disease, poorer mental health, smoking, and socio-economic status. Few studies to date have reported on the incidence of hearing loss, and the association that progressive hearing loss has with demographic and other health factors. We report on a longitudinal study of hearing loss in middle-aged adults, and associations between the progression of hearing loss over six years.
Materials and Methods: The Busselton Healthy Ageing Study is a population study of Baby Boomers (born 1945 to 1964), who were assessed between 2010 and 2016 (aged 45 to 70 years) and between 2016 and 2022 (aged 50 to 75 years). Approximately 75% of those eligible participated in Phase 1 (n=5097) and of those 70% participated in Phase 2 (n=3599). Participants completed a clinical history survey, which included questions on hearing and tinnitus, and their individual effects on daily life; work-place exposure to noise and use of protection; other health conditions diagnosed by their doctor; mental health. They also participated in a four-hour physical assessment, that included air- and bone-conduction audiometry, and a blood test.
Analysis: Hearing thresholds were summarised by calculating the better-ear four-frequency average (air conduction thresholds at 500, 1000, 2000 and 4000Hz) (BE4FA), and classified as per the World Health Organization's classifications of hearing loss. Participants were also classified into five-year age groups. Age-related typical audiograms (ARTA) were plotted by age group and sex, for both phases and the change between phases. Univariate and adjusted linear mixed models were applied to assess the associations between the change in BE4FA between Phase 1 and 2 and age, sex, body mass index, working in a noisy place and associated use of protection, tinnitus, chronic ear infection, smoking (pack years), diabetes (based on biochemistry analysis of blood), cardiovascular disease (self-report medical history, blood pressure), and a general health score (SF10). Results: Males were slightly less represented than females, and there were relatively fewer participants in the 45-to-50, and the 65-to-70-year age groups at baseline compared to the general population. Over the six years, participants with WHO classified normal hearing reduced from 86.0% to 73.9%, with the percentage of those with mild HL increasing from 12.1% to 20.6%, and those with moderate and greater HL increasing from 2.0% to 5.5%. Males with moderate or greater hearing loss increased from 2.8% to 5.53%; for females this increased from 1.3% to 3.71%. The six-year incidence of hearing loss i.e. a progression from normal to mild or greater hearing loss was 17.2%.
The ARTAs showed there was a change in thresholds that increased linearly with increasing frequency, with approximately 0 to 10 dB HL change at 500Hz, through to 7 to 12 dB HL change at 8000 Hz. Greater change was observed in males compared to females, especially those younger than 55 years.
The univariate linear mixed model showed significant associations of a six-year change in BE4FA and increasing age, male sex, higher BMI, less frequent protection of hearing in workplace, tinnitus, chronic ear infection, pre-diabetes and diabetes, elevated blood pressure, and a history of cardiovascular disease.
The adjusted linear mixed model showed significant associations with a six-year change in BE4FA: Older age, male, a history of chronic ear infection and self-report of tinnitus.
Discussion and conclusions: This study demonstrated the nature of the deterioration of hearing thresholds over time in middle-aged adults. Over six years, close to 20% of those with normal hearing at baseline progressed to a significant hearing loss, although most of these were to a mild hearing loss. The number of those who could potentially benefit from hearing aids almost tripled. Being a male, having a history of ear disease and having tinnitus were significant risk factors for a progression of hearing loss. This information can be used by clinicians when counselling their clients about their prospective hearing loss, and for developing public health policy.

Keywords: epidemiology, adult hearing loss, incidence, prevalence.

216 - The Relation Between Hearing Loss and Psychosocial Health in Adults, a Longitudinal Study

Rick Lammers [(1)] - Thadé Goderie [(1)] - Birgit Lissenberg-Witte [(2)] - Sophia Kramer [(1)] - Marieke Van Wier [(1)]
Amsterdam UMC, Otorhinolaryngology / Head and Neck Surgery, Amsterdam, Netherlands [(1)] - Amsterdam UMC, Department of Biostatistics, Amsterdam, Netherlands [(2)]

Objectives This study aims to establish the longitudinal relation between 5-year change in hearing ability in noise and the 5-year change of the psychosocial health outcomes, loneliness, anxiety, depression, and distress.
Methods Baseline, 5-year, 10-year and 15-year follow-up data of participants of the Netherlands Longitudinal Study on Hearing (NL-SH) were included. The NL-SH is a web-based prospective cohort study which started in 2006 and includes both normal hearing as well as hearing impaired adults aged 18 to 70 years at baseline. The NL-SH uses the National Hearing Test, which is an online digit-triplet speech in noise test to asses hearing ability. Speech-Reception-Thresholds in noise, corresponding to 50% speech recognition, were calculated. Psychosocial health parameters (i.e. distress, depression, and anxiety) were assessed using the "Four-Dimensional Symptom Questionnaire." Loneliness was assessed using the "De Jong-Gierveld" loneliness scale. Furthermore, demographic, health and socioeconomic characteristics were collected through questionnaires. Linear mixed models were used to assess the association between 5-year change in hearing ability (independent variable) and 5-year change in levels of distress, depression, anxiety and loneliness (dependent variables). For each psychosocial variable separate analysis were performed. Participants could be included multiple times in the analysis correcting for repeated measures. The models were checked for effect modification and confounding of factors known to be associated with either hearing ability or psychosocial health and available in the NL-SH. In case of effect modification stratified analysis were performed.
Results We included 1595 unique participant from who 2882 measurement intervals were analyzed. In participants who experienced no or moderately elevated depression, deterioration of hearing ability was associated with an increased level of distress (distress scale 0-32; $\beta = 0.15$, 95% CI = 0.03 to 0.26, $p = 0.03$). In participants who experienced no or moderately elevated depression deterioration of hearing ability was associated with an increased level of anxiety (anxiety scale 0-24; $\beta = 0.04$, 95% CI = 0.002 to 0.084, $p = 0.04$). In participants who are current tobacco smokers deterioration of hearing ability was associated with an increased level of depression (depression scale 0-12; $\beta = 0.14$, 95% CI = 0.01 to 0.27, $p = 0.03$). No association was found between changes in hearing ability and loneliness.
Conclusions Deterioration of hearing ability in noise in specific subgroups is associated with increased levels of distress, depression, and anxiety, but not loneliness. Health care workers should address psychological health in patient with hearing loss. Further research should focus on interventions ameliorating the psychological consequences of hearing loss.

Keywords: hearing, psychosocial health, longitudinal

59 - Ten-Year Association between Change in Speech-in-Noise Recognition and Falls due to Balance Problems: A Longitudinal Cohort Study

Lotte A. Jansen [(1)] - Marieke F. van Wier [(1)] - Freek Vernimmen [(1)] - Thadé Goderie [(1)] - Raymond van de Berg [(2)] - Ulrike Lemke [(3)] - Birgit Lissenberg-Witte [(4)] - Sophia E. Kramer [(1)]
Amsterdam UMC location Vrije Universiteit Amsterdam, Department of Otolaryngology – Head and Neck Surgery, section Ear and Hearing, Amsterdam, Netherlands [(1)] - Maastricht University Medical Centre, Division of Vestibular Disorders, Department of Otorhinolaryngology and Head and Neck Surgery, Maastricht, Netherlands [(2)] - Sonova AG, Research &Development, Straefa, Switzerland [(3)] - Amsterdam UMC location Vrije Universiteit Amsterdam, Department of Epidemiology and Data Science, Amsterdam, Netherlands [(4)]

Background**:** Hearing and balance issues can lead to increased risk for falls, which are detrimental causes of injury and disability, particularly among older adults. Both hearing impairment and incidence of fall-related injuries tend to accelerate around the age of 50 years. While cross-sectional studies have found significant associations between hearing loss and falls, longitudinal studies investigating the association between hearing loss and fall risk are limited and show mixed results. It is also currently unclear what role dizziness plays in this association, and whether hearing aid use can mitigate the risk for falls. A deeper insight into these associations can help make a positive contribution to improving fall prevention programs and ultimately help improve quality of life among adults at risk for falls. The aim of the present study is therefore to examine the longitudinal relationship between hearing ability and falls over a 10-year period. To investigate this, this study answers the following three research questions (RQs):

1) RQ-1, what is the relationship between baseline speech-in-noise recognition and incident/recurrent falls due to balance problems ten years later?
2) RQ-2 (a), what is the association between 10-year change in hearing ability and falls due to balance problems at 10 years, and (b) does this association differ among adults with and without dizziness complaints?
3) RQ-3, is there a cross-sectional association between hearing aid use and falls among those with hearing impairment?

Methods**:** Data was collected from the Netherlands Longitudinal Study on Hearing between 2006 and December 2022. Participants completed an online survey and digits-in-noise test every five years. For this study, data was divided into two 10-year follow-up time intervals: T0 (baseline) to T2 (10-year follow-up), and T1 (5-years) to T3 (15-years). For all RQs, participants aged ≥40 years at baseline, without congenital hearing loss, and non-CI users were eligible (n=592). Additionally, for RQ-3 participants with a speech reception threshold in noise (SRTn) ≥-5.5 dB signal-to-noise ratio were included (n=422). Analyses used survey variables on demographic characteristics, hearing, dizziness, falls due to balance problems, chronic health conditions, and psychosocial health. Logistic regressions using General Estimating Equations were conducted to assess all RQs.

Results**:** After adjusting for confounders, poor SRTn at baseline was significantly associated with a higher odds of falling recurrently (≥2 falls) (odds ratio (OR):2.91, 95% confidence interval (CI) [1.21, 7.02]). Particularly among individuals with obesity, those with poor baseline SRTn had a higher odds of falling incidentally (1 fall) 10 years later (OR:14.7, 95% CI [2.12, 103]). After adjusting for confounders, a 10-year worsening of SRTn was significantly associated with a higher odds of falling recurrently (OR:2.20, 95% CI [1.03, 4.71]) but not incidentally. No significant interaction was found between dizziness and 10-year change in SRTn. Hearing aid use (no use or <2 years of use vs. ≥2 years of use) was not significantly associated with incident nor recurrent falls. Although there was a significant interaction with sex for this association, the effect of hearing aid use on incident/recurrent falls was not statistically significant among males nor females.

Conclusions**:** A longitudinal association between the deterioration in SRTn and recurrent falls due to balance problems after 10 years was confirmed in this study. This result stresses the importance of identifying declines in hearing earlier and justifies including hearing ability assessments within fall risk prevention programs. Further prospective research that collects additional details on causes of dizziness could provide a better insight into the role of vestibular symptoms on the relationship between hearing impairment and falls. Mixed results of hearing aid use on fall risk warrant further investigation into the temporality of this association and possible differences between men and women.

Keywords: falls, dizziness, hearing ability, longitudinal, hearing aids.

174 - Communication in the digital workplace – effect on participation for individuals with hearing impairment and deafness

Elisabeth Ingo [(1)] - Josefine Andin [(1)] - Rachel Ellis [(1)] - Peter Nordqvist [(2)]
Linköping University, Behavioural Science and Learning, Linköping, Sweden [(1)] - KTH Royal Institute of Technology, Division of Speech, Music and Hearing, Research Institute Hearing Bridge, Stockholm, Sweden [(2)]

Introduction In Sweden, 55% of individuals with hearing impairment and deafness are of working age (18–65 years of age), and this proportion is increasing. Several studies indicate that individuals with hearing impairment or deafness, as a group, are disadvantaged in the workplace, primarily due to inaccessible communication. Higher levels of effort in communication, lower participation, and more stress-related sick leave (leading to higher societal costs) have been observed. The COVID-19 pandemic resulted in a rapid transition to a digital workplace with increased digital communication, such as virtual meetings during remote work. Adults with active employment in Sweden are entitled to state-funded assistive devices and tailored adjustments to the acoustic work environment, as well as interpretation (sign language or written) following the individual's work situation and need. However, the support is often tailored to the individual's needs in the physical workplace and may be less beneficial in digital communication and remote work. This can have negative consequences for participation in work-related communication.
Purpose & aim the purpose of this study is to investigate how the shift towards increased digital communication and remote work during the COVID-19 pandemic has affected participation in work-related communication among individuals with hearing impairment or deafness. Furthermore, the aim is to examine the factors that have facilitated/hindered a successful transition to remote work and trust in digital communication, as well as identify any elements that may be missing for sustainable digital work-related communication in the future.
Method This research represents Phase 1 of a larger project conducted in two phases, with Phase 1 consisting of survey data and Phase 2 of in-depth interviews. Survey data for Phase 1 will be collected from Dec 2023 to Feb 2024. The survey will be distributed through interest organizations, social media, and nationwide newspapers. The study will include participants with varying degrees of self-reported hearing impairment or deafness, different levels of utilization of technical aids, and different primary communication methods. Participants will be instructed to reflect on experiences from before, during, and after the pandemic. To further strengthen the generalizability and the validity of the results a subset of our questions will be compared to the Swedish Quality Register of Hearing Rehabilitation, a database with questionnaire answers from patients who undergo hearing rehabilitation at hearing clinics at 18 out of Sweden’s 21 regions.
Relevance The survey of participants' experiences and future needs can contribute to the development of a more inclusive digital workplace for individuals with hearing impairment or deafness. The results may also serve as a basis for the formulation of new guidelines for technical aids that are compatible with the digital workplace.

Keywords: Communication, participation, workplace, hearing impairment, deafness

227 - Hearing Loss and Mortality: Meta Analysis

Chuan-Ming Li [1] - Howard J. Hoffman [1] - Bo Engdahl [2] - Bamini Gopinath [3] - Catherine M. McMahon [4] - Christa L. Themann [5] - Vilmundur Gudnason [6] - Adrian C. Davis [7]
National Institute on Deafness and Other Communication Disorders (NIDCD), National Institutes of Health (NIH), Epidemiology, Statistics, and Population Sciences, Bethesda, United States [1] - Norwegian Institute of Public Health (NIPH), Department of Physical Health and Ageing, Oslo, Norway [2] - Macquarie University Hearing, Department of Health Sciences, Sydney, Australia [3] - Macquarie University, Department of Linguistics, Sydney, Australia [4] - National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention (CDC), Noise and Bioacoustics Team, Division of Field Studies and Engineering, Cincinnati, United States [5] - Icelandic Heart Association (IHA) Research Institute and University of Iceland, Faculty of Medicine, Kópavogur, Iceland [6] - Imperial College, Departments of Audiology and Ear, Nose and Throat (ENT), London, United Kingdom [7]

Background: Hearing loss is associated with multiple negative consequences, including poorer health, reduced quality-of-life, depression and cognitive decline. A few studies have suggested hearing impairment is also associated with increased mortality risk. To reduce potential biases from small sample sizes in previous studies, we performed a meta-analysis using data from Australia, Iceland, and the United States followed by a replication study using data from Norway to examine the association between hearing loss and mortality. Data and Methods: Hearing threshold data from four population-based studies were matched to mortality data:

1. Australia: The Blue Mountains Hearing Study (BMHS), conducted 1997–2007, a population-based survey of age-related hearing loss in a representative sample of older adults in an Australian community, provided audiometric exam data cross-matched with the Australian National Death Index (NDI) for deaths through December 2007.
2. Iceland: The Age, Gene/Environment Susceptibility-Reykjavik Study (AGES-RS), conducted 2002 to 2006, a population-based prospective cohort study was designed to investigate interacting genetic and environmental factors on common age-related conditions. Mortality status through 2016 was determined by the Icelandic Heart Association (IHA), based on the registry of deaths from the Icelandic National Roster maintained by Statistics Iceland.
3. United States: The National Health and Nutrition Examination Survey (NHANES), conducted by the National Center for Health Statistics, CDC, is an ongoing, nationally representative study of the health and nutritional status of the civilian, non-institutionalized population. Audiometric testing of adults from NHANES 1999-2006, was linked to the U.S. National Death Index through 2015.
4. Norway: The Nord-Trøndelag Hearing Loss Study (NTHLS), conducted in Norway from 1996 to 1998, is part of the longitudinal Nord-Trøndelag Health Study (HUNT), a large, general health-screening study for the adult population of Nord-Trøndelag County. Information on death and causes of death was obtained from the National Cause of Death Registry.

The datasets with hearing and mortality data from BMHS (n=2,940), AGES-RS (n=5,183), and NHANES (n=6,065) were combined for the meta-analysis. Cox regression was used to estimate hazard ratios (HR) and 95% confidence intervals (CI) while simultaneously adjusting for age, sex, education, body mass index (BMI), cigarette smoking, hearing aids use, diabetes, hypertension, and stroke. We used Global Burden of Disease (GBD) and WHO criteria to categorize hearing loss as “mild”, *i.e.*, pure-tone average of thresholds at frequencies of 0.5, 1, 2, and 4 kHz ranging from 20.0-34.9 dB hearing level (HL), moderate (35.0-49.9 dB HL), and moderately severe or greater (≥50 dB HL) hearing loss in the better ear. Data from the NTHLS was analyzed independently to conduct a replication study for the meta-analysis.
Results: The combined BMHS, AGES-RS, and NHANES data included 14,188 participants (males, 45.1%; females, 54.9%) aged 20 years or greater, with average age 62.0 years (standard deviation: 4.0). The prevalence of mild hearing loss, by GBD/WHO criteria, was 42.5% (males, 43.1%; females, 42.0%), moderate hearing loss, 25.4% (males, 28.1%; females, 23.3%), moderately severe or greater hearing loss, 9.2% (males, 11.6%; females, 7.3%). After multivariate adjustment, mild [HR=1.54 (95% CI:1.17-2.02)], moderate [HR=1.98 (95% CI:1.45-2.70)], and moderately severe or greater hearing loss [HR=2.26 (95% CI:1.49-3.41)], were all significantly associated with increased risk of mortality. Risk factors associated with increased mortality included stroke, diabetes, and cigarette smoking. Mortality was reduced significantly among those who had ever worn hearing aids, HR=0.63 (95% CI:0.47-0.84). The NTHLS replication study included 50, 277 adults (males, 46.8%; females, 52.2%) aged 20 years or greater, with an average age of 50.0 years (standard deviation: 16.9). The prevalence of hearing loss was mild, 13.7%; moderate, 5.4%; and moderately severe or greater hearing loss, 1.8%. Hazard ratios based on the NTHLS were mild, HR=1.14 (95% CI:1.10-1.19),

moderate, HR=1.23 (95% CI:1.16-1.30), and moderately severe or greater hearing loss, HR=1.34 (95% CI:1.22-1.47).
Conclusion: The Norwegian replication study confirmed meta-analysis findings from the combined Australian, Iceland, and United States cohorts. After adjustment for other risk factors of individuals, increasing severity of hearing loss was significantly associated with increasing risk of mortality, *i.e.*, dying at younger age. The use of hearing aids was associated with reduced mortality risk. These findings highlight the importance of public health messaging and awareness around the benefits of earlier intervention to increase life expectancy in adults with hearing loss.

Key words: hearing loss, mortality, hearing aids, hazard ratios

15 - Analyzing the Relationship between Hearing Loss and Physical Activity: A Scoping Review
Matthew Bush [(1)] - Caroline Heltsley [(1)] - Jate Bernard [(1)] - David Adkins [(1)] - Anthony Mahairas [(1)]
University of Kentucky, Otolaryngology - Head and Neck Surgery, Lexington, Kentucky, United States [(1)]

Methods**:** PubMed, Cochrane Database of Systematic Reviews, Web of Science, and CINAHL were used to search for relevant publications. Peer-reviewed publications written in English during or after the year 1995 were deemed eligible for inclusion. Articles were screened for study design. Randomized control trials, non-randomized control trials, prospective and retrospective cohort/longitudinal studies, observational studies, case control studies, and case series were included for review. Eligible studies contained assessments of hearing loss as well as physical activity in patients 18 and older. The initial search queries yielded 28,761 articles which were screened for relevance based on the title and abstract. The remaining articles were reformatted into an EndNote library and underwent full text review. After full text review, 33 articles were deemed appropriate for inclusion. Using REDCap software, two members of the research team to analyze the articles based on inclusion criteria, study design, definitions, as well as strength of relationship between physical fitness & hearing loss. Qualitative data was coded and compiled into a RECAP database to facilitate review and analysis.
Results**:** While the measurement physical activity and hearing loss are inconsistent between included studies, the qualitative data suggests a relationship between hearing loss and decreased physical activity.
Conclusions**:** Hearing loss and physical activity are independently well-studied, but there is limited research regarding the relationship between the level of physical activity and hearing impairment. Additional research is required to further investigate this relationship and assess the viability of interventions that may be able to treat both physical inactivity and hearing loss.

OUTCOME OF EDHI PROGRAMS (1)

106 - Universal Newborn Hearing Screening Ireland – ensuring early intervention, in relation to hearing, is an option to all Newborn babies in Ireland

Charlotte Karlsson [(1)] - Charlene Hynes [(1)] - Mark Fenton [(1)] - Gary Norman [(2)]
UNHS ROI NEC Care, Newborn Hearing Screening, Cork, Ireland [(1)] - HSE, Audiology, Dublin, Ireland [(2)]

Introduction

In 2011 the urgent requirement for a Universal Newborn Hearing Screening (UNHS) programme in the Republic of Ireland was a key recommendation from the National Audiology Review Group (NARG).

The Health Service Executive (HSE) undertook a formal procurement process and in 2011 Northgate, now NEC, was awarded the contract to deliver the UNHS along with a National ICT system.

The programme was rolled out on a phased basis, becoming a National programme in November 2013.

The delivery method is a hospital centred service, based on the 1-3-6 recommendations by the AJA & JCIH.

1st month of baby's life – hearing screen to be completed

3rd month of baby's life– ensure all babies who require a follow-up with Audiology have had their hearing status confirmed

6th month of life – ensure a full diagnosis is confirmed, as far as is reasonable, and that all support/care providers are engaging with the patient.

From an early intervention perspective, the 1-3-6 framework provides a quality standard for services to assess themselves against, with the goal that appropriate care is put in place from the very start of baby's life.

Delivery

The UNHS is a hospital-based service, with a dedicated team of screeners based in each of the 19 hospital maternity units in Ireland.

Babies are tracked through a dedicated IT solution, Smart-for-Hearing (S4H), NECs bespoke Newborn Screening solution. S4H guides patients along their care pathways based on screen outcomes and the associated protocols. It uses a simple green/orange/red colour coded system which allows users to easily identify patients who are getting close to breaching the specific Key Performance Indicators (KPIs) pertaining to the particular stage of the care pathway.

S4H provides a dedicated system for ensuring test data quality, screener equipment data quality (SEDQ), and it also provides comprehensive referral management and reporting capabilities which allow for onward referrals, and monitoring of the prevalence of permanent childhood hearing loss (PCHL).

Relevant care providers are linked in via S4H, thus ensuring both effective and cohesive patient management as well as GDPR compliance.

Governance

Structured governance is the backbone of the UNHS programme. The programme adheres to several Service Level Agreements (SLAs), Key performance indicators (KPIs), Policies Protocols Procedures and Guidelines (PPPGs) – all carefully monitored on a national, regional, and local level.

Staff training is structured, with established learning modules, competency assessments take place before screeners can screen individually – operational reports and screener performance are reviewed on an ongoing basis. Regular internal and external audits are carried out to ensure the programme is compliant and effective.

Service improvement plans are in place to ensure recommendations are followed up on in a timely manner.

The NEC Care screening teams are now heavily involved in the recently introduced targeted cCMV pilot in Ireland, allowing for the early identification of asymptomatic cCMV positive babies from as early as a few weeks of life. This paper will report on the programme outcomes demonstrating the provision of a world class newborn hearing screening programme, allowing for rapid referral for the early intervention and management of those infants diagnosed with permanent childhood hearing loss.

April 2011 - Nov 2023
Total number of babies registered: 691179
Percentage of babies who completed the screen by 4 weeks of age: 98.73%

Key words: UNHS, screening 1-3-6 approach, governance

161 - Outcomes of the National Quality Assurance Process for Neonatal Diagnostic Hearing Assessments in Ireland

Gary Norman [(1)] - Mark Fenton [(2)]
HSE, Audiology, Dublin, Ireland [(1)] - NEC Software Solutions, Clinical Risk, Hemel Hempstead, United Kingdom [(2)]

Introduction

Universal Newborn Hearing Screening (UNHS) became a National programme in Ireland in November 2013. Babies who fail the hearing screen from the 19 maternity hospitals are referred to one of 9 Diagnostic Audiology Centres (DAC's) where further audiological assessment of the babies' hearing is undertaken, using Auditory Evoked Potentials (AEPs) predominantly the Auditory Brainstem Response (ABR) to determine whether a hearing loss is present, the degree of hearing loss and its configuration.

The AEPS are physiological and objective assessments; however, they require not only the correct methodology and clinical protocols being implemented but also the subjective interpretation/analysis of the recorded ABR waveforms. Further, the correct application of age / frequency and transducer specific correction factors to provide estimated hearing levels are required to ensure correct interpretation conclusion.

To ensure maintenance of consistent and high quality ABR assessment of Newborn hearing screen referrals, in compliance with the internationally recognised UK NHSP guidelines[1-5] the HSE tendered for an ABR Peer Review Information Technology System (ABRPRITS) to facilitate the introduction of a national peer review process in a systematic way. The System for Online ABR peer review (SONAR) was contracted by HSE in 2016 for this purpose.

This paper will outline the outcomes for 711 reviews performed between 01/01/2017 to 30/01/2024, key benefits and issues arising afforded by establishing a robust IT system which we consider essential for on-going efficient clinical audit, risk management and quality assurance.

References

1. BSA Recommended Procedure for Auditory Brainstem Response testing in babies. (2019)
2. BSA Practice Guidance: Auditory Steady State Response (ASSR) Testing. (2023)
3. BSA Practice Guidance: Guidelines for the Early Audiological Assessment and Management of Babies Referred from the Newborn Hearing Screening Programme (2021)
4. BSA Recommended Assessment and Management of Auditor Neuropathy Spectrum Disorder ANSD in young infants.
5. BSA Recommended Procedure: Cochlear Microphonic Testing, (2019)

162 - Early Identification of Hearing Loss

Gary Norman [(1)]
HSE, Audiology, Dublin, Ireland [(1)]

Every year, around 120 of the 62,000 children born in Ireland will have a significant, permanent hearing loss. Late identification can affect language and communication skills, creating longer-term risks for social and educational achievement. Following a key recommendation of the National Audiology Group[1] report (2011), the Health Service Executive (HSE) introduced universal screening in April 2011, with a phased roll out leading to a National programme form November 2013.
Before the introduction of the UNHS programme, hearing loss was previously detected through referrals to the HSE Community Audiology service from GPs, speech therapists or the public health nurses who administered the Distraction Test at nine months and at school entry age. The tests were of low specificity and led to a high referral rate. The median age of diagnosis of PCHL was reported as 24 months for children with severe and profound hearing loss and 60 months for children with moderate hearing loss[1.]
Following an EU-wide tender, Northgate Public Services (now NEC Soloutions) were selected to deliver the national Newborn Hearing Screening (UNHS) programme as a managed service from 19 maternity hospitals. The HSE Community Audiology Services provides the immediate diagnostics and habilitation services from eight locations, to ensure critical mass.
A national ICT system (S4H), with in built logic, provides a mechanism to operationally manage the service, essential to minimize loss to follow up cases as well as comprehensive key performance metrics which enable the programmed to be evaluated.
This paper will report the outcomes arising following the introduction of UNHS, with particular reference to the 1-3-6 international recommendations from the Joint Committee on Infant Hearing

1.National Audiology Review Group Report. 2011.
https://www.hse.ie/eng/services/publications/corporate/audiologyreview.pdf. Accessed 12.1.2020.
2. Joint committee on Infant Hearing. Position Statement: 2019. Principles and guidelines for early hearing detection and intervention programs. The Journal of Early Hearing Detection and Intervention. 4(2):1-44

187 - Changes in the Universal Newborn Hearing Screening Program in Poland over 20 years

Monika Zych [(1)] - Grażyna Greczka [(2)] - Piotr Dąbrowski [(1)] - Jarosław Szydłowski [(1)]
Otolaryngology and Oncological Laryngology Clinic, Department of the Otolaryngology and Oncological Laryngology of the Poznań University of Medical Sciences, Poznań, Poland [(1)] - Otolaryngology and Oncological Laryngology Clinic, Department of Computer Science and Statistics of the Poznań University of Medical Sciences, Poznań, Poland [(2)]

The Universal Newborn Hearing Screening Program (UNHSP) has been operating in Poland since 2003. Over the last 20 years, there have been several changes resulting from the need to adapt the functionality of UNHSP to current needs. These changes concerned: legal and administrative aspects, changes in management, methods of conducting audits and controls, IT changes. Poland is one of the few countries in Europe where hearing screening tests are managed by a non-governmental organization - the Great Orchestra of Christmas Charity Foundation. This makes it much more difficult to oversee such a large Program. The most important issues that have been modernized over the last two decades are the central database and coordination of the Program from one place. Currently, in Poland, additional testing using the AABR method is being introduced in neonatal centers with intensive therapy. There are plans to create a call center system supervising the system of diagnostic visits among children requiring early audiological intervention. Thanks to the Program, all Polish children born with hearing impairments have a great chance for very quick detection, diagnosis and early treatment (hearing aids, cochlear implantation). The program shortened the time needed to detect hearing disorders in children and led to hearing aids and rehabilitation being provided at the age of just a few months. Before the creation of the Program, the average time for detecting a hearing impairment was 3 years, currently it is approximately 6 months. Thanks to the Program, children with profound bilateral hearing loss are implanted with cochlear implants at the age of 12 months.

189 - 20 years of the Universal Newborn Hearing Screening Program in Poland

Grażyna Greczka [(1)] - Monika Zych [(2)] - Piotr Dąbrowski [(2)] - Jarosław Szydłowski [(2)]
Otolaryngology and Oncological Laryngology Clinic, Department of Computer Science and Statistics of the Poznań University of Medical Sciences, Poznań, Poland [(1)] - Otolaryngology and Oncological Laryngology Clinic, Department of the Otolaryngology and Oncological Laryngology of the Poznań University of Medical Sciences, Poznań, Poland [(2)]

The Universal Newborn Hearing Screening Program has been operating in Poland for over 20 years. Its structure includes 370 neonatology and obstetrics centers and 91 laryngology and audiology centers. By January 31, 2024, 7,565,513 newborns were registered in the central hearing screening database. The database represents 97% of the newborn population in Poland. On average, 8.8% (664,905) of children who had been tested on I level were referred for further diagnosis. The median age of the diagnosis during the analyzed period was 85 days. According to the Central Database of the Program, about 75-85% of children who had been referred for further tests are recorded and diagnosed in laryngological centers. To increase the number of children coming for further diagnostics, at the end of 2024, it is planned to introduce several changes in the contact between centers and parents by introducing an advanced call center system. These changes are intended to improve early diagnosis of children with suspected hearing loss. Currently, hearing loss above 20 dB was recorded in 17,843 children. It is estimated that this occurs in about 2 per 1000 children born in Poland. Bilateral sensorineural hearing loss was diagnosed in 65.2% of children, conductive in 22.3% of children, and mixed in 12.5% of children. In contrast, single-side sensorineural hearing loss was diagnosed in 49.2% of children; conductive in 37.8% of children; and mixed in 13.0% of children. All children who are diagnosed with hearing loss are referred to the III-level centers to undergo treatment, including fitting a hearing aid – 61.8% of children, rehabilitation - 27.6% of the children, or surgical treatment - 10.6% of the children.

SCREENING AND EPIDEMIOLOGY (NEWBORNS / CHILDREN) (3)

103 - The prevalence of otitis media in early childhood and its long-term impact on child development: Findings from the Western Australian Pregnancy Cohort (Raine) Study

Chris Brennan-Jones [(1)] - Ali Altamini [(2)] - Eman Alenezi [(2)] - Robert Eikelboom [(3)]
Telethon Kids Institute, Curtin University, Ear Health, Perth, Australia [(1)] - Telethon Kids Institute, The University of Western Australia, Perth, Australia [(2)] - Ear Science Institute Australia, Curtin University, Perth, Australia [(3)]

Background
Otitis media (OM) is the most common cause of hearing loss in children and the most common reason a child will be prescribed antibiotics and undergo surgery. However, effective prevention strategies are lacking, and there is limited understanding of the long-term impact of this disease on developmental outcomes. The Western Australian Pregnancy Cohort (Raine) Study is one of the largest successful prospective cohorts of pregnancy, childhood, adolescence and now early adulthood to be carried out anywhere in the world and provides unique insights regarding the onset and early life impacts of otitis media in children and young adults.
Methods
The Raine Study cohort recruited 2900 pregnant mothers at 18 weeks gestation from Perth, Western Australia in 1989-1991, with follow-up for over 25 years, including the identification of OM, hearing loss and a range of developmental outcomes. Multi-variate regression models were used to identify risk and protection factors for OM, developmental sequelae associated with OM, and the impact of treatment with ventilation tubes on later language outcomes at six and 10 years of age. Outcome measures include the Strengths and Difficulties Questionnaire (SDQ), Childhood Behavior Checklist (CBCL), Peabody Picture Vocabulary Test – Revised (PPVT-R) and the Clinical Evaluation of Language Fundamentals (CELF-III). Children receiving ventilation tube insertion (VTI) surgery in the first three years of childhood were categorized into three groups: children who had a history of recurrent OM (rOM) but did not undergo VTI (rOM group); children who received VTI (VTI group); children without a history of rOM (reference group).
Results
In the Raine Study cohort, 26.8% of children suffered from recurrent OM in early childhood (0 to 3 years). OM was found to be associated with significant, negative effects on outcomes such as language development (β = −3.17 [−6.04, −0.31], p = 0.030), behavioral problems (β = 1.10 [0.33 to 1.86], p = 0.005) and attentional difficulties (β = 0.56, [OR 1.16, 2.62], p = 0.008) that persisted until at least 10 years of age. For those children treated with VTI surgery, by six years of age mean PPVT-R scores were significantly lower in the VTI group than the reference (no OM) group (β = −3.3; 95% CI [−6.5 to −0.04], p = 0.047). At 10 years, while the difference between the VTI and reference groups was less pronounced for PPVT-R scores, there was a small but consistent trend of lower scores, on average, across CELF-III scores (expressive: β = −3.4 [−7.1 to 0.27], p = 0.069; receptive: β = −4.1 [−7.9 to −0.34], p = 0.033; total: β = −3.9 [−7.5 to −0.21], p = 0.038). There was no evidence to suggest that language outcomes in the rOM group differed from the reference group.
Conclusion
One in four children in the Raine Study suffered from recurrent OM in their first three years of life. The early onset of OM was associated with a number of significant impacts on later developmental outcomes at 10 years of age. These findings highlight the need for more effective prevention and treatment for OM, and improved pathways to ensure timely access to ear health care to prevent potential negative impacts this disease, and its associated hearing loss, may have on a child's development.

Keywords: epidemiology; otitis media; child development; hearing; language

36 - Summary of the implementation of the 12 years of hearing screening programs among first and sixth graders attending the primary schools

Piotr H. Skarżyński [(1)] - Henryk Skarżyński [(2)] - Krzysztof Kochanek [(2)] - Natalia Czajka [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(3)]

Background
Children's mass hearing screening is based on the concept of secondary prevention. In recognition of the importance of early identification and intervention in children with congenital or early acquired (i.e., in the neonatal period) hearing disorders, numerous newborn hearing screening programs have been introduced worldwide. In Poland, there is no continuation of such programs for school-age children. On the other hand, the Institute of Physiology and Pathology of Hearing, commissioned by the Bureau of Health Policy of the Office of the City of Warsaw, was the implementer of the hearing screening program among students of first and sixth grades in Warsaw. The paper summarizes 12 years of implemented hearing screening programs among students starting and finishing elementary school in Warsaw. The purpose of the programs were to detect hearing disorders, increase awareness among parents and the school community of early detection of hearing disorders and the possibility of early diagnosis and therapy.
Material and methods
The participants in the study were 162,193 students from grades I and VI attending elementary schools in Warsaw. The hearing threshold for air conduction was determined for frequencies of 0.5–8 kHz. Hearing screening was performed using the Sensory Examination Platform.
Results
An abnormal screening result was found in 13.3% of the examined children. Most of the hearing losses were unilateral – 67.7%.
Conclusions
Properly carried out preventive measures in the field of hearing disorders, together with health education and health promotion, lead, in the long term, to minimizing the phenomenon of disability, thereby improving the health of the population, reducing the number of people with permanent disability due to hearing defects and reducing the cost of treatment. The use of information technology, through ongoing control of parameters affecting the quality of the tests performed while ensuring optimal acoustic conditions and adherence to recommended procedures, significantly reduces the number of false positives and false negatives. Integration of a screening audiometer with a central management system is the optimal model for mass hearing screening.

Key words: hearing screening • pure tone audiometry • school-aged children • Sensory Screening Platform

95 - Ear and hearing outcomes in Aboriginal infants living in an Australian urban area: findings from the Djaalinj Waakinj birth cohort study

Tamara Veselinovic [(1)] - Valerie Swift [(2)]
Ear Health, Telethon Kids Institute, Perth, Western Australia - School of Human Sciences, The University of Western Australia, Perth, Western Australia - Department of Audiology, Fiona Stanley Hospital, Perth, Western Australia [(1)] - Ear Health, Telethon Kids Institute, Perth, Western Australia - School of Allied Health, Faculty of Health Sciences, Curtin University, Perth, Western Australia [(2)]

Background**:** Otitis media (OM) has a high prevalence in the paediatric population and is the most common cause of childhood hearing loss in the world. OM and associated hearing loss (HL) disproportionately affect Aboriginal and/or Torres Strait Islander children in Australia from early infancy and throughout childhood, with known impacts on hearing, speech, language, developmental, and academic outcomes. The prevalence of OM and associated HL among Aboriginal and/or Torres Strait Islander children has been widely explored in rural and remote areas across Australia, with one of the highest global rates reported in some regions. However, the majority (79%) of the Australian Aboriginal and/or Torres Strait Islander population reside in urban centres, and the prevalence of OM and associated hearing loss has not been widely explored, particularly in the first year of life.
Method**:** The *Djaalinj Waakinj* (listening, talking in local language) birth cohort study estimated the proportion of Aboriginal infants living in an urban area with OM and HL and associated risk factors. From study inception, the cohort design, recruitment, and community engagement aspects were conducted through an established Aboriginal Community Advisory Group. 125 infants were enrolled in the study before or soon after birth and received routine ear health assessments at 2, 6, and 12–18 months of age and a full audiological assessment at ~12 months of age. Routine ear health checks included otoscopy and tympanometry and were performed in family homes. Of the enrolled infants (n = 125), 67 attended the audiological assessment in a clinical setting, which included otoscopy, tympanometry, and visual reinforcement audiometry (VRA). Sociodemographic and environmental characteristics were collected at enrolment and at each subsequent visit for time-dependent characteristics.
Results**:** The proportion of children with OM was 35% (29/83) at 2 months, 49% at 6 months (34/70), and at 12 months (33/68) of age. Early onset of OM strongly predicted subsequent disease (OM at 12 months: 70% if prior OM vs. 20% no prior OM relative risk = 3.48; 95%CI: 1.22, 40.1). Over two-thirds of infants had HL (68.9%). However, using the recommended correction factor of 10 dB for free-field VRA testing in infants 7 to 12 months of age, we found 44.8% of infants had HL (≥25 dB HL). More male infants had HL than females (X^2 = 5.4 (1 df, p = 0.02). Infants with OM on the day of assessment had worse overall hearing responses (30.35 dB HL (95% CI: 27.24, 34.59) than in those without OM (20.69 dB HL (95% CI: 18.04, 23.51).
Conclusion**:** Aboriginal infants living in an urban area have high rates of OM and HL, with onset in early infancy. Early onset of OM was predictive of later disease, which prompts early surveillance of OM and hearing together with timely medical and audiological treatment to prevent the developmental effects OM and hearing loss can have later in childhood.

Keywords: otitis media, hearing loss, Aboriginal and/or Torres Strait Islander, infants, birth cohort

96 - Is COVID-19 infection during pregnancy a risk for congenital hearing loss? A retrospective audit of data from a universal newborn hearing screening program

Jane Sheehan [(1)] - Alison Jagger [(1)] - Patrick Gornall [(2)] - Melinda Barker [(1)] - Kate Francis [(3)] – S. Ghazaleh Dashti [(3)] - Valerie Sung [(2)] - Zeffie Poulakis [(1)]

The Royal Children's Hospital, Victorian Infant Hearing Screening Program, Centre for Community Child Health, Parkville, Australia [(1)] - Murdoch Children's Research Institute, Centre for Community Child Health, Parkville, Australia [(2)] - Murdoch Children's Research Institute, Clinical Epidemiology and Biostatistics, Parkville, Australia [(3)]

Background The leading environmental cause of congenital hearing loss is maternal viral infections during pregnancy, such as STORCH infections (syphilis, toxoplasmosis, others (Hepatitis B), rubella, cytomegalovirus, and herpes simplex). The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the virus that causes the disease known as COVID-19. COVID-19 infection during pregnancy has the capacity to cause maternal immune activation, placental damage or injury and may transmit across the placenta, presenting a potential risk to hearing development. The evidence to date exploring the relationship between COVID-19 infection during pregnancy and infant hearing has been limited by small sample sizes, hearing screening results as a proxy for hearing loss diagnosis and a lack of comprehensive diagnostic audiology data. Universal newborn hearing screening (UNHS) programs play a critical role in the early detection of hearing loss and are well placed to investigate the potential harm to hearing posed by novel viruses. This study, embedded within a UNHS program, aimed to address current knowledge gaps and is the first to investigate population incidence of congenital hearing loss in infants whose birth parent had COVID-19 during pregnancy. Method The Victorian Infant Hearing Screening Program (VIHSP) in Victoria, Australia, follows a two-stage screening protocol using automated auditory brainstem response technology. In this retrospective clinical audit, records of infants born between the 1st January 2022 and 31st December 2022 (n = 75,330) were reviewed. Information regarding birth parent COVID-19 status, timing of COVID-19 infection during pregnancy and number of COVID-19 infections during pregnancy was collected by self-report at the time of the hearing screen. Infant records were divided into two groups: infants whose birth parent reported at least one COVID-19 infection during pregnancy (infection group, n=25,547; 33.9%), and infants whose birth parent reported no COVID-19 infection during pregnancy (non-infection group, n=49,783; 66.1%). A small number of records were excluded if COVID-19 status of the birth parent was unknown (n=783). Infants with risk indicators for hearing loss were retained in the sample. General linear regression models with a binomial distribution, adjusted for socio-economic status were used to estimate differences in proportions between the groups for both hearing screening and diagnostic audiology outcomes. Results Characteristics of birth parents and infants in both groups were similar, including gestational age at birth, sex of infant and the presence of risk indicators for hearing loss. Infant age at hearing screen one, hearing screen two, and at completion of the diagnostic audiology assessment was similar in both groups. The proportion of infants who obtained a refer (positive) result on hearing screen one (infection group: 10.6%, 95%CI 10.2 – 11.0 versus non-infection group: 11.3%, 95%CI 11.0 - 11.5) and hearing screen two (infection group: 1.4%, 95%CI 1.2 - 1.5 versus non-infection group: 1.3%, 95%CI 1.2 - 1.4) were comparable between the groups. Similarly, the proportion of infants diagnosed with any type of hearing loss was very similar in the two groups (infection group: 0.6%, 95%CI 0.5 - 0.7 versus non-infection group: 0.6%, 95%CI 0.6 - 0.7). When restricted to the VIHSP target hearing loss condition (permanent, bilateral, moderate to profound hearing loss), prevalence was 0.06% (95%CI 0.03 - 0.08) in the infection group and 0.05% (95%CI 0.03 - 0.07) in the non-infection group. There was no evidence that trimester of infection and the number of infections within a single pregnancy impacted these findings.
Conclusion Infants whose birth parent reported COVID-19 during pregnancy were not at increased risk of obtaining a refer result on their newborn hearing screen, nor at increased risk of congenital hearing loss. This study's findings do not support changes to universal newborn hearing screening program protocols or guidelines in order to manage the pathway of infants born to a parent with COVID-19 during pregnancy. Longitudinal data would be beneficial to examine if COVID-19 during pregnancy impacts progressive hearing loss in children. This study provides the first population-based estimate of congenital hearing loss in infants born to parents with COVID-19 during pregnancy. It also demonstrates the clinical and public health value of UNHS programs being included in assessing the risk to infant hearing posed by novel viruses. This study also adds to the body of evidence available regarding the health impacts of COVID-19.

Key words: COVID-19; newborn hearing screening; congenital hearing loss

IMPROVING HEARING CARE AND SERVICES

225 - A Different Lens: Social Determinants of Health and Childhood Hearing Loss

Patti Martin [(1)] - Madison Howe [(2)]
Arkansas Children's Hospital, Patient Care Services, Little Rock, United States [(1)] - Arkansas Children's Hospital, Audiology, Little Rock, United States [(2)]

In the United States, Early Hearing, Detection, and Intervention (EHDI) systems continue to evolve and bring more families to our places of service that say “Yes” in response to newborn screening, timely diagnostics, and prompt referrals for services. Despite this evolution, too many families find themselves struggling in the gap between the promise of early identification and desired outcomes. Their struggle emphasizes that our skill sets are not “enough” and that families need and deserve more from us.
Learning about what impacts outcomes of families of children who are Deaf/hard of hearing requires us to look at the work we do through a different lens. It sends us in search of insights from different research streams and bodies of literature peripheral to hearing and language development. We are challenged to rethink what being a “good” Audiologist, Speech-Language Pathologist or Educator means to ensure “success” for our clients. It requires thoughtful consideration of what might positively change the story for children we serve, acknowledging that it will take more than highly trained professionals.
Despite early diagnosis and intervention, there are a litany of factors unrelated to hearing status that will influence their long-term outcomes. These non-medical conditions in the environments where people are born, live, learn, work, play and worship are defined as Social Determinants of Health (SDOH) by the World Health Organization. SDOH are often grouped into five domains: Economic Stability, Education Access and Quality, Health Care Access and Quality, Neighborhood and Built Environment, Social and Community Context. These conditions shape daily life and can influence health equity positively and negatively. Examples include safe housing, transportation, access to nutritious food,wor and education.
This presentation highlights the journey to address SDOH through both an individual, as well as a systemic lens as part of a five-year strategic plan for a pediatric hospital in the Southern United States. Screening for social determinants was introduced as one tactic to impact outcomes of children in our state in their first 2100 days. As an initial step, a screening tool was introduced across the system that was completed by families upon arrival to a clinic visit. Once concerns were identified, we sought a framework to prioitize how to address identified issues that was applicable within Audiology and related areas.
We will share our experience with prioritizing issues and share application of a tool called the “5As”, published in a 2019 report by the Natinoal Academies of Scienes, Engineering and Medicine. This tool can be helpful in focusing initial conversations about SDOH regardless of setting. The tool uses five complementary activities called the “5As”--Awareness, Adjustment, Assistance, Alignment, Advocacy. Using the tool resulted in choosing priorities around transportation-related issues and food insecurity in our setting. It can also be used to foster innovative interventions beyond the direct patient/client level, and promotes consideration of interventions with potential community and/or systems level impact.
Using the 5As to consider the issue of access to reliable transportation allowed us to consider how increasing transportation options could improve access to healthcare, including audiological, early intervention and/or quality day care for an individual family. More broadly, the 5As challenged us to think beyond “just” a ride and to consider issues more inclusively and in partnership with others—what are the public and private transportation options available for this family? Are there places that offer age-appropriate car seats at no cost? Can appointments be coordinated to reduce trips? Additionally, replicating the process for numerous conditions allows not only prioritization, but also helped us to pinpoint potential interventions that cross-cut multiple social determinants.
Learning about SDOH expanded the call-to-action for our teams that champion the improvement of outcomes for children who are Deaf/hard of hearing and their families. It offered us further insight into how professionals truly support families and continues to drive our curiosity about “what’s missing” from our intervention approaches. Seeking to understand and mitigate Social Determinants of Health may indeed hold the answer to optimizing outcomes for these children and provide the missing piece for their families.

229 - Rethinking Hearing Health Without Age Bias

Razan Alfakir [1]
Auburn University, Speech, Language, and Hearing Sciences, Auburn, United States [1]

As we strive for a more inclusive and nuanced understanding of hearing health, this presentation titled "Rethinking Hearing Health Without Age Bias" embarks on a journey to transcend traditional narratives surrounding age-related hearing loss. In a world where ageism can inadvertently shape our perspectives, this session seeks to unravel the complexities of hearing health by centering the discourse on inner ear influences rather than perpetuating age-centric biases.

The presentation begins with an exploration of the current landscape of hearing health discussions, acknowledging the prevalent focus on age-related hearing loss. Despite the undeniable link between age and changes in auditory function, our discourse often oversimplifies a complex, multifactorial issue. This presentation challenges the status quo by encouraging participants to question the assumptions associated with age and hearing impairment.

The first segment of the presentation sets the stage by examining the limitations of age-centric perspectives. We delve into the psychological and societal impacts of ageism within the realm of hearing health, recognizing the potential for bias to influence clinical decisions, research priorities, and public perceptions. By shedding light on these challenges, we create a foundation for the core theme of the presentation: the significance of embracing inner ear influences without age bias.

The second segment focuses on the intricate inner ear processes that contribute to hearing health. We navigate through the genetic, environmental, and lifestyle factors that shape the inner ear's role in auditory function. Drawing on recent research, we uncover the variability within the inner ear and emphasize the need to consider these nuances when addressing hearing impairment. By shifting our attention to the inner ear, we broaden our understanding of hearing health beyond a singular focus on age.

The third segment explores practical implications in clinical settings. Participants will gain insights into how adopting an inner ear-centric perspective can enhance diagnostic accuracy, treatment strategies, and patient outcomes. Through case studies and interactive discussions, we aim to empower healthcare professionals to approach hearing health with a more comprehensive and unbiased lens.

The fourth segment envisions future directions in hearing health research and practice. By acknowledging the limitations of age-centric approaches, we pave the way for innovative methodologies and interventions. We discuss the potential for personalized therapies, advanced diagnostic technologies, and collaborative efforts to shape the future landscape of hearing healthcare.

Throughout the presentation, an emphasis is placed on fostering a collaborative and inclusive environment. Attendees are encouraged to share their experiences, insights, and challenges in navigating hearing health discussions without succumbing to age-related biases. By engaging in open dialogue, we aim to create a collective consciousness that values the unique contributions of individuals while promoting equitable access to hearing health resources.

In conclusion, "Rethinking Hearing Health Without Age Bias" is a call to action for all stakeholders in the field of audiology and beyond. By challenging age-centric norms, we aspire to cultivate a more compassionate and informed approach to hearing health that celebrates diversity and empowers individuals irrespective of their age. Through this transformative exploration, we redefine the narrative surrounding hearing health and pave the way for a future free from age bias.

226 - Enhancing Treatment Adherence and Compliance through Self-Care Caregiver Counseling

Katandria Demps [1] - Keith Demps [1]
K&K Services/Childrens/Cook Childrens, Clinical Research, Cedar Hill, TX, United States Of America [1]

The COVID-19 pandemic has disrupted and demolished many support systems that we were accustomed to. Everything from in person gatherings to therapeutic hobbies has been deemed dangerous due to the contagiousness and unpredictability of coronavirus. The pandemic has taken a toll on the most vulnerable of our society from the homeless to children and families- especially those who are informal caregivers. In fact, it is said that caregiver stress has skyrocketed since the beginning of the pandemic. First, we must identify that there are different types of caregivers- family members who care for children with disabilities, family members who care for older adults/parents and those healthcare professionals who assist families with the caregiving process. The pandemic has affected each category of caregivers in different ways. Studies have shown that those who are primary caregivers tend to have a healthier state of mind if there is a secondary caregiver also involved. This form of social support is a particularly important factor because it shows how relationships and social bonds positively impact those who are caregivers. Having good relationships and social bonds is key to overall well-being of caregivers. Self-care for caregivers can look like enjoying an indoor hobby like crafting, coloring, and other artistic activities. Non-strenuous exercise such as stretching or yoga, which can be done indoors or outdoors, can be greatly beneficial in reducing stress. This presentation is designed to help healthcare professionals identify and implement a self-care roadmap to increase patient adherence and compliance towards positive treatment outcomes. The healthcare professional will have an outline on how to counsel family members on caregiving for a loved one without sacrificing his or her own health while reducing hospital readmission and possible perseveration of chronic health conditions, due to patient, non-adherence and compliance to the treatment plan of care.

7 - Fostering Caregiver Well-Being

Joanne Travers [1]
Partners for A Greater Voice, Executive, Ipswich, United States [1]

Practitioners are often challenged with a host of delivery services that include children's hearing health, communication development, parent support, and technical assistance. Alongside hearing health and child development, parents cope with grief, community stigma, and isolation; many lack relational and emotional support. Psychological well-being is considered important, for both practitioner and parent, yet often left off a busy agenda. The complexity of the global hearing health industry, and the predicament of most parents who struggle emotionally with their children's needs, imply a traditional approach to parent intervention is not effective and must change.

Research indicates good outcomes in children's social, emotional, and communication development necessitate parents have good self-perception, better psychological health, and high family function. Because caregivers are most influential in a child's development, attention to their psychological well-being is essential. Approaches that foster well-being prepare caregivers to feel emotional ready and enabled to lead their children's learning and communication development.

Based on twenty years of qualitative experience, the science of positive psychology, and results from parent surveys, PGV (Partners for A Greater Voice) concludes that there is a need to include holistic practices that innately enable parental caregivers. Equally important is the well-being of practitioners who serve them. The well-being of all carers is therefore significant in the goal to support children's communication and learning.

This presentation is based on the science of positive psychology. Focusing on ways people 'thrive' originates from humanistic science which, in more recent years, is received with more curiosity and interest. Research shows that positive psychology intervention enhances overall well-being, improves relationships, and manages ways to overcome problems. Further, science indicates that outcomes in children's development are best realized when parental caregivers have good self-esteem, develop competencies, and are emotionally and informationally equipped to cope with hearing loss and the needs of their children. This translates to unique ways practitioners can support parents using effective tools that address parental stress and improve ways parents engage in their children's development.

Given the challenges and demands of hearing health and habilitation practices, traditional parent supports are enhanced when practitioners apply positive psychology tools. This presentation includes interactive exercises that build innate capacity, foster confidence, and instill competence. Through strengths-based practice, leadership assessment and resilience exercises, participants will learn ways to guide themselves and the parents they serve toward greater feelings of empowerment and happier journeys. The approach introduces practitioners to innovative and insightful supports and interventions. The intention is to foster domains of caregiver well-being and build caregiver capacity so that all carers of children with hearing loss discover innate potential and engage with more fulfillment.

Three objectives of this presentation are:

1) Participants will learn ways to identify and engage innate character strengths,
2) Participants will learn at least one strategy for assessing leadership skills,
3) Participants will learn several domains of caregiver well-being that foster personal potential.

About the Presenter

The presenter brings 20 years of experience in international training and education. As a parent of two adult, aural children, she has founded and directed programs in the Caribbean, India, Central and North America. She has consulted over 1000 parents from all levels of socio economics as well as hundreds of practitioners who serve them. As a founder of Partners for A Greater Voice, founding Director of the Coalition for Global Hearing Health, and parent specialist Joanne has delivered hundreds of presentations to practitioners and parental caregivers. Her recent book, *Coaching and Empowering Caregivers, an approach to foster well-being*, was published in 2019.

102 - Development of Quality Standards for Auditory Implant Services in Wales in the context of the All Wales Audiology Quality Strategy and Framework

Linor Jones [(1)]
BCUHB, North Wales Auditory Implants Team, Rhyl, United Kingdom [(1)]

Background and aims

Wales Audiology assure the quality of their services by their portfolio of government-endorsed Quality Standards (QS) Audit Tools, which up to 2022 included Adult Rehabilitation, Paediatric, Balance and Tinnitus standards. The QS guide a quality assurance process for Audiology services as they measure their performance against the QS using the Audit Tools by rating their services against the standards and providing evidence of the rating presented. This is done by a yearly self-assessment with every third-year being an external audit of services. The objective of the external audit process is to externally verify self-assessment scores and the evidence presented against the standards. Externally assessed scores must be presented to the Chief Executives and Heads of Audiology for each respective service, prior to being made available to Welsh Government Audiology Specialist Service Advisory Group (ASSAG) and put in the public domain (e.g. on the Welsh Scientific Advisory Committee (WSAC) website).

In late 2021, ASSAG, along with the Audiology Heads of Service (HoS) Wales group proposed the need to develop QS for Auditory Implants Services in Wales to add to the portfolio of standards.

Methods

A task and finish group was created with senior clinicians involved in Auditory Implant services in Wales (including Audiology and ENT representatives), auditory implant service users, existing QS co-ordinators and representatives from third sector organisations. The task and finish group went on to write the individual standards using the 2018 British Cochlear Implant Group (BCIG) QS document with consideration for other QS relating to bone conduction hearing implants and middle ear implants. The Standards were written to follow the structure of the existing QS documents with a *Standard Statement* supported by evidence (*Rationale and References*) followed by specific *Criteria* with suggested sources of E*vidence of compliance*.

During the development of the document a small survey was conducted by the National Deaf Children's Society (NDCS) Cymru to gather thoughts from parents of service users on what makes a good implantable device service and its results fed into the development of the Standards.

Results

The final QS for Auditory Implant Services consist of seven Standards covering the following areas of the patient pathway and implant service: Accessing the Service, Communication & Information Provision, Assessment, Surgery, Post-operative Management, Clinical Skills and Expertise and Outcomes & Service Improvement. Following reaching a consensus within the Task and Finish group, the document went through a two-stage consultation process. The first stage included ASSAG and HoS colleagues in Wales, and then the second stage was a UK-wide consultation with the document shared with all relevant stakeholders. Consultation responses were generally very positive and were all considered in the development of the final document. The final document was submitted to ASSAG for approval.

Conclusion

The QS for Auditory Implant Services in Wales is now approved as part of the portfolio of QS in Wales. Audiology in Wales have a clear structure for assuring quality through the development of their QS Audit Tools. These sit under a Welsh-Government endorsed broad Quality Standards document which sits within the newly developed Quality Strategy and Framework for Wales.

24 - Shared decision making: audiology student perspectives

Saira Hussain [(1)] - Claire Wilkes [(1)] - Nisha Dhanda [(2)]
Aston University, Audiology, Birmingham, United Kingdom [(1)] - University of Birmingham, College of Medical and Dental Sciences, Institute of Applied Health Research, Birmingham, United Kingdom [(2)]

Aims**:** Healthcare students need to ensure they have the knowledge and skillset to facilitate patient centred care. This encompasses joint goal setting and discussing evidence-based approaches for patients to actively participate in the management of their condition. This is a concept taught across Higher Education Institutes that deliver Audiology training in order for students to provide holistic patient care. Therefore, a pedagogical study was conducted to investigate the perceptions of Audiology students and the use of shared decision making in their clinical training.
Methods**:** Twelve students participated in three focus groups from across the undergraduate BSc audiology cohort. This consisted of one focus group comprised of Year 1 and Year 2 students, one with Final Year students, and one with Work-Based Learning students. Students were asked to comment on their beliefs on Shared Decision Making, clinical tools to support patients with this and teaching feedback and appraisal. All interviews were transcribed and data were analysed using Thematic Analysis.
Results**:** Student's ability to define Shared Decision Making was influenced by three factors. These included the use of Decision Aids, using a Range of Resources and The Ida Institute. Students provided further insights into enhancing pedagogical approaches to teaching and assessing patient centred care.
Conclusion**:** Shared Decision Making was valued by the students in this study. Whilst this topic is explored in wider healthcare/medical field, this study is one of the first to explore audiology students specifically. This study indicates what aspects of clinical training support their development as healthcare professionals and how future teaching practices can be adapted and improved for students across the audiology field. Future research will explore the role of patient's perception of clinical teaching around shared decision making.

Key words: Healthcare, Students, Shared-Decision-Making, Education, Training

129 - Changes in participatory and societal outcomes during the waiting period for cochlear implantation – an observational study

Hugo Nijmeijer [(1)] - Nikki Philpott [(1)] - Gert Jan van der Wilt [(2)] - Rogier Donders [(2)] - Erwin George [(3)] - Ralf Boerboom [(4)] - Johan Frijns [(5)] - Marre Kaandorp [(6)] - Wendy Huinck [(1)] - Emmanuel Mylanus [(1)]
Radboudumc, Otorhinolaryngology, Nijmegen, Netherlands [(1)] - Radboudumc, Department for Health Evidence, Nijmegen, Netherlands [(2)] - Maastricht University Medical centre, Otorhinolaryngology, Maastricht, Netherlands [(3)] - University Medical Center Utrecht, Otorhinolaryngology, Utrecht, Netherlands [(4)] - Leiden University Medical Center, Otorhinolaryngology, Leiden, Netherlands [(5)] – Amsterdam MC, Otorhinolaryngology, Amsterdam, Netherlands [(6)]

Introduction: Various factors, including an aging population and expanding eligibility criteria, may increase the demand for cochlear implants (CIs), potentially resulting in longer waiting times. In most Dutch CI centers, the time between referral and surgery exceeds 6 months. Clinical experience suggests that during the waiting period for cochlear implantation, hearing and communication difficulties increase. Simultaneously, there is an interest in outcomes more closely aligned with patient values and needs, which resulted in the SMILE (Societal Merit of Interventions on hearing Loss Evaluation) study. This paper presents results on observed changes in societal and participatory outcomes during waiting time in participants with a time to CI surgery exceeding 6 months.
Methods: SMILE is a prospective multi-center study including 232 individuals who were referred for unilateral CI. Continuous and nominal data from multiple questionnaires, sent immediately after referral and subsequently shortly before surgery, were analyzed by computing differences, Cohen's D, and odds ratios.
Results: Of the total 232 participants, 102 had a time between inclusion and surgery exceeding 6 months. Of these, 89 had (partially) filled out surveys at both time points. Of all the domain scores 55% did not show differences between timepoints. All Cohen's D estimates were relatively small, ranging from -0.298 to 0.388 for those outcomes that showed a significant change.
Conclusion: Waiting time from referral to surgery, even though exceeding 6 months, does not seem to seriously affect non-clinically-prioritized patients in an adverse way. Future investigations should identify subgroups on tolerable waiting times regarding short- and long-term outcomes.

PATIENTS AND FAMILIES

157 - Parental preferences for genetic testing in deaf and hard of hearing children

Valerie Sung [(1)] - Kayla Nowrojee [(2)] - Sharon Lewis [(3)] - Libby Smith [(4)] - Lilian Downie [(5)]
The Royal Children's Hospital, Centre for Community Child Health, Parkville, Australia [(1)] - The University of Melbourne, Melbourne Medical School, Parkville, Australia [(2)] - Murdoch Children's Research Institute, Reproductive Epidemiology & Genomic Medicine, Parkville, Australia [(3)] - Murdoch Children's Research Institute, Prevention Innovation Research Group, Parkville, Australia [(4)] - Murdoch Children's Research Institute, Victorian Clinical Genetics Services, Parkville, Australia [(5)]

Background
Genetic testing for deaf and hard of hearing (DHH) children can offer multiple benefits such as providing a diagnosis and cause of deafness, directing management, informing recurrence risk for future pregnancies and information for family planning. Genetic testing for childhood deafness will become more available and accessible with national government funding in Australia. In keeping with family-centred care, it is important to consider family preferences in offering genetic testing.
Aim
This study aimed to elicit the preferences of parents for genetic testing in their DHH children, including preferred timing of genetic testing and what format the genetic testing information is provided in. Additionally, we aimed to determine factors that influenced parental preferences.
Methods
The Victorian Childhood Hearing Longitudinal Databank (VicCHILD) is an Australian statewide population based prospective databank for children with congenital hearing loss. In 2023, 184 VicCHILD families responded to an online survey that explored family perspectives on genetic testing for childhood deafness. We performed descriptive statistical analysis, describing proportions for categorical variables. We used $\chi 2$ (chi-squared) analysis to explore factors associated with parental preferences.
Results and Conclusion
Close to 90% of parents surveyed believe that genetic testing should be routinely offered to find the cause of childhood hearing loss. Most parents expressed a preference for genetic testing to be offered after their child's hearing loss diagnosis. 'Face to face' consultations was the most preferred method for counselling, discussing consent and receiving genetic testing results. Among parents who believe genetic testing should be routinely offered to children with hearing loss, approximately 60% prefer to be offered trio testing, rather than testing the child first, then testing the parents later if necessary. We did not find any participant characteristics that were associated with parental preferences. This research provides vital information to healthcare professionals and policy makers regarding how best to deliver genetic testing for DHH children. By aligning services with these parental preferences, we can deliver better family-centred care, ultimately benefiting DHH children and their families.

Key words: consumer preferences, genetic testing, DHH children

177 - The experience of caregiver burden for friends and relatives of people with hearing loss

Helen Pryce [(1)] - Georgina Burns-O'Connell [(1)] - Sian Smith [(1)] - Saira Hussain [(1)] - Rachel Shaw [(2)] - Jean Straus [(3)]

Aston University, Department of Audiology, Birmingham, United Kingdom [(1)] - Aston university, Aston Institute of Health and Neurodevelopment and School of Psychology, Birmingham, United Kingdom [(2)] - Unaffiliated, PPIE lead, Birmingham, United Kingdom [(3)]

This is a piece of work within a larger study. The Hearing Loss and Patient Reported Experience (HeLP) study is a National Institute of Health Research Health Service and Delivery Research funded programme in the NHS in the UK (grant no NIHR 131597), sponsored by University Hospitals Bristol and Weston NHS Trust and delivered with Aston University and the University of Bristol.

Our study aimed to explore the lived experience of people with hearing loss and those who support them. Hearing loss impacts on everyday life and family and friends (caregivers) can be a source of support, however, providing such support could create a burden for the person who is providing care. Given that one in two people will experience significant hearing loss in older life, caregivers have the potential to provide valuable emotional and practical support in the everyday lives of people with hearing loss.

This presentation will report on the findings from the qualitative in-depth interviews which were conducted with caregivers of people with hearing loss. These interviews were analysed using constant comparative methods and reflexive thematic analysis to identify patterns in the experiences described by caregivers. Data were gathered from a diverse mix of people of varying ages and with different relations to the person they were supporting. The perspectives provided included those from parents of children with hearing loss, partners, and adults with parents who had hearing loss.

This presentation describes different levels of caregiver burden across the life course, and the factors that influence this variation.

Keywords: Hearing loss, caregiver, burden, qualitative

153 - What are the research interests of parents of deaf and hard of hearing children?

Zara Gray [(1)] - Libby Smith [(2)] - Amy Gray [(3)] - Valerie Sung [(1)]
The Royal Children's Hospital, Centre for Community Child Health, Parkville, Australia [(1)] - Murdoch Children's Research Institute, Prevention Innovation Research Group, Parkville, Australia [(2)] - The Royal Children's Hospital, General Medicine, Parkville, Australia [(3)]

Background:
The future of childhood hearing research should be directed by families with lived and living experience. In our project we partnered with parents to explore through focus groups what they perceive are important areas to research for children who are deaf or hard of hearing.
Aims:
The primary objective of this project was to explore parental perspectives of research topics relevant to their deaf or hard of hearing (DHH) children.
Methods:
Parents of DHH children from the Victorian Childhood Hearing Longitudinal Databank (VicCHILD) were invited to participate in focus groups. VicCHILD is an Australian state-wide population databank open to every Victorian child with congenital hearing loss. VicCHILD parents who had previously consented to be contacted about additional research were sent an email invitation and those who expressed interest in taking part were organized to attend one of four semi-structured online focus groups. Focus groups were conducted via Zoom and duration was 70-90 minutes. Each focus group was recorded and then transcribed verbatim.
This qualitative study used the theoretical perspective of social constructionism, whereby knowledge and meaning is built through social interactions and exchange. We used inductive content analysis to form the main themes that arose during the focus groups.
Results:
1046 parents were invited to participate in the semi structured focus groups. Fifty parents expressed interest in participating. Twenty parents attended across the four focus groups, ranging from four to seven parents per group. Comparison on key sociodemographic and hearing loss factors revealed the participating group were similar to the non-participating group.
Five main themes on parental perspectives of important research topics were derived from the focus groups:

- Getting the diagnostic pathways and conversations right,
- What is normal development and how can I decide what is best for my child,
- Navigating transitions as my child's needs change,
- Support schools, who support my child to learn and grow; and
- The family impact and the family influence when a child is deaf or hard of hearing.

Conclusion:
Our study highlighted research areas which are important to parents of deaf and hard of hearing children. It is a first step in ensuring the voices of families of deaf and hard of hearing children are heard and incorporated into future research, so that child hearing research will be relevant to those with lived experiences.

Keywords: Parent-partners, future research, DHH children

121 - Young People with Cochlear Implants: Listening to their perspective

Sue Archbold [(1)] - Connie Mayer [(2)] - Brian Lamb [(1)] - Qais Khan [(1)]
CIICA.AISBL, Education, 1050 Bruxelles, Belgium [(1)] - York University, Education, Toronto, Canada [(2)]

Paediatric Cochlear Implantation (CI) has grown rapidly over the last 30 years, and in high income countries the majority of profoundly deaf children receive implants, and increasingly early. There is now a considerable cohort of young adults with CI, who are the first group to be implanted as children, and now adults who have grown up with hearing through CI. There is a great deal of research on outcomes from early implantation and a focus on early intervention to promote outcomes. However, there is less focus on these children as they enter high school, higher education and the world of work. It is estimated that over 25% of CI-users implanted as children are now over 18 and the needs of this group are rarely studied. This study explored the views of this group about their CI and the services they receive.

A global survey containing qualitative and quantitative questions was piloted with CI users, distributed globally online through the CIICA network. The views of those implanted as children and now adults were analysed separately, looking at satisfaction with CI and with CI Services.

Following this, a series of on line conversations were held with global groups to explore the issues raised further. In total, 1076 adults with CI responded to the survey. Of these, 105 were young people from 26 countries implanted under the age of 18; 24% were implanted aged 2 and under and 70% 11 and under. 62% had bilateral CI. Among the findings:

- None stopped wearing their implant; 70% wore them all time, 27% most of the time, and 3% some of the time.
- When asked about their satisfaction with CI: 70% were very satisfied, 27% were satisfied and 2% were not satisfied,
- When asked about overall satisfaction with services received:49% were very satisfied, 48% were satisfied and 5% were not satisfied. There was greater dissatisfaction with rehabilitation services than with fitting services received.
- Funding: 10% paid personally for fitting, 20% for rehabilitation.
- For 35%, batteries were paid for by personal funding; 33% paid for repairs with personal funding, in addition to those who used Private Insurance. 10% had no spares at all.

The free comments raise some issues which were followed up in the seven Conversation groups:

- The challenges of the technology, with a lack of robustness of the technology, with problems retaining the processor, wearing it in damp conditions and during sports.
- The daily challenges of background noise, of listening in groups
- Concerns about ensuring the daily functioning of the technology on which they were reliant for daily communication
- The lack of understanding and awareness by the public, by colleagues, fellow students and managers in the workplace of the accommodations needed and the challenges experienced; others often didn't realise that they were deaf and were reliant on technology to communicate or that they faced listening difficulties in many situations.
- The value of meeting others with CI, who experienced the same challenges; peer group support was important.
- They commented on wanting greater control of technology settings, to manage their fittings.
- There were major concerns about the ongoing costs of CI; for repairs, upgrades, accessories, and replacements where necessary.
- The need for lifelong, funded services to ensure that the technology functions optimally and timely access to technology support.

To conclude: the perceptions of this first group of young adults who have used CI since they were young children reveal their reliance on CI for daily communication, but some concerns about their lifelong services. There were high levels of usage rates and satisfaction with their cochlear implants and the services received. However, there are major issues to be addressed, including long-term funding, and management of the technology. One commented: *Am so used to it that without my CI can't do anything.* Funded, lifelong services are a responsibility for us all.

Key words: CI, Services, Funding, technology management, peer group, awareness

178 - Cochlear Implants and Deafness; Case Study of the creation of a global network to address policy awareness and investment in Cochlear Implants

Brian Lamb [(1)] - Sue Arcbbold [(2)] - Z. Yen Ng [(3)]
Derby University/CIICA, Education, Derby, United Kingdom [(1)] - CIICA, AISBL, Brussels, Belgium [(2)] - University of Queensland, School of Health and Rehabilitation Sciences, Brisbane, Australia [(3)]

Despite the fact that there are now over a million users of Cochlear Implants (CI) globally we know that only between 5 to 10 of those who could benefit actually have a CI. This is, in part, because of the limited activity in global health networks and advocacy addressing hearing loss and deafness which has contributed to its relatively low visibility with policymakers compared to other health conditions. At the same time, there has been a major growth in global health networks to address other health issues including tobacco use, alcohol abuse, and maternal mortality.
Most conditions that incur high costs have provoked networks of advocates working to mitigate the impact, increase investment in research, and establish campaigns which helps explain their success at increasing funding for research and health provision. Global health networks often work simultaneously across policy, knowledge creation, and advocacy.
The lack of visibility of hearing loss and deafness and the success of CI in addressing profound deafness directly impacts the awareness of Cochlear Implants as a solution to hearing loss and affects access and ongoing funding as the visibility and awareness around CI's remain relatively low as a health issue. If the provision of Cochlear Implants is going to move from benefiting a limited number of recipients, we need new ways to promote global awareness about the benefits of CI.
This presentation reports on a global consultation that explored the views of advocacy groups and individuals on advocacy for the management of hearing loss, and CI. It focuses on stakeholders' views of current advocacy endeavors, opportunities and barriers, and the possible development of a global advocacy network to improve access to cochlear implantation and supporting services. Key barriers included;

1) the lack of awareness of the Impact of Hearing Loss,
2) the lack of awareness of CI as a potential solution,
3) the lack of referrals.

These barriers then were seen to drive the lack of investment in CI as a solution.
We then look at the subsequent development of a global health network, the Cochlear Implant International Community of Action (CIICA) and examine the conditions necessary for the successful development of a global health network to advocate for better CI provision. This includes an examination of what the success criteria are for any global network and how this can be applied to advocacy for better CI provision. We then illustrate the key actions that countries and jurisdictions can take to develop a stronger case for increasing research on CI, ensuring there is more provision and awareness of the benefits of CI and developing better long-term funding for aftercare.

The presentation will build on the evidence and analysis put forward in the recent journal article B. Lamb, S. Archbold & Z. Yen Ng (2023): Cochlear implants and deafness: a global case study to increase policy awareness and action on an under-resourced health issue, International Journal of Audiology. https://doi.org/10.1080/14992027.2023.2231634

Key Words: Cochlear Implants, Advocacy, Access, Global Network.

143 - Person Centred Approach in Audiology – service users perspectives. "We are not walking audiograms"

Lidia Best [1]
European Federation of Hard of Hearing People (EFHOH), Advocacy, Houten, Netherlands [1]

Recently "functionality and hearing loss" and "Person Centred Approach" has gained attention of those working in hearing care field and seeking to improve hearing care provision.
This is positive trend in hearing care profession, and we should encourage more discussions about it. Some people can adapt and manage their hearing loss reasonably well, but others cannot, they need support and reasonable adjustments to help them all to thrive.
Do audiologists discuss different accessibility aspects with their clients? How well are they preparing clients for the world after receiving the hearing aids or CI? Are they able to advise on different assistive technologies? How often audiologists discuss hearing loops?
Unfortunately, accessibility aspects of using hearing technologies are rarely part of the rehabilitation and counselling, not sure why? Is this because audiologist often are not themselves someone with hearing loss or maybe because it is not part of their curriculum, or because it is hard to keep up with all changes brought in from manufacturers? Most likely it is a combination of all different reasons.
During presentation, results of different surveys will be presented with guidelines on good practice presented.
Discussion: Implementing person centred approach and the role of audiologists in supporting users with adaptation to a new reality.

47 - Theory of Mind and Written Language: An Investigation of School-age Deaf Writers

Connie Mayer [(1)] - Beverly Trezek [(2)]
York University, Faculty of Education, Toronto, Canada [(1)] - University of Wisconsin-Madison, Rehabilitation Psychology and Special Education, Madison, United States [(2)]

Introduction**:** Historically deaf children have shown delays in the development of language abilities and Theory of Mind (ToM). ToM is described as the ability to impute mental states to oneself and others including thoughts, feelings, beliefs, and desires. However, advances in hearing technologies, including cochlear implants (CIs), have allowed for more meaningful access to language, with greater potential for developing language-related abilities such as ToM. While studies to date have focused on passing false belief tasks, questions have been raised as to whether written language can serve as a source for investigating ToM. Therefore, this study focused on the extent to which school-age deaf students evidence ToM in a story elicited as part of a standardized measure of written language.
Methodology**:** Data were collected as part of a larger investigation of literacy achievement of 70 deaf students enrolled in grades 4 through 12 (i.e., age 9 to 19). Demographic information was collected and standardized measures of reading and writing, including the *Test of Written Language-Fourth Edition* (TOWL-4), were administered. The current study represents a secondary analysis of the TOWL-4 writing samples for evidence of ToM. All participants used spoken language as their primary mode of communication and used a range of hearing technologies including 64% with hearing aids (*n* = 45), 19% with cochlear implants (*n* = 13) and 7% with BAHAs (*n* = 5). Across participants 59% (*n* = 41) had a home language other than English, with16 different languages represented. The cohort included 13% (*n* = 9) with a unilateral loss and 20% (*n* = 14) with an additional documented disability. A rubric adapted from Westby and Robinson (2014) was used to code the narratives by stages of ToM development: No Evidence of ToM, Early ToM (e.g., use of emotional/mental state terms), First Order (e.g., predicting causes for emotions/mental states or actions), Second Order (e.g., ascribing beliefs, feelings, or thoughts to others), and Higher Order (e.g., understanding conflicting emotions, deceit, the use of figurative language). Samples were also coded for the inclusion and frequency of mental and emotional state terms.
Results**:** Based on the application of the analysis framework, 80% (*n* = 56) of the written language samples revealed some evidence of ToM, with Early ToM evidenced in 14% of the narratives (*n* = 10), First Order in 43% (*n* = 30), Second Order in 9% (*n* = 6), and Higher Order in 14% (*n* = 10). Interestingly, except for three participants, Second and Higher Order ToM were only evidenced in the stories of participants enrolled in grade 8 and higher. A total of 14 unique mental state terms were included across the 70 samples, with the most frequently occurring terms being *thought* (*n* =13), *know* (*n* = 8), *decided* (*n* = 7), and *realized* (*n* = 5). In seven instances, participants used a phrase to indicate a mental state (e.g., told himself, not quite sure). Significantly more emotional state terms were included in participants' stories, with 35 unique terms being used. The terms *worried* (*n* = 8), *happy* (*n* = 7), *mad* (*n* = 7), *angry* (*n* = 6), *nervous* (*n* = 6), *panic* (*n* = 5), *shocked* (*n* = 5), and *sorry* (*n* = 5) were among the most frequently used. Phrases were also used five times to indicate emotional states (e.g., with a smile on her face, lighten his mood).
Conclusion**:** Findings of this study add to the literature on ToM development in deaf students, a group that has historically evidenced delays in this area. Such an investigation is particularly timely, given that this population has demonstrated improvements in language and literacy achievement, abilities closely tied to ToM development. With the growing focus on the relationship between ToM and literacy, these findings can inform pedagogical practice in terms of supporting the development of ToM.

Keywords*:* deaf, language, Theory of Mind, writing

83 - Cochlear Implant Awareness Day - Are We Making an Impact?

Mihai Bentan [(1)] - Joshua Kang [(1)] - Daniel Coelho [(1)]
Virginia Commonwealth University, Otolaryngology - Head & Neck Surgery, Richmond, United States [(1)]

Objective: Despite substantial efforts to educate patients and professionals, awareness about cochlear implants (CI) amongst the general public may still fall short of desired goals. The aim of this study was to determine if the major public awareness campaign for cochlear implants "International Cochlear Implant Day" influenced national and international public interest as measured by internet search activity.
Methods: Weekly search volume data in the United States, Canada, Australia, Germany, United Kingdom, Brazil, India, Japan, and a "Worldwide" group for the search topic "cochlear implant" was collected from Google Trends. Data over a 5-year period (2017-2021) was analyzed. The "Campaign" window was defined as 1 week before, the week of, and 2 weeks after International Cochlear Implant Day (February 25th). "Non-Campaign" weeks were considered any data outside the "Campaign" window. A Welch's unpaired t-test was used to determine statistically significant differences between "campaign" dates and "non-campaign" dates.
Results: Of the regions studied, the United States, United Kingdom, Australia, India, and "Global" demonstrated a significant increase in internet search activity during the time frame of interest between 2017 and 2021. Although there were some individual years with significant increases during the "Campaign" period for Canada, Germany, Brazil, and Japan, none showed statistically significant increases over the 5-year period studied.
Conclusion: Public awareness campaigns have been widely recognized as a crucial element of delivering effective healthcare. However, efforts to increase public awareness can have varying degrees of success, especially when examined at a global scale. The data from the present study suggest that efforts to raise awareness through International Cochlear Implant Day, as measured by internet search traffic, has had varying degrees of impact around the world. Interestingly, many but not all the 5 developed countries studied demonstrated a spike in activity during the campaign. Likewise, one of the developing countries (India) demonstrated a statistically significant increase while the other (Brazil) did not. Clearly factors other than GDP play a role, including type of payer, cultural norms and the degree to which CI is already adopted in that country to name a few. It is worth noting that countries with high utilization rates of CI are those with significant elevations in search activity. Rather than demonstrating a ceiling effect – where already high awareness would not result in elevated search activity following a campaign – it appears societies may have a tipping point beyond which awareness translates into adoption and vice versa. While data from Google Trends suggests that cochlear implant awareness campaigns can translate into increased internet searches, greater efforts can be made in select countries to improve public interest. The success of International Cochlear Implant Day in bringing awareness to CI may be attributed to multiple interconnected factors. Central to this is the influence of the World hearing Day on March 3rd, led by the World Health Organization (WHO), who annually curates and disseminates evidenced-based advocacy materials to international government partners and civil societies. The inclusion of the World Hearing Day within this study's "Campaign" period likely supports the popularity and impact of the WHO and other advocacy groups on supporting the success of International Cochlear Implant Day. Additionally, growing worldwide activism and a heightened focus on health literacy further extends the reach of International Cochlear Implant Day. National health literacy campaigns, like those seen in the United States of America and Germany, combined with the WHO's Global Conference on Health Promotions, facilitate the awareness and comprehension of CI information. In the end, increasing CI adoption will require a two-pronged approach – with education targeted at both the public *and* health professionals. This is an area ripe for study as little is known about which barriers in the CI process are more amenable to advocacy. Moreover, precious little is known about what formats (print, social media, television, in-person, etc.) are the most efficient and cost-effective. Ultimately, further study is required to determine the most effective methods of spreading CI awareness to different target populations.

52 - Empowerment through Advocacy

Michelle Christie [(1)]
No Limits for Deaf Children and Families, Education, Los Angeles, United States [(1)]

Research supports the importance of parent involvement as a predictor of success for the communication and language development of children with hearing loss (Yoshinaga-Itana, 2003). More than 90% of children with hearing loss are born to hearing parents, yet most families have never even met a deaf person let alone possess knowledge of hearing loss and its associated challenges. Parent support groups and the teaching of advocacy skills have been proven to alleviate the stress that parents encounter due to the enormous weight of decisions needed to ensure success for a deaf child in a hearing world (DesGeorges, 2003). It can be a daunting and lonely process. For economically disadvantaged families with minimal to no resources, it can often feel unbearable.

My presentation will outline the fundamental tools of family advocacy, as well as highlight methods to unite families and communities through digital media and story sharing. The presentation will feature the outcomes of the acclaimed theatrical documentary, Silent NO MORE (with a book of the same name), which has been performed at Carnegie Hall and throughout the United States. According to a study by Stanford University, stories are up to 22 times more memorable than facts alone (Aaker, 2017). Silent NO MORE demonstrates the power of storytelling by individuals with hearing loss and their families. This advocacy movement features the real-life hardships and successes of growing up with a hearing loss. These are not actors, but rather people residing in the local community. The stories by hearing siblings, parents, and educators provide a comprehensive personal experience about how deafness has impacted their lives, allowing families to relate to and learn from one another. Surveys distributed after each performance highlighted significant outcomes. The surveys showed that parents found the stories inspirational, educational, emotional, and informative. By videotaping these honest, true-life stories (which are stored in an easily accessed digital library), educators can help parents of newly diagnosed children learn to advocate for their child's future and find a human connection to the often-overwhelming medical diagnosis of hearing loss.

The personal stories from adults with hearing loss are particularly powerful, as they not only provide role models for children with hearing loss, but also a way forward for the entire family. Based on a 2013 study by Rogers and Young, introducing families to a diverse range of deaf role models has been instrumental to making families feel reassured and thereby becoming more positive and confident about their child's deafness and future. As parents, educators, deaf adults, and siblings share their perspectives, parents can assess their own lives and gain insight about how to best care for their child with a hearing loss.

Data indicates that 80 percent of internet users own a smartphone (Smart Insights), Facebook has more than 1.66 billion monthly smartphone users (DMR), and there are 4.92 billion mobile internet users globally (We Are Social, 2017). Educators can capitalize on this incredible access to technology by working with clients to capture their stories on a smartphone or tablet, without having to drive to an educational center. Thus, parents from remote locations or who have few resources especially benefit. They can watch the stories or create their own video from home. These stories empower communities throughout the world via websites, YouTube, social media, and other media outlets. Family advocacy through digital technology can capture, educate, and enliven one's own community and communities around the world by bringing role models and other families together so no one ever feels they are alone on this often-unexpected life journey.

Aaker, J. (2017). Harnessing the Power of Stories. [Video file]. *Stanford Center for Women's Leadership*. Retrieved from: https://womensleadership.stanford.edu/stories

DMR. (2017). *70 Amazing Facebook Mobile Stats.* Retrieved from: https://expandedramblings.com/index.php/facebook-mobile-app-statistics/

Mitchell RE, Karchmer MA. Chasing the mythical ten percent: Parental hearing status of deaf and hard of hearing students in the United States. (link is external)
(PDF) Sign Language Studies. 2004;4(2):138-163.

Rogers, K.D. and A.M. Young (2011). Being a Deaf Role Model: Deaf People's Experiences of Working with Families and Deaf Young People. *Deafness & Educational International, 13,* (1), 2-16. https://doi.org/10.1179/1557069X10Y.0000000004

Smart Insights. (2018). *Mobile Marketing Statistics compilation*. Retrieved from: https://www.smartinsights.com/mobile-marketing/mobile-marketing-analytics/mobile-marketing- statistics/

We Are Social. (2017). *Digital in 2017: Global Overview*. Retrieved from: https://wearesocial.com/special-reports/digital-in-2017-global-overview

13 - Readability and Quality of Online Health Information about Cochlear Implants and Hearing Aids

Matthew Bush [(1)] - Evan Nix [(2)] - Abbigayle Willgruber [(1)] - Brian Kinealy [(1)] - David Adkins [(1)] - Daniel Zeitler [(3)] - Jennifer Shinn [(1)] - Trey Cline [(1)] - Ryleigh Board [(1)]

University of Kentucky, Otolaryngology - Head and Neck Surgery, Lexington, Kentucky, United States [(1)] - University of North Carolina, Otolaryngology - Head and Neck Surgery, Chapel Hill, North Carolina, United States [(2)] - Virginia Mason Medical Center, Otolaryngology - Head and Neck Surgery, Seattle, Washington, United States [(3)]

Objective: Based on American Medical Association (AMA) recommendations, internet website health information should be written at or below a 6th grade reading level. The purpose of this study was to evaluate the readability and quality of cochlear implant and hearing aid website health information.
Methods**:** The terms “Cochlear implant” and "Hearing Aid" were queried separately in 4 internet search engines and the top 200 English and Spanish websites for each search were aggregated. After removing duplicates, the websites were evaluated for readability by using the Flesch Reading Ease Score (FRES) for English websites and the Fernandez-Huerta Formula (FHF) for Spanish websites. Information quality was assessed using the validated DISCERN quality criteria and the presence of Health on the Net Code of Conduct (HONcode) certification.
Results: A total of 91 cochlear implant websites (47 English and 44 Spanish) and 67 hearing aid websites (37 English and 30 Spanish) were included in the study. For all cochlear implant and hearing aid websites, the readability scores averaged between a 10th to 12th grade reading level. English cochlear implant websites were written at a higher reading level than Spanish websites ($p<0.01$) and English hearing aid websites were written at a higher reading level than the Spanish websites ($p=0.04$). Overall DISCERN quality was low for all websites. Of cochlear implant websites, only 27% of English websites and 12% of Spanish websites were HONcode certified. Of hearing aid websites, only 6 English (16%) and 4 Spanish (13%) websites were HONCode certified.
Conclusions: Patient-directed English and Spanish websites regarding cochlear implantation and hearing aids are written at reading levels that significantly exceed those recommended by the AMA. Furthermore, these websites have significant quality shortcomings. Patients would benefit from more accessible and accurate health information regarding hearing loss treatments.

TELEAUDIOLOGY

12 - Tools for Telehealth: A Correlational Analysis of App-Based Hearing Testing

Matthew Bush [(1)] - David Adkins [(1)] - Anthea Phuong [(1)] - Trey Cline [(1)] - Jennifer Shinn [(1)]
University of Kentucky, Otolaryngology - Head and Neck Surgery, Lexington, Kentucky, United States [(1)]

Objective**:** The objective of this study was to evaluate the correlation between the pure tone averages of audiograms obtained from commercial and consumer app-based programs and a traditional audiogram.
Methods**:** A prospective within-subject and between-subject study design was chosen to evaluate the correlation of audiogram results between app-based hearing programs and a traditional audiogram. All participants completed a traditional audiogram, 1 commercial app-based test (SHOEBOX), 2 consumer app-based tests (EarTrumpet, HTEAT), and Hearing Handicap Inventory screening version (HHI-S). Traditional audiometry was conducted in an acoustically controlled environment and app-based hearing tests were performed in a quiet exam room.
Results**:** A total of 39 participants were enrolled in the study (21 with normal hearing and 18 with hearing loss). Among hearing apps, the SHOEBOX test resulted in the strongest statistically significant correlation observed between the audiogram and for normal hearing participants in both right ears (r=0.7, p=0.005) and left ears (r=0.66, p=0.001) and among participants with hearing loss in both right ears (r=0.8, p=0.0002) and left ears (p=0.7, p=0.0015). Regarding the accuracy of the PTA for each test, SHOEBOX was within 10dB of the audiogram PTA threshold in 94% of for all ears (both normal hearing and hearing loss). The overall accuracy of the HHI-S to predict normal hearing and hearing loss was 92%.
Conclusion**:** Commercial-based apps provide the most accurate audiometric evaluation of pure tone average with a strong correlation with traditional audiometry. The HHI-S assessment; however, remains a valid and useful tool to predict normal hearing and hearing impairment.

25 - Telehealth and Simulated Patient Learning Environments – Preparing students for the changing face of healthcare

Saira Hussain [(1)] - Claire Wilkes [(1)]
Aston University, Audiology, Birmingham, United Kingdom [(1)]

Background**:** Audiology teaching involves a plethora of activities, including authentic teaching and learning opportunities. One aspect of this clinical education is the use of patients and simulated patients in practice. Aston University (Birmingham, UK) has trained and utilised simulated patients in BSc undergraduate training since 2003. However, the role of healthcare professionals in the UK is constantly changing, which was emphasised during the COVID pandemic and the subsequent rise of telecare. Therefore, it is imperative to help students develop and adapt their clinical practice for online situations. Further to this, advancements in audiology technology across hearing aids and equipment are continuously changing and our challenge is to ensure students are prepared for this.
Method**:** Students on the BSc Undergraduate degree at Aston University undertake clinic training sessions with simulated patients. With the COVID-19 pandemic, these sessions were converted to online practice appointments. However, this format of teaching has been retained and enhanced as a catalyst to support the use of Telehealth in education settings. These online telehealth sessions have been embedded into the students' timetable through the First and Second Semester. These have taken place since 2020, where a stepped approach from Year 1 through to Final Year is utilised to build upon their confidence and competence in online healthcare appointments. This presentation will discuss how these opportunities facilitate simulated patient interaction through telehealth and online engagement, as well as feedback opportunities from peers, staff and simulated patients.
Findings**:** Whilst healthcare courses must meet specific standards set by Professional, Statutory and Regulatory Bodies (PSRBs), it is important to evaluate novel processes for both quality assurance and student experience. The practice of incorporating telehealth appointments into the undergraduate curriculum was recognised by the National Health Service's education provider, the National School of Healthcare Science. Simulated patient feedback highlights the importance of their roles as a clinical resource. Moreover, student feedback, through both qualitative reflections and surveys, indicate the usefulness, confidence building and value these sessions add to their training.
Conclusion**:** This innovative teaching practice prepares students for the changing world of healthcare. It is our job as educators to support and foster safe and effective learning environments for students to practice various skills, in line with person-centered care. This teaching practice is a clear example of implemented innovations that benefit student learning and development for future professionals that could be shared globally.

Keywords: Telehealth, Simulated Patients, Telecare, Students

97 - Healthy Ears: A telehealth-facilitated randomised-controlled trial utilising the 'Blow, Breathe, Cough' health promotion program to resolve otitis media with effusion in children

Jaimee Rich [(1)] - Tamara Veselinovic [(1)] - Tanisha Cayley [(1)] - Greta Bernabei [(1)] - Valerie Swift [(1)] - Melinda Edmunds [(1)] - Jafri Kuthubutheen [(2)] - Peter Richmond [(3)] - Christopher Brennan-Jones [(1)]
Telethon Kids Institute, Wesfarmers Centre of Vaccines and Infectious Diseases - Ear Health, Perth, Australia [(1)] - Perth Children's Hospital, Ear, Nose and Throat, Perth, Australia [(2)] - Telethon Kids Institute, Vaccine Trials Group, Perth, Australia [(3)]

Introduction*:* The prevalence of persistent otitis media with effusion (OME) is estimated to affect over a quarter (26.8%) of children in Western Australia by the age of three, and over half of Aboriginal children by 6 months of age. A simple, low-cost, family-led health promotion intervention was developed in Australia to promote resolution of OME without surgical intervention. Known as the 'Blow, Breathe, Cough' program (or 'BBC'), it encourages children to breathe deeply, blow their nose and cough to clear secretions from the lungs and nose, and practice good hand hygiene. Due to resource limitations and high service demand, children requiring treatment for their OME in the Western Australian public health system will often be faced with a waiting period of over 12 months to see an Ear, Nose and Throat (ENT) specialist and additional 6 to 12 months for surgical treatment, making the overall referral-to-treatment time frequently exceeding two years. A paediatric tertiary hospital-based telehealth (virtual care) service, named the Ear Portal, was developed to improve access to specialist ENT care in response to these extensive waiting periods.
Objectives*:* This study aims to recruit children with unilateral or bilateral persistent OME (Type B tympanogram/s on two separate occasions at least three months apart) referred to primary, tertiary and regional healthcare service providers in Western Australia into a telehealth-facilitated randomised-controlled trial of the BBC program to assess the resolution rate of OME.
Methods*:* The study is a two-arm, blinded outcome assessment, randomised-controlled adaptive clinical trial. Intervention arm participants complete the BBC intervention twice daily for a 4-6 week period, with the BBC program involving a hand hygiene component. Control arm participants undertake a hand hygiene component only, twice daily for 4-6 weeks. The primary outcome is resolution of OME, assessed with tympanometry (type A or C tympanogram/s), measured at 4-6 weeks and 6-8 months post-randomisation. Each participants' case is periodically reviewed by an ENT multidisciplinary team using the Ear Portal telehealth platform, enabling care to be escalated, alternative care pathways to be sought or children to be discharged from care.
Results*:* Currently recruiting. The interim analysis will be undertaken once 100 participants are enrolled and randomised into the trial.
Conclusions*:* This is the first clinical trial to assess the effectiveness of the BBC program. If efficacious, there is potential for the program to become standard practice for the management of OME, reducing risks and costs associated with surgical intervention. Additionally, the trial will continue to enhance the provision of faster access to specialist ENT care through the Ear Portal telehealth platform compared to the standard ENT care pathway in Western Australia.

Key words*:* Otitis media with effusion, health promotion, virtual care, randomised-controlled trial

98 - Ear Portal: Using asynchronous tele-audiology to improve access to Ear, Nose and Throat services for children with otitis media in an urban area

Greta Bernabei [(1)] - Chris Brennan-Jones [(1)]
Telethon Kids Institute, Ear Health, Perth, Australia [(1)]

Background**:** Diagnostic assessments and treatment for chronic otitis media (OM) often requires tertiary Audiology and Ear, Nose and Throat (ENT) consultation. In some states in Australia, the mean waiting time for non-urgent ENT outpatient appointments has been reported to be between 700 to 1500 days. Long waiting times can lead to poorer behavioural outcomes, quality of life and language delays for children with untreated OM as well as an increased financial burden on the healthcare system.
Tele-audiology models of care for rural and remote patients have been widely adapted across the world, however this model of care may be beneficial to children living in urban areas, facing significantly long waiting times to receive appropriate care for OM.
Method**:** The Ear Portal project recruited children living in urban areas of Perth, Western Australia. Children were divided into three cohorts, reflecting children waiting time since referral. Children that met the inclusion criteria for the study were invited to a face-to-face assessment by a research audiologist, whom collected a comprehensive medical history and conducted the following assessments: video otoscopy (HearScope), tympanometry (Titan Middle Ear Analyser), distortion product otoacoustic emissions (Titan Middle Ear Analyser) and screening audiometry (HearX). Parents or caregivers were asked to complete questionnaires, which included the Otitis Media 6 (OM-6), Hearing & Talking Scale (HATS), Parent-evaluated Listening and Understanding Measure (PLUM), Strengths and Difficulties Questionnaire (SDQ) and The Auditory Process Domain Questionnaire (APDQ). The information and results obtained during the face-to-face consultation were reviewed by the Ear Portal multidisciplinary team (MDT), which included an Ear, Nose and Throat registrar, a clinical ENT nurse and an audiologist, to make a diagnosis and provide a care plan for each patient. Caregivers were contacted by a research audiologist via telephone to be informed of the child's care plan. Upon completion of each appointment, family and staff resources were investigated to pilot an economic assessment to compare the efficacy and effectiveness of Ear Portal, a telehealth service, compared to standard hospital care.
Results**:** A total of 250 children were enrolled in the Ear Portal project from 2020-2023. Children in the Ear Portal waited shorter (28 days (IQR = 19.8)) than children in the control group (450 days (SD = 211.4)). Parents reported language and communication oucomes were significantly better (i.e., higher mean HATS scores = 40.3 ± 10.1) for children that encounterd shorter waiting times, than children with high waiting times (i.e., lower mean HATS scores = 32.9 ± 14.4) (p=0.004). Furthermore, longer waiting times in the study were significantly correlated with overall behavioural problems (based on total SDQ scores) (95% CI: 1.2-9.1, p=0.013).
The Ear Portal showed a cost-benefit compared to standard tertiary care pathway, with the initial assessment 43.8% less expensive, and the follow up assessment 43.4% less expensive. A cumulative sum of 223 appointments were necessary to recover the initial investment (i.e. equipment) of the project.
Conclusion**:** The Ear Portal project established a novel model of care for urban children with otitis media in Australia, which combats long waiting times and reduces the burden of language, behavioural and quality of life impacts that waiting for care may have. Ear Portal may act as an adjacent service run by audiologists in tertiary-care settings, and provide a cost-benefit for patients and providers.

Keywords: e-health, tele-audiology, otitis media, children

Keynote Lecture

9 - Auditory Situation Awareness: the Conundrum when Your Life Depends upon your Hearing and your Hearing Depends on your Hearing Protector or Earphone

John Casali [(1)]
Virginia Tech University & H.E.A.R., LLC, Industrial & Systems Engineering, Auditory Systems Lab, Blacksburg, Virginia, United States [(1)]

Hearing protection devices (HPDs) for prevention of noise-induced hearing loss and earphones for music and communications are both in common use internationally. However, along with their usage in many dynamic settings, concomitant preservation of the user's auditory situation awareness (ASA) and vigilance to the surrounding acoustic environment, is critical. Examples include construction workers who wear electronic earmuffs but must hear backup alarms on vehicles in their vicinity, trail runners who wear earphones but need to hear bicyclists that overtake from behind, emergency vehicle drivers who need hearing protection from the siren but must hear car horns, and military personnel who wear gunfire noise-protective headsets but must hear enemy threats and speech. Furthermore, in the consumer setting, in-ear earbuds and over-the-ear headphones are in prolific use to provide cellphone and other auditory content to users' ears, but due to the occlusion provided, these devices often compromise audibility of ambient sounds. The human auditory sense provides key sensory-perceptual inputs for establishing a person's situation awareness, due to the fact that it is always "on" and primed for response, is relatively "omni-directional" and thus reactive to sounds coming from all directions, renders an "acoustic startle response" which provides quick arousal to dangers, and has a relatively low threshold of sensitivity even during sleep. Unfortunately, when the ears are occluded with HPDs or earphones of various types, these auditory capabilities are typically compromised. This presentation will provide a brief introduction into recent technologies in HPD and earphone design, which rely on either passive (i.e., dynamically-nonlinear acoustic "valves") or active (i.e., battery-electronic sound transmission) technologies with digital signal processing, that are intended to provide "pass-through" hearing capability. In addition, human subject research results from several in-field and in-laboratory ASA experiments will be covered. Resultant data demonstrate that some devices, including certain augmented HPDs and military-fielded Tactical-Communications-and-Protective-Systems (TCAPS), in fact do not provide natural hearing or "transparency" but instead render an imprint on the incoming signals, and thus can impose deleterious effects on one's situation awareness. Experimental stimuli have included vehicular warning alarms and a variety of sound signatures of broadband, low-frequency, and high-frequency content. Metrics of ASA performance have included: hearing threshold at *detection*, accuracy and response time in *recognizing/identifying* and *localizing* signals, and *intelligibility* of communications. Based on these experiments, an objective, repeatable test battery was developed for evaluating ear-occluding device impacts on: **D**etection, **R**ecognition/**I**dentification, **L**ocalization (azimuth and frontal elevation), and **COM**munication, known as DRILCOM. Example results, in particular with ubiquitous reverse alarms required by the United States' Occupational Safety and Health Act (OSHA) on industrial-construction vehicles as well as various military threat signatures such as gunshots, are covered. Also, the interactive effects of HPD design with the low-frequency interaural time difference (ITD) cues and high-frequency interaural level difference (ILD) cues that are critical to localization are covered. In addition to *testing* results, research on auditory *training* will be covered, particularly in regard to the ability of both the natural and occluded ear to be trained to achieve better localization performance. Using a **P**ortable **A**uditory **L**ocalization **A**cclimation and **T**raining System (PALAT) developed and validated at Virginia Tech, which provides an array of directional loudspeakers and a dissonant tonal complex that is highly localizable, human factors experiments have demonstrated that spatial localization accuracy with the open ear can be improved with training by up to about 30% over baseline in some individuals, and when wearing *certain* HPDs, improvements can also be obtained with training. However, other HPDs and earphones have been found to be insensitive to training effects and induce localization and other errors, giving rise to questions about whether they should be deployed, especially in a military or occupational setting, when the user needs to maintain ASA. The presentation postulates the need for ASA testing of HPDs and TCAPS, in similar fashion to Noise Reduction Rating (NRR) and other forms of pure attenuation testing. Furthermore, the negative implications for increasing the probability of noise-induced hearing loss when users' perceive that HPDs impede their hearing of important signals and communications, and remove their protectors, are discussed.

NOTE: Received the "Safe in Sound Award for Innovation in Hearing Conservation," from United States National Institute for Occupational Safety and Health (NIOSH). See: http://www.safeinsound.us/winners.html

IDENTIFICATION AND PREVENTION OF HEARING LOSS

252 - What the audiogram does not show

Mark Laureyns [(1)] - Lidia Best [(2)]
Thomas More University College, Audiology Department, Antwerp; Amplifon Centre for Research and Studies CRS, Milano, Italy; AEA – European Association of Hearing Aid Professionals [(1)] - EF Board, (European Federation of Hard of Hearing People) Houten, Netherlands [(2)]

Background and Aim: In the WHO World Report on Hearing, it is stated that "*While audiometric descriptors provide a useful summary of an individual's hearing thresholds, they should not be used as the sole determinant in the assessment of disability or the provision of intervention(s) including hearing aids or cochlear implants.*" But most public and insurance reimbursement systems, use the average hearing loss as the main eligibility criterium for hearing aids. In this presentation, we show the limitations of the audiogram and suggest other criteria to be included.
Method: In this study we used the latest EuroTrak results for 11 European countries. In total 157.970 people were interviewed and 14.166 people with self-reported hearing loss were included in this overview. Furthermore, we use the information from EFHOH, AEA and EHIMA to make the best estimates on the number of hearing aids sold and used in Europe.
Results: The audiogram is not a reliable indicator of hearing disability.
The audiogram alone should not be used as the measure of difficulty experienced with communication in background noise. Patients with even very mild hearing loss, but problems understanding in noise, can show significant improvement with hearing aids. Audiometric levels of hearing loss, show a very different picture than self-reported levels of hearing loss. Reimbursement systems refunding hearing aids for mild hearing loss, lead to significantly higher uptake of hearing aids. For the eligibility for hearing aids, next to the audiogram, also speech understanding in noise and a questionnaire such as the HHIE-S should be used.
The eligibility criteria and the level of reimbursement are correlated with the uptake of hearing aids.
The system with the highest uptake is the one which covers hearing aids for people with mild hearing loss and where hearing aids are provided free of charge by a public system, but unfortunately, this system results in a lower satisfaction rating, which can be explained by the limited freedom of choice, the longer waiting lists and possibly the reduced availability of person-centred hearing care.
Conclusions: To avoid the consequences of untreated hearing loss, we must ensure that everybody, who experiences communication problems due to hearing problems, can benefit from hearing care to reach their full potential.

183 - Preliminary outcomes of a hearing loss screening program of 5,360 older adults at the Medical University of South Carolina

Lauren Dillard [(1)] - Theodore McRackan [(1)] - Judy Dubno [(1)]
Medical University of South Carolina, Department of Otolaryngology – Head and Neck Surgery, Charleston, United States [(1)]

Background and objectives: Hearing loss is common and impactful in aging adults, yet often goes undiagnosed and unaddressed. This may occur because many older adults are unaware of their hearing loss, or if they are experiencing hearing difficulties, they may not know how to get help for their hearing problem. A visit to a primary care provider has been identified as an important opportunity for older adults to receive or obtain referrals for a wide variety of health screenings, including hearing loss. Moreover, specific questions about health screenings and other health conditions, including hearing loss, are asked of patients during their Medicare Annual Wellness Visits to primary care clinics. Therefore, a pilot program to screen for hearing loss was implemented in primary care clinics at a major academic medical center. An important innovation was to implement an automatic referral to the medical center's audiology clinic for further diagnostic assessment based on patients' responses during the hearing screening. This study describes demographic differences in responses to screening questions and preliminary outcomes of this program.
Methods: A sequence of one to four questions with branching logic was asked of patients ≥65 years of age during visits to primary care (family medicine and internal medicine) outpatient clinics at the Medical University of South Carolina (Charleston, South Carolina, USA). As part of the pilot program, the same questions were asked during visits to otolaryngology outpatient clinics, but these data are not included in the current results. The questions were: 1. Do you think you have hearing loss? If yes, 2. Are you being treated for hearing loss? If no, 3. Would you like a referral to audiology? If no, 4. Why not? If yes, a referral to audiology was automatically generated. We used one-way analysis of variance and chi-square tests to determine demographic differences in responses to screening questions. Age-, sex-, and race-matched patients who did not undergo hearing screening served as a control group.
Results: Of the 5,360 patients screened, the mean age was 73.0 (SD 6.7) years, 58.3% were female, and 68.8% were White race (29.0% were Black or African American, 2.2% were other races). Of the patients screened, 42.3% self-reported hearing loss, and among those, 38.9% reported not being treated for hearing loss. Of those not treated, 53.4% agreed to an audiology referral.
Conclusion: This screening program, which used simple questions, identified a high percentage of older adults with perceived hearing loss, many of whom were not treated. Over half of these patients requested audiology referrals when prompted. Additional results will include demographic differences in response to the screening questions, other outcomes of this program, including the reasons for denying a referral, and the impacts of screening on seeking further audiology assessment and treatment uptake.

Keywords (3-5): Screening, age-related hearing loss, electronic medical record, primary care, hearing aids

79 - Auditory environments at early intervention groups and daycare centers visited by young children with hearing loss

Annerenee Meijer [(1)] - Ruben Benard [(1)] - Aart Woonink [(2)] - Deniz Başkent [(3)] - Evelien Dirks [(4)]
Pento, Speech and Hearing Centers, Zwolle, Netherlands [(1)] - Cauberg Huygen, Zwolle, Netherlands [(2)] - University Medical Center Groningen, University of Groningen, Department of Otorhinolaryngology/Head and Neck Surgery, Groningen, Netherlands [(3)] - Dutch Foundation of the Deaf and Hard of Hearing Child, NSDSK, Amsterdam, Netherlands [(4)]

Objectives**:** The early years of life play a vital role in language acquisition, making it crucial for children to have sufficient exposure to speech during this period. This poses a challenge for children with hearing loss, as their access to auditory information is deteriorated. To gain a better understanding of the access that children with hearing loss have to speech, it is crucial to examine the various environments they encounter on a daily basis. These environments encompass not only their homes, but also daycare centers and early intervention groups specifically designed for children with hearing loss. Early intervention groups are a standard component of care in the Netherlands, with the primary goal of promoting language skills, communication abilities, and social-emotional development. One important environmental factor is the auditory environment, which is characterized by factors such as signal-to-noise ratios (SNRs), background noise levels, and reverberation times. The current study aims to investigate the auditory characteristics at the early intervention groups. Our aim is to present the findings as an illustration of what an optimal environment, designed for groups of young children, should encompass. Additionally, there will be an initial exploration of the auditory environment at regular daycare centers visited by children with hearing loss.
Design**:** This study involved 26 children with hearing loss, aged between 22 and 46 months, who attended seven different early intervention groups. Additionally, six children with hearing loss aged between 24 and 42 months, who visited six different regular daycare centers attended. Each child wore a LENA device, a small digital language processor, which was placed inside a LENA T-shirt throughout the entire duration of their intervention group or daycare visit. The LENA analysis software identified the sound sources in the recordings and provided corresponding sound levels. These identified sound sources were then categorized into conversation blocks and pause blocks. The speech and noise levels in the conversation blocks, as well as the noise levels in the subsequent pause blocks, were analyzed to determine the SNR within the conversations. Additionally, at both the intervention groups and daycare centers, the ambient noise levels and reverberation times were measured.
Results**:** The average SNR measured with LENA in the intervention groups was approximately +13 dB SNR. Around 42% of the speech produced by the professionals at the early intervention groups exceeded the +15 dB SNR recommended by the American Speech-Language-Hearing Association. Ambient noise levels ranged from 28.9 to 38.6dB LAeq, which aligns with acoustic norms for classroom environments in six out of the seven groups. The reverberation time ranged from 0.3 to 0.6 seconds across all groups, meeting the acoustic norms for classroom environments for children without hearing loss. However, only one group complied with the norm of 0.3 seconds for children with hearing loss.
Preliminary data on the auditory environment at six regular daycare centers revealed that ambient noise levels ranged from 31.3 to 49.2 dB LAeq. The reverberation time varied from 0.4 to 0.8 seconds among the different groups. Both ambient noise levels and reverberation time comply with acoustic norms for classroom environments for children without hearing loss in four out of the six locations. None of the groups met the norm for children with hearing loss. Results regarding SNRs at daycare centers will be analyzed and presented.
Conclusions**:** This study aimed to evaluate the auditory environments of early intervention groups and daycare centers visited by young children with hearing loss. The evaluations conducted at the early intervention groups provide valuable insights in the auditory conditions of relatively optimal environments. The findings indicate that despite the attention being paid to audibility and acoustics, it is not realistic to expect low noise levels that allow for good SNRs. This is, among other factors, attributed to the noise produced by young children playing in these environments. Therefore, these results highlight the importance of paying attention to optimal auditory conditions and acknowledging that not all spoken language may be accessible to young children with hearing loss. The data from the daycare centers will complement this knowledge with information on what auditory environments are like if young children gather in an environment that is not specifically designed for children with hearing loss.

64 - Innovative Approaches to Timely Detection: A Quick Listening Performance Checklist for Recognizing Preschool Children with Potential Hearing Loss

Yu-Chen Hung [(1)] - Ming Lo [(1)] - Yi-ping Chang [(1)] - Yi-Chih Chan [(1)] - Pin-Chun Chen [(1)] - Shu-Ting Chang [(1)] - Jia-Shin Fan [(1)]
Children's Hearing Foundation, Speech and Hearing Science Research Institute, Taipei, Taiwan [(1)]

Introduction**:** Since 2012, Taiwan has excelled in universal newborn hearing screening (UNHS) with a screening rate of approximately 99.5%. Despite this success, there remains a pressing concern about late-onset, progressive and minimal hearing loss that UNHS may not effectively detect. Additionally, untreated hearing loss in children can adversely impact their development and auditory-related performance. Unfortunately, Taiwan lacks a universal preschool hearing screening program, raising concerns about unaddressed hearing issues, especially given the higher incidence rate of hearing loss in preschoolers compared to newborns. The gap in preschool hearing screening likely stems from the inherent cost and personnel demands of conventional methods, particularly the necessity for professionals to conduct screening audiometry. This challenge is intensified by the general belief that passing UNHS ensures lasting good hearing, leading to an undervaluation of regular hearing checks. Our study aims to bridge this gap by proposing a practical and cost-effective solution—a quick listening performance checklist that focuses on behavioral red flags indicative of poor hearing. This checklist should aid in recognizing preschool children with potential hearing loss while also enhancing caregivers' awareness of issues related to hearing difficulties. Methods**:** The initial checklist evolved from a comprehensive synthesis of literature and clinical experiences, incorporating 10 questions about demographics and medical history along with 29 listening performance items. This checklist underwent content validity assessment by 7 experts, including 2 pediatric audiologists, 1 speech-language pathologist, 2 auditory-verbal practitioners, and 2 preschool teachers of deaf. For clinical verification, parents and teachers of 3-to-6-year-old children, with untreated hearing loss (n=122) and typical hearing (n=180), completed the checklist. Inter-rater reliability between parents' and teachers' scores was assessed using a one-way Chi-test, and discriminant validity was examined using Fisher's exact test. Subsequently, sensitivity and specificity values were calculated to determine the cutoff value, indicating whether the child should be referred to further hearing/ear examination. A set of neural network computational simulations, employing backpropagation, was utilized in the final verification stage to serve two primary purposes. Firstly, to verify the reliability and discriminant validity of the checklist. Secondly, to assess the likelihood of each item being indicative of hearing loss in children.
Results: Expert evaluation showed that all items had a score significantly higher than 3 on a 4-point Likert scale (mean = 3.60, standard deviation = 0.24) with 1 denoting "very inappropriate" and 4 indicating "very appropriate," confirming that they had content validity. Subsequently, 21 items were excluded due to their suboptimal inter-rater reliability and/or discriminant validity. The refinement process resulted in the retention of 8 listening performance items, demonstrating a sensitivity of 88.1% and specificity of 84.0%, with the referral criterion being the absence of listening performance in one of the items. In the computational simulations, an output value close to 0 suggests a low risk of potential hearing loss, while a value near 1 indicated a high risk. With a cutoff value of 0.2, the simulation yielded sensitivity and specificity values of 87.7% and 84.4%, respectively, which were similar to those obtained through initial validation. This supports the validity of the determined criterion. A higher output value is indicative of greater discriminatory power of an item because the behaviors described by this item, from the model's perspective, are often found to be exhibited differently between children with and without hearing loss. Accordingly, the simulation outputs suggested five out of the eight items can provide a pronounced indication of hearing loss, with output values ranging from 0.62 to 0.99.
Discussion**:** The proposed listening performance checklist is not intended to replace the formal preschool hearing screening test. Instead, it serves as a rapid tool for teachers and parents to recognize children at risk for unaddressed hearing loss and heightens their awareness of associated behavioral issues. If the child displays the behavioral indicators described in one of the items, especially those with a simulation value over 0.5, or if the caregivers have any other concerns, the caregivers are advised to timely discuss the concerns with the child's doctor and inquire about further hearing/ear examinations. Conclusion**:** The Quick Listening Performance Checklist is a feasible tool for recognizing preschool children with potential unaddressed hearing loss, enabling timely audiological assessment, medical treatment, and auditory rehabilitation.

Keywords: Preschool hearing screening, unaddressed hearing loss, timely intervention

51 - Farmworkers' Noise Exposure: A Community-Engaged Project in a US/Mexico Border Community

Laura Coco [(1)] - Gabriela Sanchez [(1)] - Chris Rodriguez [(1)]
San Diego State University, Speech, Language, and Hearing Sciences, San Diego, United States [(1)]

Occupational noise-induced hearing loss (NIHL) is permanent and irreversible, yet it is completely preventable. Excessive noise is associated with worker stress and fatigue, and the cumulative effect of hazardous noise leads to disabling hearing loss. Commonly, hearing loss is associated with an increased risk of communication problems, as well as isolation, depression, and cognitive decline. In the United States (US), migrant and seasonal farmworkers are a vulnerable subpopulation with a potentially high risk for occupational NIHL due to noise exposures on the farm. The majority the United States (US) agriculture workforce is made up of migrant and seasonal Spanish-speaking Latino workers, and research indicates that this demographic may be at a uniquely high risk for subjective hearing difficulty and greater barriers to hearing protection use due to low acculturation. Strategies to reduce risk of noise exposure are urgently needed. Community-engagement may be particularly important given that, in the US, federal and state hearing loss prevention programs are rarely enforced in agriculture. The overarching goal of this work is to reduce risk of noise exposure in farmworkers. Our focus is on farms in the US Southwest/Mexico border region, an area known as "America's winter lettuce capital". Among the limited existing studies on hearing loss and noise exposures in farmworkers, none have focused on farms in this region, despite this being one of the most productive agricultural areas in the country. The outcomes from this project will contribute to culturally-situated, sustainable safety intervention measures that help lower the risk of noise-induced hearing loss in a vulnerable, under-resourced population. In this presentation, we will discuss our recent and ongoing community-engaged research, including findings from a subjective survey on farmworkers' hearing difficulties (n = 132), objective pure-tone hearing screenings and detailed information on noise exposures (n = 31), as well as our community engagement with a farmworker advocacy organization, and steps towards co-developing strategies to reduce noise exposure. We will also present future plans that include an intervention focused on preventing noise exposure in agricultural settings, tailored for Spanish-speaking Latino farmworkers.

Key words: noise-induced hearing loss, agriculture, disparities, community-engagement

TINNITUS

214 - Tinnitus in immigrants to Sweden attending language education classes for adults

Radi Jönsson [(1)] - Nina Pauli [(2)] - Ylva Dahlin-Redfors [(1)]
Sahlgrenska University Hospital/Sahlgrenska Academy, Otorhinolaryngology, Gothenburg, Sweden [(1)] - Sahlgrenska Academy, Institute of Clinical Sciences, Otorhinolaryngology, Gothenburg, Sweden [(2)]

Background
The prevalence of hearing loss and ear disease depends on health and socioeconomic factors. In immigrant populations, it has been shown that there is an overrepresentation of some ill-health compared to the native-born population. There are though other studies that have shown the presence of a “healthy immigrant effect”. When immigrants arrive at their new country, it is of utter importance that they can safely settle and learn the new language to socialize into the new setting. In Sweden, it is strongly recommended to attend the free-of charge national Swedish language program for adults – Swedish for immigrants (SFI). Learning a new language can be challenging, especially for people with hearing impairment and other health conditions.
Objectives
The aim of the present study was to investigate tinnitus prevalence in immigrants attending SFI, compared to the adult general population in Sweden. Tinnitus was explored in relation to hearing and health status in the present population.
Methods
The study was prospective, with inclusion of SFI students in 2019. They were audiometrically tested at their school by a licensed audiologist with pure-tone audiometry after undergoing otoscopy. They filled out a study-specific questionnaire that contained questions from the Swedish national public health survey.
Tinnitus in immigrants in SFI was the primary endpoint, in comparison to the general population. Other endpoints were hearing loss and high-frequency hearing loss. Adjustments for age and sex were made for the population comparisons.
Results
A total of 188 participants were evaluated. The mean age was 40 years, women dominated in the SFI group, and the most common origin for the studied population was Asia followed by Africa (Syria, Iraq, Afghanistan, Somalia). Elementary school education, as the highest achieved, was reported by 61%.
Tinnitus was reported by 38% of the immigrants, 30% were reported as mild problems and 8% as severe problems. The corresponding prevalence in the general population was 17% and 3%.
Hearing in conversational turns was reported with no difficulties by 81%, and with difficulties by 17% and a further 2% with hearing aid use. In the general Swedish population, the report was 86%, 11% and 4%.
At pure-tone audiometry and the definition of hearing loss by a pure-tone average (PTA_4) >25 dB in the better ear, 9% had mild, 3% moderate, and 3% severe hearing loss. High frequency hearing loss (PTA_{h3} >25 dB) was present in 39% of the SFI attendees. Hearing loss was more pronounced for the respondents reporting tinnitus.
Conclusion
Severe tinnitus was found to be three times more common in the immigrant population undergoing Swedish language education, compared to the general population. Hearing loss, high-frequency hearing loss and self-reported ill health were significant predictors for tinnitus. It is of utmost importance that both tinnitus and hearing loss/problems be identified and screened for. They can hamper learning a new language and can be alleviated by counselling, adjustments in the educational setting and by rehabilitation.

61 - Tinnitus Treatment and Healing from Home

Corrie Holmes [(1)] - Jenn Holst [(1)] - Jennifer Gans [(2)]
Idaho State University, Communication Sciences and Disorders, Audiology Program, Pocatello, United States [(1)] - Mindfulness Based Tinnitus Stress Reduction Developer, Private Practice - Clinical Psychologist, San Francisco, United States [(2)]

Background: Around the globe, 740 million adults experience tinnitus (Jarach et al., 2022). Tinnitus, often a chronic condition, may not always be bothersome, however recent studies have suggested that 120 million individuals perceive it as an issue (Jarach et al., 2022). For those with severe, bothersome tinnitus, quality of life is reduced and the treatment options may be limited. Those with bothersome tinnitus may experience other symptoms such as annoyance, anxiety, depression, sleep issues, and difficulty concentrating (Bhatt, Bhattacharyya, & Lin, 2017; Folmer, Griest, Meikle, & Martin, 1999; Halford & Anderson, 1991). Interventions such as sound therapy, behavioral therapy and education help individuals cope and the tinnitus may become less bothersome. Common evidenced based behavioral interventions include Tinnitus Retraining Therapy (TRT), Cognitive Behavioral Therapy (CBT), Progressive Tinnitus Management (PTM), and Acceptance and Commitment Therapy (ACT). Each intervention utilizes behavior modifications with or without sound therapy. Another evidenced based intervention typically used to treat a variety of other conditions such as chronic pain or anxiety is Mindfulness Based Stress Reduction (MBSR). MBSR is a treatment program where participants learn to apply non-judgmental awareness and acceptance of chronic symptoms by incorporating meditation, mindful movement, psychoeducational support, and daily home practice. MBSR is effective at reducing distress of chronic conditions (Rosenzweig et al., 2010) and it has been adapted for other conditions such as depression (Williams, Teasdale, Segal, & Soulsby, 2000).
A modified version of MBSR, Mindfulness Based Tinnitus Stress Reduction (MBTSR) is a management tool for individuals with chronic tinnitus. This program utilizes components of mindfulness-based stress reduction (MBSR) with the addition of a tinnitus component. In the pilot study conducted by Jennifer Gans (2013), results illustrated the effectiveness of MBTSR on tinnitus perception using a traditional in-person format. A subsequent study has since been conducted by Jennifer Gans et al, in which MBTSR was provided in an online format.
Purpose: The purpose of this presentation is to explore the effectiveness of an internet delivered Mindfulness Based Tinnitus Stress Reduction (i-MBTSR) program. The research sought to determine if there was a meaningful and statistically significant change in tinnitus intrusiveness after treatment. Furthermore, were the changes retained at the 6-month follow-up.
Method: This study examined the data collected from an online i-MBTSR course using a retrospective design. The intervention included an 8-week self-paced i-MBTSR course, including didactic information about mindfulness and tinnitus, as well as meditation practices. Outcome measures included the Tinnitus Functional Index (TFI) and Perceived Stress Scale (PSS), which were measured at four time periods. The time points included pretreatment, mid-treatment at 3 weeks, immediately post-treatment, and at 6-month follow-up.
Results: Participants were recruited internationally and a total of 677 individuals enrolled in the course with 577 providing some initial data. There were 43 participants who completed the intervention. The mean pre-intervention tinnitus severity rating was 59.96 (Severe tinnitus) as measured by the TFI. Mean TFI scores dropped to 44.16 ($p < .001$) at mid-treatment and to 34.23 ($p = .001$) at post-treatment. Repeated-measures analysis of variance and multivariate analysis of variance tests were conducted to determine changes in the two scales at the four time periods. There were significant differences in perceived stress and tinnitus severity found in all measures and submeasures between the pre-, mid-, and post-treatment time points with the exception of the TFI Auditory subtest. These gains remained significant for those who completed the 6-month follow-up. Additionally, study findings were evaluated from a clinically meaningful perspective deemed as a difference of 13 points or more on TFI scores (Miekle et al., 2012). Out of the 94 participants who completed the pre- to mid- assessment, 44% had clinically meaningful improvements. Among the 43 participants who completed the pre- to post- TFI assessment, 72% experienced clinically meaningful improvements.
Conclusions: The i-MBTSR course appears to be a viable and effective treatment modality and may be an option for individuals around the globe. A shorter course may also be effective. Case-control studies to more systematically investigate the effectiveness of i-MBTSR for tinnitus are required. Based on the positive results of this study, the iMBTSR program is currently in the process of being translated into Spanish, therefore increasing access to treatment.

Keywords: tinnitus, mindfulness, online tinnitus treatment

38 - Telemedicine solutions for tinnitus patients

Piotr H. Skarżyński [(1)] - Aleksandra Kołodziejak [(2)] - Natalia Czajka [(2)] - Henryk Skarżyński [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(3)]

Background**:** Telemedeicine is a form of medical and healthcare delivery that combines elements of telecommunicatins, IT and medicine. The first applications of information technology in medical care appeared at the end of the 19th century, while the first recorded case in the early 20th century concerned the transmission of ECG data over a telephone network. The USA is the country where the first steps in modern telemedicine were taken. In 2000, Prof. Henryk Skarzynski and his team developed and implemented a modern telemedicine program in Poland. One of the first telemedicine consultation programmes was implemented, in which the ear image in the form of video-otoscopy was sent via the Internet to other centres.
As we know tinnitus can have a big impact in your quality of life and has many causes. Diagnosis is a key element in helping a person with tinnitus. Another important element is providing ongoing support to help the patient cope with everyday situations.
Material and methods**:** Telemedicine solutions that may be useful for tinnitus sufferers were examined in our study. We have analysed the solutions available on the Polish and foreign markets and selected those that could be useful for tinnitus patients.
Results**:** As a result of our research, we have highlighted tools that can be useful for people with tinnitus. Patients can have their hearing tested using mobile diagnostic equipment. We found only one smartphone app dedicated to people with tinnitus, offering a combination of sound therapy, relaxation exercises, meditation and guidance. A device called a tinnitus sound generator (TSG) is available that delivers sound to the ear to 'mask' the perceived tinnitus. There are also devices that take advantage of neural plasticity by targeting a specific area of the brain associated with tinnitus production. The patient qualifies for these therapies on the basis of a medical history and a completed and signed questionnaire. The patient uses the devices at home according to a schedule.
Conclusions**:** Tinnitus has many causes, so a reliable and detailed diagnosis is very important. Tinnitus can interfere with normal daily functioning. Persistent tinnitus leads to a reduced quality of life. It can lead to isolation from the world around you and problems with sleep and concentration. Unbearable ringing in the ears can cause anxiety, stress and even depression. It is very important to continue to research tinnitus and to provide comprehensive care for those affected. We believe that more work needs to be done on tools to support the daily functioning of people with tinnitus.

Key words: • telemedicine • tinnitus • telemedical solutions

PERSON-CENTERED CARE

10 - Experiences of adults with undiagnosed or "hidden" hearing loss seeking hearing healthcare

Aryn Kamerer [(1)] - Makenzie Meadows [(1)] - Cassidy MacFarlane [(1)] - Brittan Barker [(1)]
Utah State University, Communicative Disorders and Deaf Education, Logan, United States [(1)]

Background: 5-10% of adults who seek hearing healthcare for significant hearing concerns will receive a diagnosis of “normal hearing”. Not surprisingly, the majority of these patients leave their evaluation appointment dissatisfied with their diagnosis and with few recommendations from their healthcare provider. What we know about the experience of these patients during the evaluation appointment is from the perspective of hearing healthcare providers. In the present study, we gathered stories from patients with undiagnosed hearing concerns about their experiences seeking hearing healthcare.
Methods: We conducted semi-structured narrative interviews with 15 adults from across the United States. Participants were included if they had at some time seen a hearing healthcare provider for concerns about their hearing, and were not given a diagnosis of hearing loss or other medical reason to explain their concerns. Participants were provided with a prompt to tell the story of when they saw a healthcare provider for their hearing concerns and then answered several follow-up questions. Four researchers conducted thematic analysis of the interview transcripts to uncover salient themes that spanned patient experiences.
Results: Three themes emerged from the patient dialogues: (1) dismissive healthcare providers, (2) misalignment of patient concerns and assessment protocols, and (3) doctor shopping. The most salient theme was dismissal of patient concerns by their healthcare providers. Experiences of provider dismissal ranged from misjudgment by providers that no diagnosis of hearing loss would be good news for the patient to overtly dismissive behaviors such as eye-rolling. The second theme uncovered issues with diagnostic assessment protocols. Interviewees stated that the tests they were given seemed inadequate for addressing their concerns and very few interviewees indicated they were given a speech-in-noise assessment despite telling their provider their primary complaint was difficulty understanding speech in noise. Finally, many patients engaged in “doctor shopping” or continuing to seek answers from other hearing healthcare providers when they were not given a satisfactory diagnosis or treatment plan.
Conclusions: Understanding experiences of patients when seeking hearing healthcare is crucial for improving audiological care. Our findings suggest that hearing healthcare providers may not be following recommended guidelines for best practice and may be relying too heavily on audiometric results for their clinical decisions regarding diagnosis and treatment. All three themes revealed the need for patient-centered approach that follows a biopsychosocial model of care.

Keywords: hidden hearing loss; interview; healthcare

56 - Hearing Loss and Patient Reported Experience (HeLP): Using Patient Experience to improve audiological care

Helen Pryce [(1)] - Sian Lickess [(1)] - Georgina Burns-O'Connell [(1)] - Saira Hussain [(1)] - Nisha Dhanda [(2)] - Rachel Shaw [(3)] - Rebecca Knibb [(3)] - Amanda Hall [(1)] - Melanie Ward [(4)] - Laura Turton [(5)] - Jean Straus [(6)]
Aston University, Audiology, Birmingham, United Kingdom [(1)] - University of Birmingham, Public Health, Birmingham, United Kingdom [(2)] - Aston University, Psychology, Birmingham, United Kingdom [(3)] - HCRG Care Group, Hearing Therapy and Audiology, Bath, United Kingdom [(4)] - NHS Tayside, Audiology, Dundee, United Kingdom [(5)] - NIHR, Applied Research Collaborative, London, United Kingdom [(6)]

The Hearing Loss and Patient Reported Experience study is an National Institute of Health Research Health Service and Delivery Research funded programme in the NHS in the UK (grant no NIHR 131597), sponsored by University Hospitals Bristol and Weston NHS Trust and delivered with Aston University and the University of Bristol.

Background: Hearing loss will affect 1 in 2 of us. There is typically no cure and in most cases people are given hearing aids which amplify all sounds, making it difficult to distinguish between them. To learn to hear through hearing aids takes time and effort. We consider this 'work'. Up to 40% of people reject hearing aids and find the work of getting used to them more difficult than the work of living with hearing loss. We recognise that this trade off represents a logical reaction on the part of patients.

Aims and Objectives: We aim to understand the features of the work of living with hearing loss ('illness work') and the work of accessing & living with hearing aids ('treatment work') are. This knowledge will enable us to develop a tool to capture patient work. In doing so we inform services about what is particularly challenging about using their services & treatments. This will lead to changes in how services are delivered that means they support their patients' needs better.

Methods: We present a pluralist study using qualitative methods to develop a theoretical model of patient experience based on interview data and interpretative synthesis of published literature.

Results: This presentation will present findings from two studies to help us understand what the experience of living with hearing loss and help-seeking is. What is helped and what is currently missing. We will include findings from a large-scale systematic review of 75 articles from across the world and a large scale qualitative investigation of what it is like to live with hearing loss in the UK.

66 - Development and validation of the first Patient Reported Experience Measure (PREM) for people with hearing loss: the PREM HeLP

Sian Smith [(1)] - Helen Pryce [(1)] - Georgina Burns-O'Connell [(1)] - Rebecca Knibb [(2)] - Rosemary Greenwood [(3)] - Rachel Shaw [(2)] - Saira Hussain [(1)] - Jonathan Banks [(4)] - Amanda Hall [(1)] - Jean Straus [(1)] - Sian Noble [(5)]
Aston University, College of Health & Life Sciences, School of Optometry, Department of Audiology, Birmingham, United Kingdom [(1)] - Aston University, College of Health & Life Sciences, School of Psychology, Birmingham, United Kingdom [(2)] - University Hospitals Bristol and Weston NHS Foundation Trust, Department of Research and Innovation, Bristol, United Kingdom [(3)] - National Institute for Health Research, Applied Research Collaboration West (NIHR ARC West), University Hospitals Bristol and Weston NHS Foundation Trust, Bristol, United Kingdom [(4)] - University of Bristol, School of Social and Community Medicine, Bristol, United Kingdom [(5)]

The Hearing Loss and Patient Reported Experience study is an National Institute of Health Research Health Service and Delivery Research funded programme in the NHS in the UK (grant no NIHR 131597), sponsored by University Hospitals Bristol and Weston NHS Trust and delivered with Aston University and the University of Bristol.

Background**:** Hearing loss is a common chronic health condition and adversely affects communication and social function resulting in loneliness, social isolation and depression. Understanding the daily illness and treatment burdens experienced by people with hearing loss is important in improving service provision. There is growing support for the use of self-report, validated questionnaires in assessing the quality of healthcare. While patient reported outcome measures (PROMs) are routinely used in audiology, there are currently no validated patient-reported experience measures (PREMs) to capture the impact of living with hearing loss alongside experiences of audiology care.
Aims**:** We aim to develop, pilot and validate the first PREM to understand patients' experiences of living with hearing loss alongside their interactions with audiology services (the PREM-HeLP). The PREM will be developed using co-design principles that bring together patient and
staff experience and relevant stakeholder input.
Methods**:** We present three key phases of the development and validation of the PREM-HeLP: (1) development of PREM prototype, (2), cognitive interview testing of the PREM prototype using a 'think aloud' approach to assess its acceptability, and (3) psychometric testing of the modified PREM with 300 participants to assess the reliability and validity of the tool using Rasch analyses with sequential item reduction. Participants were recruited from three NHS clinical sites located in England (Bath, Bristol) and Scotland (Tayside) and non-clinical settings (e.g., lip reading classes, residential care settings, national charity links, social media).
Results**:** This presentation will present the results of each key phase. This will include the process of generating PREM items using methodological triangulation of findings from our large-scale qualitative work of what it is like to live with hearing loss across the life course, and a systematic review of international evidence focused on the lived experience of hearing loss. Results from our cognitive interview study will shed light on the face and content validity of the items. Finally, our survey findings will identify whether the dimensionality of the tool can be ignored in favour of a much shorter form that might have better uptake when used within a clinical setting.
Conclusion**:** We hope the PREM-HeLP can be used in audiology practice to facilitate staff to understand the patient perspective and to identify specific needs that could improve tailored care e.g. referral to Hearing Therapy; lipreading classes; assistive listening devices etc.

Key words: Patient reported experience measure (PREM), survey, hearing loss, audiology, lived experience, validation

250 - The history and future of Person-Centred Hearing Care

Mark Laureyns [(1)] - Lidia Best [(2)]
Amplifon, Centre for Research and Studies CRS, Milano, Italy; Thomas More University College, Audiology, Antwerp, Belgium [(1)] - EFHOH - European Federation of Hard of Hearing People, Board, Houten, Netherlands [(2)]

Background and Aim:
In the WHO World Report on Hearing, Person-Centred Care is strongly recommended. We analysed the history of Person-Centred Care and Person-Centred Hearing Care and suggest how to implement this better in the future.
Method:
We did a search to find the most relevant publications on Person-Centred Care (PCC) and Person-Centred Hearing Care (PCHC). For both topics we evaluated the evidence for the following questions:

- When was PCC first introduced and where are we now?
- Does PCC lead to better health outcomes?
- Is PCC the best approach for all patients?
- When was PCHC first introduced?
- Is PCHC implemented widely?
- How do we see the future of PCHC?
- What is the users' point of view?

Results:

- When was PCC first introduced and where are we now? The oldest publication we found was Rogers in 1046.
- Does PCC lead to better health outcomes? We found careful positive conclusions, such as improved overall health outcomes, clinical effectiveness, healthcare utilisation, treatment adherence, and self-management or self-efficacy.
- Is PCC the best approach for all patients? Stewart (2001) states: "patient centred, means that you also individualise and take the patients preference for information and for shared decision making into account."
- When was PCHC first introduced? The oldest publication we found was Stephens and Hétu in 1991.
- Is PCHC implemented widely? We still have a long way to go, so far the implementation is limited, but we see a slow improvement.
- How do we see the future of PCHC? PCHC needs to be an essential part of audiology education and practice, but more quality research and systematic reviews need to be conducted.
- What is the users point of view? Lidia Best, the president of EFHOH shares her vision on this topic.

Conclusions:
Compared to PCC, we need to step up, in order to achieve better hearing health outcomes, clinical effectiveness, hearing care utilisation, treatment adherence, and self-management or self-efficacy.

278 - Uzbekistan's model of specialized care for children with hearing loss – 9 years of implementation

F.I. Inoyatova [(1)] - J.A. Rizaev [(2)] - V. Primako [(3)]
Head of program of rehabilitation for children with hearing loss, Tashkent, Uzbekistan [(1)] - Samarkand State Medical University, Samarkand, Uzbekistan [(2)] - Republican Specialized Scientific Practice Medical Center of Pediatrics, Tashkent, Uzbekistan [(3)]

The issue of hearing impairment and cochlear implantation is of global significance. According to the WHO data, 466 million people worldwide have disabling hearing loss, including 34 million children. Hearing loss leads to enormous economic losses, estimated as high as $750 billion annually on a global scale. Cochlear implantation (CI) has been recognized as a cost-effective solution to solve this problem in many countries. This work presents a 9-year experience in organizing specialized care for children with hearing impairments through cochlear implantation in the Republic of Uzbekistan. The aim of the study was to evaluate the results of CI program in Uzbekistan.
Materials and Methods: Over a 9-year period from 2014 to 2023, 2,102 CI surgeries were performed on children from all regions of Uzbekistan. The age of children at the time of CI and the waiting time for surgery had significant changes during this period. CI operations were carried out by specialists from the Republican Specialized Scientific and Practical Medical Center of Pediatrics using speech processors.
Results: According to research, the need for CI in Uzbekistan is over 2,000 children, considering the incidence of hearing impairment at 2 cases per 1,000 newborns and an annual increase of 85-170 cases of children with this pathology. The mean age of children during the CI program period decreased from 4.6 years in 2014 to 1.3 years in 2023, and the waiting time for surgery was reduced from 5 years in 2014 to 4 months in 2023 due to the introduction of the CI program at the Pediatric Center and the implementation of the State CI program. Prior to CI program, the level of neuropsychological development in children did not correspond to the age norm in 100% of cases in 2014 and in 61.8% of cases in 2023. After undergoing the personalized hearing-speech rehabilitation program developed by Center specialists, the speech development of children corresponded to their age in 81.2% of cases in 2014, 88% in 2015, and 91.4% in 2016.
Conclusions: The CI program demonstrated high social effectiveness: of all the children operated on during the period 2014-2016, 89.3% were successfully adapted and socialized due to comprehensive support and rehabilitation. Thus, the cochlear implantation program in Uzbekistan has proven highly effective, allowing children with hearing impairments successfully adapt and integrate into society.

Keywords: children, cochlear implantation, program organization

OUTCOME OF EDHI PROGRAMS (2)

118 - Audit of the newborn hearing screening system: rationale and results

Gaziz Tufatulin [(1)]
Center of Pediatric Audiology; St Petersburg Scientific ENT Research Institute; North-Western State Medical University named after I.I.Mechnikov, ENT, St Petersburg, Russian Federation [(1)]

The Russian national model of newborn hearing screening (NHS) includes two steps: (1) otoacousctic emissions (OAE) – based universal screening of all the newborns in maternity wards or community clinics and (2) auditory brainstem response diagnostics in audiology centers for babies who failed OAE or have risk factors. This NHS model was implemented in 2008, but still the overall coverage of the newborns by screening is 88.6% (2022), only 19% of the children with hearing loss were diagnosed before 3 months, only 5.4% of children started their intervention program before 6 months.

Goal**:** To reveal the weaknesses, problems and develop the strategy of improvement NHS in St Petersburg.

Materials and methods**.** The audit program was performed in 2020 and in 2023 years. The audit methodology included visits in maternity wards, pediatric hospitals with newborn intensive care unit and community clinics to check the key indicators of NHS good practice and collecting filled report forms from them.

To evaluate the key indicators the checklist was developed:

- At least 1 OAE device working appropriately,
- No more than 1 year since the last calibration procedure,
- Staff is certified on the NHS topic,
- Appropriate testing conditions,
- Appropriate personnel's skills on testing children,
- Appropriate documenting of the results and information exchange.

During the audit workshops and lectures for the pediatricians and nurses were also performed. Some methodological and technical problems with equipment and screening procedure were solved during the inspection.

In 2020 year 78 medical institutions were visited by audiologists: 16 maternity wards and pediatric hospitals, 62 community clinics. In 2023 year the audit was performed again, totally 81 medical institutions were inspected (21 maternity wards and pediatric hospitals and 60 community clinics).

Results**.** After the audit in 2020 year it was find out that only 14% of inspected institutions meet the checklist criteria of good practice. The rest 86% of the institutions had the following common problems:

- Necessity of renovation the screening equipment – 61% of devices are older than 7 years,
- Untimely calibration – 20% of devices,
- Discontinuity in the testing process (6% in maternity wards, 69% in community clinics),
- Absence of certificates in staff – 27% in community clinics,
- Violations in methodology and testing conditions,
- Problems with results' documenting.

The key NHS results in St Petersburg improved after the audit program in 2020. The NHS coverage rate increased from 89.6% (2019) to 96.5% (2020). Follow-up rate (to the 2nd stage of NHS) increased on 18%.

The audit program in 2023 showed that 36% of institutions meet the good practice criteria: 33% of maternity wards and 37% of community clinics. The common problems are mostly the same as in 2020:

- Necessity of renovation the screening equipment – 69% of devices are older than 7 years,
- Untimely calibration – 53% of devices,
- Absence of certificates in staff.

On the other hand, repeated audit showed that problems with violations in methodology and testing conditions, discontinuity in the testing process and with results' documenting became less common comparing with 2020.

Conclusion**.** NHS isn't a self-regulating system. Assessment of the screening program is useful and important tool of improving audiology care services. It helps to reveal problems and develop the management strategies. The audit of NHS system in St Petersburg led to increase the coverage rate and follow-up rate. Repeated audit showed the improvement in following good practice (the number of institutions who met criteria is doubled in 3-years period). Therefore, the audit should be performed on the regular basis.

169 - Cultural and linguistical diversity in early hearing detection and intervention programs: Family and service provider perspectives

Hayley Wong [(1)] - Jane Sheehan [(2)] - Valerie Sung [(2)] - Stephanie Best [(3)] - Greg Leigh [(1)]
Macquarie University, NextSense Institute, Sydney, Australia [(1)] - Murdoch Children's Research Institute, Prevention Innovation, Melbourne, Australia [(2)] - University of Melbourne, School of Health Sciences, Melbourne, Australia [(3)]

Few studies have investigated the challenges for families from CALD backgrounds in accessing the hearing screening and diagnostic components of Early Hearing Detection and Intervention (EHDI) programs. This study explored the experiences of families from CALD backgrounds in their engagement with the Victorian Infant Hearing Screening Program (VIHSP) and Victorian diagnostic audiology services. Specifically, the aims of this study were to (a) examine factors experienced by families from CALD backgrounds that enabled or impeded their engagement in hearing screening and diagnostic audiology services, and (b) explore service providers' experiences of supporting families from CALD backgrounds.
We conducted an exploratory qualitative study using semi-structured interviews with both families and service providers. Data were analysed using inductive content analysis. Thirteen parents and twelve service providers participated. Overall, parents expressed satisfaction with the services provided, and reported that using interpreters, having family support, and seeking additional resources from the Internet enabled engagement in services. Lack of interpreters, parental emotions and anxiety, lack of family support and logistics (e.g., transportation) were all barriers that families encountered in accessing services. Service providers identified several issues that resulted in differences in service delivery, communication, and support needs for families from CALD backgrounds, compared with families from English-speaking backgrounds. Perceived barriers included communication difficulties, cultural factors and external influences, logistical and financial concerns, and the COVID-19 pandemic.
Parents and service providers reported different barriers and enablers to engaging with hearing screening and diagnostic audiology services. Findings from this study will inform the provision of support services throughout the infant hearing screening and diagnostic pathway for families from CALD backgrounds.

Keywords: culturally and linguistically diverse (CALD), hearing loss, newborn hearing screening

DIGITAL SOLUTIONS

173 - HearChoice Online: improving help-seeking, informed choice and decision-making in hearing healthcare

Melanie Ferguson [1] - Ellen Bothe [1] - Bec Bennett [2] - Barbra Timmer [3] - Kerry Sherman [4] - Bronwyn Myers [1] - Piers Dawes [3]
Curtin University, enAble Institute, Perth, Australia [1] - National Acoustic Laboratories, Audiological Science, Sydney, Australia [2] - University of Queensland, Audiology, Brisbane, Australia [3] - Macquarie University, Psychology, Sydney, Australia [4]

Objectives Despite a high prevalence of hearing loss, and evidence that hearing aids are clinically effective, the uptake of hearing healthcare is low. This due to numerous barriers including poor knowledge of help-seeking and decision-making, which can be addressed with the provision of clear online information. Guided by theories of behaviour change and implementation science, this Australian government-funded research aims to develop and evaluate an online, interactive, and modular decision-support intervention, called HearChoice. This is designed to increase informed decisions, help-seeking, and uptake of hearing healthcare for adults with hearing loss (AHLs). HearChoice will meet IPDAS (International Patient Decision Aid Standards) by providing choice awareness, pros and cons, and option clarification of both device and non-device options. The overall aim is to empower AHLs by offering them informed choice and control to assist in decision-making throughout their hearing journey. Design There are four work packages: (i) understanding needs, barriers, and enablers, (ii) co-development of HearChoice, (iii) evaluation of clinical effectiveness using a randomised controlled trial, plus a health economic evaluation, and (iv) co-design of an implementation plan to facilitate future scale-up and sustainability. The results from the first two work packages (WP) will be presented here.
For WP1, there were three sub-studies. First, 19 key stakeholders representing the Australian audiology landscape (professional bodies, hearing care professionals and providers, advocacy groups, adults with hearing loss, device manufacturers, policy makers) were engaged to ensure the research meets stakeholder's needs. Second, a qualitative study of semi-structured interviews with AHLs (n=16), and two focus groups of hearing care professionals (HCPs, n=9) obtained views on barriers and enablers for help-seeking and decision-making. Deductive thematic analysis was conducted, based primarily on the COM-B model of behaviour change, but also on the CFIR (Consolidated Framework for Implementation Research). Third, two online surveys of AHLs (n=300) and HCPs (currently ongoing) were conducted to gain a broader set of views on barriers and enablers, in addition to preferred features of the online HearChoice intervention.
For WP2 (ongoing), findings from WP1 and community and consumer involvement (CCI) workshops are currently informing co-design workshops to iteratively develop HearChoice. Results The stakeholder workshop resulted in a co-designed target statement to explain the 'what?' and 'how?' of the research, which obtained 100% consensus. Importantly, this workshop has also harnessed strong stakeholder 'buy-in' from the Australian hearing community. Qualitative data from focus groups with AHLs and HCPs led to the identification of key barriers: lack of knowledge on signs and impacts of hearing loss, where to go to get help, benefits of rehabilitation, alternatives to hearing aids including non-device options, costs and funding (Capability); difficulty understanding information in appointments, other health and personal issues, mismatch between the audiogram and perceived hearing difficulty (Opportunity); hearing loss as something to just live with, discouraged by lack of information, belief that hearing aids are ineffective, stigma of hearing loss (Motivation). In addition, AHLs interviewed reported they were not aware of hearing health options other than hearing aids. The majority of AHLs and HCPs supported the concept of HearChoice. The most salient barriers and enablers from the survey of AHLs included cost, a belief that hearing difficulties are not severe enough to warrant help, availability of information, and trust, with 65% or more of participants agreeing with all these items. The most important pieces of information were cost and funding, with 86% rating these as "extremely" or "very" important. AHLs also identified a hearing screening test, a questionnaire to guide decision-making, and printable information for AHLs to take to their health and hearing care professionals to be important features. 74% of participants of those surveyed reported support for HearChoice. Conclusions There is a clear need for additional support to enable active help-seeking and informed decision-making for adults with hearing loss. HearChoice will provide information on the full range of hearing care options,and assist in help-seeking and decision-making. Further, HearChoice could address the primary barriers, in particular (i) capability by providing hearing intervention options via provision of accessible information about availability, benefits and limitations of hearing interventions; and (ii) motivation, by addressing beliefs around low efficacy of hearing aids and the stigma of hearing loss.

Key words: decision-making, help-seeking, informed choice, behaviour change

107 - Towards a novel classification of noise haters and distortion haters with a mobile measure of individual listening preferences

Giulia Angonese [(1)] - Mareike Buhl [(2)] - Jonathan A. Gößwein [(3)] - Birger Kollmeier [(4)] - Andrea Hildebrandt [(1)]
Carl von Ossietzky Universität Oldenburg, Department of Psychology, Psychological methods and statistics lab, Oldenburg, Germany [(1)] - Institut Pasteur, Université Paris Cité, Inserm, Institut de l'Audition, Paris, France [(2)] - Fraunhofer Institute for Digital Media Technology (IDMT), Branch for Hearing, Speech and Audio Technology (HSA), Oldenburg, Germany [(3)] - Carl von Ossietzky Universität Oldenburg, Department of Medical Physics and Acoustics, Oldenburg, Germany [(4)]

Background: Proper hearing aid fitting is crucial for user's satisfaction and listening comfort. Therefore, individual traits of listening preferences should be considered during the fine-tuning stage. People have been shown to have variable preferences for setting noise reduction algorithms that improve signal-to-noise ratio (SNR) but introduce signal distortion. "Noise haters" prefer greater noise reduction, even at the expense of signal quality. "Distortion haters" accept higher noise levels to avoid signal distortion. So far, these preferences have been considered stable across time in laboratory test-retest measurements and individuals were classified based solely on their trait scores. This study aims at evaluating the psychometric quality of a novel mobile measure of listening preferences for noise vs. distortion. We will evaluate inter- and intra-individual variability of listening preferences over intensive longitudinal measures. Information on state-trait variance will improve the classification of noise haters and distortion haters.
Methods: A noise-distortion trade-off task was part of an Ecological Momentary Assessment (EMA) study with N=185 (106 f, M_{age}= 63.1, SD_{age}= 6.5) unaided individuals who reported subjective hearing difficulties. The mobile task compared individual preferences in three listening conditions: 1) simple linear gain vs. gain at the expense of clipping distortions with 2) general and 3) adaptive SNR ranges. Baseline assessment included questionnaires on sound preferences and hearing habits (SP-HHQ), noise sensitivity (WNSS) and personality (NEO-ffi). The same task was included in the EMA (2 weeks on workdays, morning and evening), along with measures of hearing performance (DTT). Latent State-Trait Autoregressive (LST-AR) modelling framework was used to evaluate the stability of listening preferences and explore temporal dependencies between consecutive observations. The model has been extended to Mixture LST-AR for a data-driven classification of noise and distortion haters.
Results: Individual listening preferences show considerable state-related variance, which amounts on average to 77% of the overall variance observed. This large intra-individual variability is however non-systematic. Temporal dependencies between consecutive observations (autoregressive effects) were nearly zero. Intra- and inter-individual variability was then used for a data driven classification by means of a Mixture LST-AR model. Three latent classes were identified based on the mean trait, in accordance with previous literature: noise haters, distortion haters and intermediate. In addition, we could further differentiate classes of individuals with stable versus unstable listening preferences. Individual factors that could explain the latent classes will be discussed, with a particular focus on the relationship with objective hearing performance and subjective reports of hearing preferences.
Conclusion**:** To our knowledge, this is the first study to use a mobile task to measure listening preferences for noise vs. distortion in everyday life over multiple days. The observed intra-individual variability provides novel insights into the classification of noise haters and distortion haters. Assessing individual listening preferences along the noise-distortion trade-off and accounting for their day-to-day variability could improve the individualisation of hearing aid fitting. Moreover, a more satisfying hearing aid experience could be facilitated by providing the user with mobile self-adjustment options that are informed by such preference measurements.

Keywords: listening preferences, noise-distortion trade-off, ecological momentary assessment, mHealth

88 - Using an auditory model and a deep neural network for hearing loss compensation

Peter Asbjørn Leer Bysted [(1)] - Jesper Jensen [(2)] - Lars Bramsløw [(1)]
Oticon, Eriksholm Research Centre, Snekkersten, Denmark [(1)] - Demant A/S, Eriksholm Research Centre, Smørum, Denmark [(2)]

Computational models of hearing have been used for research in normal and impaired hearing in academia and studied in industry to inspire hearing aid design. But the potential of applying them directly in hearing aid design for e.g. addressing the 'cocktail party' problem has never been fulfilled. The present project aims at applying these auditory models directly for training a deep learning (DL) algorithm to provide individualized hearing-loss compensation (HLC) and noise reduction (NR), thus paving the way towards fully neural- and AI-based hearing devices. In this study, we propose a DL-based closed loop approach for hearing loss compensation, which is trained on the outputs of hearing-impaired and normal hearing auditory models in response to speech signals.
This project encompasses three essential components for the creation of such a hearing device:
An auditory model emulator. For reasons of computational speed and backward-propagation training, an auditory model cannot be used directly in the closed loop training. Hence, a deep neural network was trained to emulate an auditory nerve model (Zilany, Bruce & Carney, 2014) for a range of speech signal, sound pressure levels and hearing losses (audiograms). A new cost function was designed to accommodate for the very large dynamic range across input levels, frequencies, and hearing losses.
A deep neural network for hearing loss compensation. The proposed compensation network was added in front of the hearing-impaired auditory model emulator and the emulator outputs from the normal and impaired branches were compared and trained to minimize the difference in a dedicated cost function.
A noise reduction system using the same deep neural network but being trained with a noise-free reference, hence a perceptually relevant noise reduction may be obtained. The noise reduction and hearing loss compensation can be combined via joint training.
The performance of the system has been evaluated by inspecting gain and output. Furthermore, listening tests with 12 hearing impaired listeners have been conducted: word recognition in noise using the Danish Hearing In Noise Test (HINT) test and sound quality rating using a variant of the Multiple Scaling with Hidden Reference and Anchor (MUSHRA) method.
The results demonstrate that the proposed approach results in feasible hearing loss compensation strategies. Our proposed approach was shown to provide an increase in speech intelligibility and was found to outperform the conventional approach in terms of perceived speech quality. Thus, the proposed DNN-based approach might hold great potential in improving the quality of life for people with hearing loss.

Index Terms: auditory modelling, deep learning, hearing loss compensation, amplification

8 - Automating the development procedure of the digits-in-noise test using text-to-speech and automatic speech recognition systems

Sigrid Polspoel [(1)] - Sophia E. Kramer [(1)] - Cas Smits [(2)]
Amsterdam UMC, location VUMc, Otolaryngology – Head and Neck Surgery, Ear & Hearing, Amsterdam, Netherlands [(1)] - Amsterdam UMC, location University of Amsterdam, Ear and Hearing, Amsterdam Public Health Research Institute, Amsterdam, Netherlands [(2)]

Background
Developing a speech-in-noise test is a time-consuming and expensive task that requires expert knowledge. The digits-in-noise (DIN) test, for instance, is a commonly used test that uses digit triplets presented in speech-shaped noise to measure the speech recognition threshold (SRT). The construction of the DIN test first involves recording high-quality speech material and creating matching masking noise. Next, speech recognition functions of each digit are constructed based on a listening experiment with normal-hearing listeners to determine the level corrections needed to achieve equal intelligibility among the digits. Then, the new digits-in-noise test is constructed from the level-corrected digit stimuli. Because the speech stimuli are language-specific, the test must be developed and validated separately for each language.
Objectives
The ultimate goal of this study was to drastically shorten and simplify the development procedure of the DIN test by using artificial intelligence (AI) techniques. Specifically, we studied whether text-to-speech (TTS) and automatic speech recognition (ASR) systems could replace human speakers and listening experiments without sacrificing the quality of the DIN test. This AI-based procedure is referred to as “Aladdin”: Automatic LAnguage-independent Development of the Digits-In-Noise test”.
Study design
The study consists of four parts. **Part I**: synthetic speech material (digits, words and sentences) was created using Google Cloud TTS in 5 languages (Dutch, French, English, Spanish and Mandarin) and its subjective speech quality was rated in a remote listening experiment with 50 participants with corresponding native languages. **Part II**: A listening experiment with 24 normal-hearing listeners was conducted where they performed the DIN test with a synthetic and natural voice. Speech recognition functions for synthetic and natural Dutch digits were obtained to determine human reference level corrections for each digit. **Part III**: The natural and synthetic digits in noise were fed to different ASR systems to determine speech recognition functions for each digit. The derived level corrections were then compared to those based on human listeners (see Part II). Next, the ASR system of which the level corrections resembled the human level corrections the most was selected and these corrections were applied to the synthetic digits. **Part IV,** New English and Dutch DIN tests were fully automatically developed using the Aladdin procedure. In a listening experiment with 28 normal-hearing and 20 hearing-impaired listeners, these versions were compared to the original DIN test in Dutch and English.
Results
Part I: Both the synthetic and natural voices were considered to be of high speech quality, with an average MOS score of over 4 (i.e., good to excellent). This was consistent for all three types of speech material in both quiet and noise, and for all languages. **Part II:** The reference speech recognition functions were determined. The mean SRTs and the mean slopes of the synthetic and natural digits did not differ significantly. The derived level corrections of the synthetic voice and natural voice were strongly correlated (r = 0.95). **Part III**: Level corrections derived by off-the-shelf, cloud-based ASR were not correlated with the ones obtained by humans. FADE, an ASR-system that mimics human auditory behavior, yielded speech recognition functions similar to the ones obtained by humans. The FADE-based and human-based level corrections were strongly correlated for both the natural (r = 0.88) and synthetic digits (r = 0.96). **Part IV:** In the group of hearing-impaired listeners, the SRTs of the Aladdin-test and original DIN test were significantly correlated in both the Dutch (r = 0.87) and English version (r = 0.91) of the test. In the normal-hearing group, the Aladdin-test SRTs were slightly but significantly lower (better) than the SRTs of the original test in both the Dutch and English version, with an average difference of 1.55 and 0.7 dB, respectively. The test-retest variability of the original and Aladdin test were similar for both languages and in both groups.
Conclusions
The development procedure of the digits-in-noise test can be considerably shortened by using synthetic speech for the creation of the speech material and by using an appropriate automatic speech recognition system to determine and equalize the intelligibility of the digits. The results of the AI-based DIN (Aladdin-test) are comparable to the results of the original DIN.

AMPLIFICATION – TECHNOLOGIES AND STRATEGIES

42 - A novel consumer-centric metric for evaluating hearing device audio performance

Vinaya Manchaiah [1] - Steve Taddei [2] - Abram Bailey [3] - De Wet Swanepoel [4] - Hansapani Rodrigo [5] - Andrew Sabin [2]
University of Colorado School of Medicine, Department of Otolaryngology–Head and Neck Surgery, Aurora, United States [1] - Hear Advisor LLC, NA, Chicago, United States [2] - Hearing Tracker Inc, NA, Austin, United States [3] - University of Pretoria, Department of Speech-language Pathology and Audiology, Pretoria, South Africa [4] - University of Texas Rio Grande Valley, School of Mathematical and Statistical Sciences, Edinburgh, United States [5]

Objective*:* The emergence of direct-to-consumer (DTC) hearing devices has introduced the need for users to be well-informed for optimal device selection. Currently, no established metric offers insights into the overall audio performance of these devices. This study aimed to introduce and assess a novel consumer-centric metric (i.e., SoundScore) for hearing device sound quality based on the overall audio performance.
Method*:* A novel consumer-centric metric of hearing device sound quality "HearAdvisor SoundScore" was developed (Sabin et al., 2023). Each hearing device is tested with two complete fittings (combination of parameters and acoustic coupling). The "Initial Fit" is designed to approximate the most likely fitting for an individual with a moderate sloping sensorineural hearing loss. The "Tuned Fit" included adjusting parameters optimized to hit NAL NL2 targets on an acoustic manikin. For each fitting, we evaluated performance over 5 dimensions (i.e., speech intelligibility in quiet and moderate, speech intelligibility in loud, own voice does not sound boomy, music streaming sounds good, and does not feedback). The 10 component scores (5 dimensions x 2 fits) were combined into a single number (the "SoundScore") using a weighted average with weights derived from user and clinician surveys. Forty-one hearing devices were tested including prescription hearing aids (Rx HA; n=10), self-fitting over-the counter hearing aids (OTC-SF; n=10), preset over-the-counter hearing aids (OTC-PS; n=8), and personal sound amplification systems (PSAPs; n=13) using this method.
Results*:* The SoundScore varied significantly ($F=9.88$, $p<0.001$) between the hearing devices with Rx-HA yielding the highest average scores and the PSAPs the lowest. SoundScore also varied significantly ($F=34.9$, $p<0.0001$) between hearing devices based on adjustment paradigm where fitting software was the highest and on-device preset control was the lowest. Rx-HA and OTC-SF had considerable variation in Initial Fit metrics, but the variability reduced substantially for Tuned Fit metrics. No significant difference ($t=0.13$, $p=0.9$) in SoundScore was found between devices of different form factors (i.e., BTE vs ITE). An increasing-and-saturating relationship was found between SoundScore and hearing device price where SoundScore increased with the device price until $1000-1500 and then saturated.
Conclusions*:* Preliminary findings suggest that the SoundScore can effectively distinguish between the overall audio performance of different hearing aids, offering consumers a valuable decision-making tool. Future studies should examine the relationship between the SoundScore and hearing aid benefit/satisfaction for lab subjects and real world users.

Key Words: Hearing aids, Consumer metrics, Sound quality

75 - The impact of hearing aid amplification on gait parameters during dual-task situations

Ann-Kristin Seifer [(1)] - Kaja Strobel [(2)] - Julia Warmuth [(2)] - Ronny Hannemann [(2)] - Björn Eskofier [(1)]
Friedrich-Alexander-Universität Erlangen-Nürnberg, Machine Learning and Data Analytics Lab (MaD Lab), Artificial Department in Biomedical Engineering (AIBE), Erlangen, Germany [(1)] - WS Audiology, Audiology, Erlangen, Germany [(2)]

Background**:** Hearing loss has been linked to challenges beyond hearing, including gait instability. Hearing impairments are associated with slower walking speed and shorter step length, contributing to a higher risk of falling. In literature it was argued that individuals with hearing loss might allocate more attention to acoustic perception, resulting in fewer cognitive resources for walking and mobility. Additionally, there is growing evidence that auditory feedback may play an essential role in controlling gait. While previous studies identified gait differences between individuals with normal hearing and those with hearing loss, the impact of hearing aids (HAs) on gait parameters in people with hearing loss remains underexplored. We hypothesize that wearing HAs to compensate for hearing disability might indirectly restore normal walking behavior because the cognitive demand for understanding decreases, releasing more resources for motion control.
Methods**:** We investigated the effect of HA amplification on gait parameters during cognitive dual-task scenarios in individuals with hearing loss. Dual tasks were selected to simulate real-world environments and increase cognitive demand, making effects related to cognitive demand more apparent [7]. Our study included 24 participants with hearing impairment (age 67 $\pm$ 16 years, BMI 25.1 $\pm$ 3.8, 21 % females, mild to severe hearing loss, PTA4 40.7 $\pm$ 15.6 dB). Conventional HAs (Signia Pure312 AX, WS Audiology) with an integrated accelerometer sampling at 50Hz were used to capture motion data. HAs were fitted using the NAL-NL2 prescription procedure [8] (adult, experienced user, vented sleeves, 100% acclimatization level). Two programs were configured, one with amplification (ON) and one without (OFF). Only the motion data of the right HA was recorded. Participants completed three walking tasks: single-task walking, an arithmetic dual-task (subtracting 3, starting from 100 while walking), and an acoustic dual-task (the Freiburger monosyllabic speech test while walking [9]). For the latter, a calibrated soundbox attached to a backpack worn by the participant was used (65dB). Each walking task was performed with HA amplification ON and OFF, resulting in six distinct conditions. For each task, participants walked up and down a 35-meter corridor. Gait parameters were estimated using EarGait, an open-source Python package developed for gait analysis with ear-worn sensors using signal processing techniques and machine learning algorithm. We concentrated on gait speed, step length, and stride time, as these are the most important parameters for fall risk.
Results and Discussion**:** No significant differences in gait parameters were observed between hearing aid ON and OFF conditions in the dual-task scenarios. Our hypothesis that individuals with hearing loss might adapt their walking style in complex acoustic environments due to an increased cognitive load was hence not proven. We also did not observe any difference between the ON and OFF condition for the single task (just walking). Therefore, our findings did not support our assumption that individuals with hearing loss might adapt their walking style because of missing auditory feedback from their footsteps.
Comparing gait parameters in single and dual-task situations, we observed significant differences, with slower gait speed and shorter step length during dual-task conditions. These results align with existing literature for dual-task scenarios. Moreover, our study also demonstrated the effectiveness of EarGait in capturing relevant gait-related changes, providing an unobtrusive measurement system for future studies on hearing loss and physical health. While arithmetic dual-tasks are common, no standardized acoustic dual-task exists. Using the Freiburger monosyllabic word test as a dual-task revealed gait changes comparable to arithmetic dual-tasking. This indicates the potential of the Freiburger test for assessing the additional acoustic cognitive costs during walking. However, further research is required to substantiate these initial findings.
Conclusion**:** In conclusion, our study suggests that in controlled laboratory environments, the mere usage of an HA may not exert a discernible impact on gait parameters. However, it is crucial to acknowledge potential differences in real-world situations, as laboratory conditions may not fully replicate the complexities of daily life. Further research is needed to investigate the influence of HA amplification on gait in ecologically valid environments and to elucidate the role of auditory feedback in dual-task scenarios. Understanding these dynamics can contribute to developing more effective interventions for individuals with hearing loss, ensuring optimal auditory and motor functioning in everyday activities.

Keywords:Gait Analysis, Motion Sensor, Accelerometer, Dual-Task situations,

119 - Paediatric amplification protocol, based on individualization of the hearing aids' fitting parameters

Gaziz Tufatulin [(1)] - Vladimir Dvoryanchikov [(2)] - Sergey Artyushkin [(3)] - Yuri Yanov [(3)]
Center of Pediatric Audiology; St Petersburg Scientific ENT Research Institute; North-Western State Medical University named after I.I.Mechnikov, ENT, St Petersburg, Russian Federation [(1)] - St Petersburg Scientific ENT Research Institute, ENT, St Petersburg, Russian Federation [(2)] - North-Western State Medical University named after I.I.Mechnikov, ENT, St Petersburg, Russian Federation [(3)]

Background**.** There are no paediatric amplification clinical practice guidelines in Russia at the moment. At the same time the technological progress of hearing aids' (HA), new algorithms and functions requires the objective evidence of safety and effectiveness for the hearing impaired children. For these reasons paediatric amplification algorithm was developed by the authors. Besides the standard procedures the algorithm includes an objective electroacoustic verification of the output parameters and separate HA functions. The research is devoted to the investigation of the protocol's advantages.
Goal: development and evaluation the paediatric amplification protocol, based on objective electroacoustic verification of the output and functions of hearing aid.
Materials and methods**.** Prospective, randomized, controlled clinical trial was performed. Two protocols' effectiveness were compared. Standard protocol (control group) is based on the subjective verification. Experimental protocol suggests an electroacoustic verification of the output and different HA functions: feedback cancellation, amplitude and frequency compression, microphone directionality, digital noise reduction (experimental group). Each group included 56 children (3–17 years old) with permanent hearing loss from moderate to moderately-severe degree. Initial amplification was performed for each child; the results were estimated in 1, 3 and 6 months using PEACH and LIFE questionnaires, speech audiometry and phoneme testing. DataLogging and first fitting appointment time were also estimated.
Results**.** In preschool-age children of the experimental group post-amplification PEACH results were 6% better than in controls. In school-age children (LIFE questionnaire) results were 11% better comparing with control group. Speech intelligibility in quiet was 3.1% ($p > 0.05$) higher for pre-schoolers in the experimental group and 9.3% ($p < 0.01$) higher for school-age children comparing with control group. Speech intelligibility in noise was higher in experimental group than in control: 7.8% ($p < 0.05$) in pre-schoolers and 13% ($p < 0.01$) for school-age children. Phoneme recognition was better in experimental group as well: 4.5% ($p < 0.05$) in pre-schoolers and 9.8% ($p < 0.01$) in school-agers than in control group. After HA fitting following an experimental protocol DataLogging time was 11–12% longer in comparison with standard procedure. On the other hand, experimental protocol took in average 1.5 hours for the first fitting and standard protocol — 53 minutes.
Conclusion**.** Protocol of paediatric amplification based on objective electroacoustic verification of HA output and functions allows to significantly increase the effectiveness of hearing rehabilitation in children.

Keywords: paediatric amplification, hearing aids, verification, real ear measurements

190 - Impact of COVID-19 on Paediatric Hearing Device Use: A Quantitative Study

Stephanie Thai [(1)] - Vivian Tran [(1)] - Libby Smith [(2)] - Valerie Sung [(3)] - Peter Carew [(2)]
The University of Melbourne, Audiology, Melbourne, Australia [(1)] - Murdoch Children's Research Institute, Murdoch Children's Research Institute, Melbourne, Australia [(2)] - The Royal Children's Hospital, The Royal Children's Hospital, Melbourne, Australia [(3)]

Background: The COVID-19 pandemic has caused unprecedented changes to the lives of all children. For children with hearing loss, the impacts of these changes on hearing device use during the pandemic are unknown. This study aimed to describe caregiver-reported hearing device use trends during the COVID-19 pandemic in a population-based sample.
Methods: The study population (n=299) comprised of children aged 0-18 years within the Victorian Childhood Hearing Longitudinal Databank (VicCHILD). VicCHILD's Advisory Group, composed of child hearing health stakeholders, meets annually to discuss research directions, and VicCHILD consults participant parents on VicCHILD's research priorities. In mid-2020, parents and caregivers were surveyed on their child's hearing device use both prior to and during the early weeks of the pandemic. They survey was repeated in 2021 to collect data on mid-pandemic hearing device use. Caregiver reports of hearing device use were analysed to determine if different patterns of hearing device use were observed during the COVID-19 pandemic compared to pre-pandemic.
Results: In school-aged children, daily hearing device use significantly reduced at early- (9.89 hrs, SD= 5.51) and mid-pandemic (9.88 hrs, SD=5.04) from pre-pandemic levels (11.06 hrs, SD=4.22), $p < .001$. Factors associated with greater reported hearing device use prior to the pandemic for school-aged children were bilateral loss, greater degree of hearing loss and higher chronological age. Maternal education level and education program were not associated with daily hearing device use in school-aged children.
In preschool-aged children, no significant difference in hearing device use was observed pre- versus during the pandemic. Maternal education level and degree of hearing loss were not associated with hearing device use in preschool-aged children.
Conclusions: There is a clear association between the COVID-19 pandemic and a reduction in hearing device use in school-aged children with hearing loss. This has implications for provision of supports during adverse childhood experiences.

Keywords: Deaf and hard of hearing children, COVID-19, Hearing aids, Cochlear implants

80 - Determining factors of hearing aids outcome

Fabien Auberger [1]
Amplifon, Paris, France [1]

Above 50% of the French hearing impaired population is now equipped with hearing aids (HAs). While this therapeutics has been increasingly financed by public and private insurances, it becomes critical to rigorously evaluate hearing aids outcome and identify factors guaranteeing a true benefit for the patient.
Our database included 77,000 patients with symmetric hearing loss and all hearing aids outcomes. Big data analyses performed on this database.

1. Allocation of patients to one of the 11 audiological clusters pre-defined (supervised methodology based on Dubno work on phenotypes)
2. Evaluation of HAs outcome per cluster based on speech in noise & speech in quiet improvement (% of patients improved ; average improvement level…).
3. Determining factors for higher outcome : HA technology ; personnalised fitting ; follow up
4. Audiological profiles of « low performers » and possible alternative/complementary therapeutics

140 - Investigating Time Constants for Optimizing Bimodal Hearing Aid Fittings

Megan Quilter [(1)] - Nikki Mutter [(2)] - Neil Wright [(1)]
GN Hearing A/S, Global Audiology, Ballerup, Denmark [(1)] - GN ReSound, Medical Channels, Minneapolis, United States [(2)]

Introduction

Bimodal hearing involves using both a cochlear implant (CI) and a hearing aid (HA) in opposite ears to enhance auditory perception. Bimodal users report improved speech perception, a strong preference for bimodal stimulation in various environments (both quiet and noisy) and increased environmental awareness.[1-4] Despite bimodal users reporting high levels of satisfaction, challenges in speech perception persist, especially in noisy conditions.

Understanding the significance of time constants in bimodal patient fittings is essential to address these challenges effectively. Time constants play a pivotal role in fine-tuning hearing aids for bimodal patients, influencing aspects such as auditory balance, speech perception, comfort, and overall satisfaction with their hearing solution. Consequently, it becomes essential for audiologists and clinicians to carefully assess and adjust these time constants as an integral part of the fitting process for bimodal patients.

Currently, there is a lack of definitive guidance regarding the programming of time constants for bimodal hearing instrument fittings. The intent of this investigation is to explore and determine the most effective time constants for bimodal fittings, with the goal of improving everyday listening experiences and enhancing user satisfaction.

Methods

The clinical, observational investigation ensures that the results obtained have clinical relevance, scientific validity, and address the clinical investigation objectives. In randomized order, participants speech recognition scores are obtained in both quiet and noise, under different time constant conditions. Ecological Momentary Assessment (EMA) is used as a real-time approach for monitoring users' behaviors, emotions, and experiences related to their hearing aids and cochlear implants in their daily lives and are recorded.

Results

This research aims to explore and determine the most favorable time constants for bimodal hearing device settings by examining potential correlations between time constant settings and speech recognition scores. Additionally, it aims to assess how these settings influence daily listening experiences and overall user satisfaction. Data analysis and full results will be reported once complete.

Conclusion

Overall, the findings of this research provide important insights into the relationship between time constants and whether they influence aspects such as auditory balance, speech perception, comfort, and overall satisfaction with their hearing solution. This research will also provide further guidance when setting up bimodal hearing solutions.

Keywords: bimodal, hearing aid, cochlear implant, compression, ecological momentary assessment

TECHNOLOGY UPDATE (1)

60 - Developing a clinically viable cortical assessment package for evaluating aided benefit

Amanda Goodhew [(1)]
International Clinical Trainer, Interacoustics Academy, Middelfart, Denmark [(1)]

Newborn hearing screening programmes have resulted in earlier diagnosis of permanent childhood hearing impairment and correspondingly earlier intervention such as the provision of hearing aid amplification and / or cochlear implantation. The benefits of early intervention are well understood however there remains a challenge in the process of validating the success of amplification in young infants. There has opened up a larger time gap between the point of amplification provision and the availability of behavioural testing, leading to lengthier periods of time before which validation can be performed behaviourally. In recent years, cortical auditory evoked potential (CAEP) testing (also known as cortical evoked response audiometry, or CERA) has begun to be used in the aided condition in order to assess young infants' access to speech sounds via their hearing aids, however many challenges have remained which need to be overcome in order to ensure this tool is clinically accurate and viable. These issues include: questions regarding the most appropriate type of stimuli to use for aided cortical testing and how such stimuli are calibrated to best represent real-life speech; challenges with test time duration for a population with limited attention span; difficulties in accurately identifying cortical morphology from the wide variety of waveforms recorded in infants and young children; and a need for a more effective and efficient method of monitoring the freefield environment.
The development of a clinically viable aided cortical assessment package will be discussed, including the optimization of the stimuli used for aided cortical testing, the development of an accurate and fast objective assessment of the likelihood of response detection, and the enhancement of both software and hardware in order to create a clinic-friendly platform as part of the Interacoustics Eclipse evoked potentials device. It is expected that this test package will have a powerful clinical utility for young infants and their care-givers, in being able to provide early reassurance of the effectiveness of the amplification provided. Additional potential clinical applications include cochlear implant patients and older patients (both children and adults) with additional or complex needs who cannot accurately perform behavioural validation testing. The experiences and feedback of clinicians using this assessment package will be shared.

Keywords: cortical, evoked, potentials, validation, aided

50 - Unveiling the Future: Exploring the Latest TV Streaming and Auracast Advancements

Lotte Hernvig [(1)] - Derya Ceylan Schjerlund [(1)]
GN Hearing, Global Audiology Development, Ballerup, Denmark [(1)]

TV listening is known to be one of the most difficult scenarios for people with hearing loss. Even with the state-of-the-art hearing aids this scenario continues to be challenging. With a TV accessory that can stream sound from the TV directly to the hearing aids, speech recognition improves and listening effort decreases. TV streamers have been on the market for more than a decade, but continuous improvements on hardware design and software features to provide added benefit to the users are needed.
BLE Audio stands for Bluetooth Low Energy Audio. It is a new technology that enhances the performance of Bluetooth audio, adds support for hearing aids, and introduces Auracast™ broadcast audio.
With GN' s latest hearing aid launch the devices now include the new Bluetooth protocol. The new TV Streamer+ is the next generation of this kind of device and introduces improved audio quality including BLE Audio and by supporting Bluetooth Hearing Aid Profile (BT-HAP). Finally, the new TV-Streamer+ is Auracast compatible and ready for future broadcasting to other compatible Auracast devices, not only hearing aids, but also other headsets and earbuds.
LE Audio also offers multi-streaming, which allows for multiple audio streams between Bluetooth devices.
Auracast broadcast audio is a new Bluetooth technology that will enable users to easily connect to a broadcast signal. This can be transmitted as a signal from a TV streamer as part of an integrated hearing system or publicly available broadcast signals like TV screens and/or audio signals in public spaces like in airports, theatres, or churches. Using Auracast is made easy with a new interface in the Smart 3D app where users can search for and connect to any available Auracast signal as well as making the broadcast available for other to connect to. In this case more people with hearing aids can benefit from using the same TV streamer.
Since the new TV Streamer+ is BLE Audio compatible it is possible to pair to a mobile device and the Smart 3D app. When paired it is possible to access streamer settings in the app. The new features available includes access to '*Mono/Stereo*' settings, '*Auracast*' signal privacy, '*Sound Delay' settings* and other edit options.
The new TV Streamer+ has a new design which includes an improved fit on wall-mounted TVs due to slimmer/smaller design and size. Furthermore, simpler user interface compared to legacy TV Streamer was achieved by eliminating cumbersome user interaction on the small hearing aids and improving the user interface for pairing on the streamer itself.
This presentation will include a walkthrough of the new features of the TV Streamer+ as well as a demo of the easy paring process and the added benefits to the user accessible thought the app. Streamer signal selection from the app will also be demonstrated. Data from internal testing will show that that test participants/users find the new TV-Streamer+ easy to set up, pair and use as well as hardware preference testing.

Keywords: New technology, TV Streamer, Bluetooth Low Energy Audio, Auracast

TECHNOLOGY UPDATE (2)

136 - Use of a portable, enhanced Auditory Brainstem Response device with reduced sensitivity to physiological artifacts and extraneous noises in young children with congenital Cytomegalovirus, in the child's home and hospital audiology department

Fleurtje A.J. Schornagel [(1)] - Wim Soede [(2)] - Ann C.T.M. Vossen [(1)] - Anne Marie Oudesluys-Murphy [(3)]
Leiden University Medical Center, Medical Microbiology, Leiden, Netherlands [(1)] - Leiden University Medical Center, Otorhinology, Leiden, Netherlands [(2)] - Leiden University Medical Center, Willem-Alexander Children's Hospital, Leiden, Netherlands [(3)]

Objective:
This study evaluated the use of a portable enhanced ABR device which is less sensitive to physiological artifacts and extraneous noises than more traditional ABR devices. The Vivosonic Integrity™ (Vivosonic Inc., 222-5535 Eglinton Avenue West Toronto, ON, M9C 5K5, Canada) was chosen because of its new signal processing technologies, improved amplification and Bluetooth wireless connection, with its ability to realize conclusive hearing thresholds, defined as a clear and reproducible response of wave V. Infants with hearing loss and a congenital cytomegalovirus infection (cCMV) were studied in the nationwide CONCERT-study (ClinicalTrials.gov Identifier: NCT02005822). The effect of six weeks valganciclovir antiviral therapy on sensorineural hearing loss was assessed, with as the primary endpoint the change in hearing level between baseline (within two months of birth) and follow-up at the age of 20 months. It was not considered ethically and medically acceptable to perform Auditory Brainstem Response (ABR) audiometry under sedation or general anesthesia. Furthermore, it was considered fitting that the ABR tests would be carried out in the child's home to minimize hospital visits. The Vivosonic Integrity™ ABR device was chosen for the follow-up. Up to then this device had not been used in the Netherlands.
Design:
As part of the study protocol, parents of 37 children enrolled in the CONCERT-study were offered a follow-up home visit, which included hearing testing with the Vivosonic Integrity™ ABR at the age of 20 months. The ABR tests were performed by a physician trained in the use of the Vivosonic Integrity™ under supervision of an experienced audiologist who also reviewed all outcomes. A conclusive result was defined as the ability to determine a hearing threshold with a clear and reproducible wave V. During the ABR test the state of the child was noted as well as the circumstances.
Results:
Of the 37 children in the follow-up of the CONCERT- study, hearing of 31 was assessed with the Vivosonic Integrity™. Six children were not assessed, (five with bilateral cochlear implants and one where ABR had been performed during general anesthesia for other reasons).
The Vivosonic Integrity™ was used during home visits in 20 children, (mean age 20.9 ± 1.3 months). Both ears were tested in 16 children, one ear in four (three with a unilateral cochlear implant and one due to restlessness and coughing). Of the 36 ears tested during home visits, 33 ears (92,1%) were successful at the first attempt and the remaining three ears at a second attempt.
Eleven CONCERT-study children (mean age 22.1 ± 4.6 months) were tested with the Vivosonic Integrity™ at the hospital audiology department, ten at the parents' request and one when a home visit was impossible due to transport problems. Eight were tested in both ears and three in one ear (two had unilateral cochlear implants and a third had otitis media with effusion in one ear). All tests were successful at the first attempt. During ABR testing with the Vivosonic Integrity™ most children, both during the home and hospital visits, were on the parents' lap or sitting/lying on a couch while watching television, eating, drinking or talking with the parent. During home visits four very restless children (crying, pulling leads, removing inserts and/or coughing) were tested successfully.
Conclusions:
Our study on the use of the Vivosonic Integrity™ in a home setting is the first of its kind. The device was simple to use and child- and parent- friendly. It is portable, easy to set up, no sleep deprivation or other preparations are necessary prior to the ABR test. Apart from the professional performing the ABR test no other personnel are needed. The parents had no prior experience with the Vivosonic Integrity™ and expressed surprise that it was possible for the child to eat, drink, watch television or talk to the parents while the ABR test was being carried out. Our experience with the Vivosonic Integrity™ shows that it is possible to test young children in a child- and parent-friendly way in an environment such as the child's home. It is probable that the Vivosonic Integrity™ device, or other devices with a similar design, will make ABR testing easier, safer, quicker, cheaper and more acceptable, especially in difficult-to-test children.

211 - CHORD: A Phase 1/2 Open-Label Trial to Evaluate Intracochlear Administration of DB-OTO Gene Therapy in Pediatric Patients with Profound Sensorineural Hearing Loss Due to Biallelic Otoferlin Mutations

Vassili Valayannopoulos [(1)]
Regeneron Pharmaceuticals, Inc., Auditory Sciences and Rare Disease, Tarrytown, United States [(1)]

Background**:** Otoferlin is a calcium-sensing protein involved in inner hair cell vesicular transport and exocytosis, a process critical for inner hair cell signal transmission to afferent auditory nerve fibers. Biallelic mutations in the otoferlin gene (OTOF) typically produce auditory neuropathy characterized by prelingual severe-to-profound sensorineural hearing loss. In these patients, the auditory brainstem response (ABR) is absent or severely reduced with normal outer hair cell function as indicated by the presence of otoacoustic emissions (OAE). Although cochlear implants are effective, replacement of the otoferlin gene is hypothesized to provide instatement of natural, physiologic, and high-quality hearing. DB-OTO is a dual adeno-associated virus (AAV1) vector with a Myo15 promoter that drives inner hair cell-selective expression of cDNA for human OTOF. Nonclinical GLP studies with intracochlear DB-OTO have been completed in otoferlin-deficient mice and in non-human primates to inform the clinical dose and safety. In this first-in-human clinical trial with DB-OTO (CHORD), the safety and preliminary efficacy of DB-OTO administered by intracochlear injection is evaluated in pediatric patients with profound hearing loss caused by OTOF mutations.
Methods**:** Pediatric patients (≤2 years of age in Spain, UK; <18 years of age staggered by age in the US) with biallelic pathogenic OTOF mutations and profound sensorineural hearing loss (≤90 dB HL) will be enrolled. Eligible patients will have experienced minimal benefit from amplification and meet the cochlear implantation criteria in the ear to be injected with DB-OTO. Present outer hair cell function is confirmed via the presence of OAE (patients ≤2 years of age) or cochlear microphonic (patients >2 years and <18 years of age). Patients with a history of prior treatment with gene therapy, anatomy that would preclude the planned surgical approach, or the presence of cochlear implants (CI) in the ear to be injected with DB-OTO are excluded. In Part A, the initial dose escalation phase of the study, DB-OTO will be administered unilaterally by intracochlear injection through the round window using a typical facial recess approach similar to CI surgery. In part B, an expansion cohort will receive bilateral DB-OTO administration with the selected dose in Part A. After administration of DB-OTO, patients are assessed for safety (labs, vital signs, antibody and shedding assays, physical exams, otoscopy, tympanometry, DPOAEs, vestibular assessments) and efficacy (ABR, behavioral audiometry, speech audiometry, hearing-related questionnaires) over a 5-year follow-up period.
Results**:** This trial has begun enrolling patients globally. Available safety and efficacy results in patients dosed by January 2024 will be presented.
Conclusions**:** We report on the trial design of a first in human, Phase 1/2 gene therapy trial with DB-OTO in pediatric patients with otoferlin related hearing loss. The trial is actively enrolling, and key initial safety and efficacy results will be presented.

Keywords: Otoferlin, CHORD trial, DB-OTO

260 - Our experience in measurements with SmartNav System

Vigen Bakhshinyan [(1)] - Gayane Sargsyan [(2)] - Gegham Khandanyan [(2)] - George Tavartkiladze [(1)] - Akira Ishiyama [(3)]

Russian Medical Academy of Continuing Professional Education, Department of Clinical Audiology, Moscow, Russian Federation [(1)] - Yerevan State Medical University, ENT, Yerevan, Armenia [(2)] - UCLA School of Medicine, Otolaryngology, Otology-Neurotology, Los Angeles, United States [(3)]

Aim**:** The new Nucleus SmartNav is a wireless system (an iPAD app and a surgical processor) from “Cochlear”, Australia. It provides the diagnostic measurements to confirm the device integrity, auditory system response and supports post-operating fittings. For surgeons it gives the additional information that the electrode array is properly placed (angular insertion depth measurement, speed of insertion and placement check functions).
The goal of our study was to prove that a new system can replace the standard clinical computer set-up for cochlear implant intraoperative ECAP measurements and is equivalent in measuring electrode impedances.
Material and methods**:** A prospective between subject comparison study was conducted with 57 test ears (31 males and 25 females aged from 9 m-38 y.o., 1 patient was implanted simultaneously bilaterally) whom cochlear implantation was performed at Erebouni Medical Centre, Yerevan, Armenia in 2021-2023. 38 ears were implanted with Nucleus CI532, 16 ears with CI632 and with CI612, CI622 and CI522 – two and one ear, respectively. The ECAP threshold measurements (via AutoNRT algorithm) were performed intra-operatively using both the Nucleus SmartNav system and the standard clinical system (CS EP) and compared.
Results**:** In all cases ECAP thresholds were measured successfully intraoperatively with both tested systems. To compare the results of ECAP threshold measurements obtained with SmartNav and the Custom Sound system the Wilcoxon Signed Ranking Test was used. It was shown that results obtained with the use of both systems were not differ within a clinically acceptable range. ECAP thresholds were correlated closely between the two measurement systems (r is tending towards +/- 1).
The comparison of the electrode impedance measurements results obtained with the use of both systems revealed a visible difference at basal electrodes (E1-8) but the difference was statistically not significant ($p>0.05$).
During the Placement check measurement tip-fold over was diagnosed in 3 cases, and in all cases re-insertion of the electrode array was successfully performed in the operating room.
Conclusions**:** The new Nucleus SmartNav system provides equivalent electrode impedances and ECAP threshold registration results, including success of making measurements, compared to the standard clinical set-up. The additional information provided by SmartNav system (angular insertion depth measurement, speed of insertion and placement check functions) will give more opportunities to increase the efficiency of cochlear implantation.

Posters

P01 - AMPLIFICATION – TECHNOLOGIES AND STRATEGIES

P01.1

58 - Analysis of knowledge held by Brazilian speech therapists about the Evaluation of Auditory Responses to Speech battery

Cilmara Levy [(1)] - Lucia Kazuko Nishino [(2)] - Thamirez Santos Silva Ribeiro do Val Bello [(3)] - Thais Rodrigues Talarico [(4)]
ISCMSP, Speech therapy, São Paulo, Brazil [(1)] - ISCMSP, Audiology, São Paulo, Brazil [(2)] - Medel, Speech therapy, Sao Paulo, Brazil [(3)] - private office, Speech therapy, Sao Paulo, Brazil [(4)]

Introduction: Technological advances related to hearing technologies have helped children with hearing loss to hear better, however, monitoring the development of hearing and language skills is necessary. Objective: This presentation deals with an analysis of the knowledge on the part of Brazilian speech therapists about the EARS Battery, which presents nine protocols for evaluating the development of auditory skills and speech perception in children who are deaf or hard of hearing can use hearing aids,or/and cochlear implants. Method: This is a quantitative and qualitative, descriptive cross-sectional study. Data collection was carried out using the Google Forms form in a digital environment. The questionnaire consisted of 13 questions, four of which were freely chosen and related to the professional's profile and eight related to the use of protocols and knowledge and/or use of protocols proposed by the EARS Battery. 67 respondents took part in this study Results: The vast majority (70%) work directly in auditory rehabilitation. 85% serve both children and adults. 41% works both in private and public services. 92% refer to applying protocols in the evaluation or follow-up, both formal and informal. Most consider important the use of assessment protocols and monitoring of auditory and language skills in children who are deaf or hard of hearing, and 92% consider that there is a lack of validated protocols.
Conclusion: The tests most used by Brazilian speech therapists are MUSS, MAIS /IT MAIS and GASP. The vast majority of professionals use more than one protocol at the time of evaluation, monitoring or even during rehabilitation. There is a need for further validated protocols and studies to help inform hearing healthcare professionals and provide robust reliable data, where assessing the effects of auditory stimulation on the development of listening and oral language skills in young children who are deaf or hard of hearing remains a challenge.

Keywords: hearing loss, cochlear implants, hearing aids, protocols

P01.2

72 - Hearing at the mall food court: Multibeam processing technology improves hearing group conversations in a real-world setting

Paula Folkeard [(1)] - Niels Søgaard Jensen [(2)] - Homayoun Kamkar Parsi [(3)] - Sascha Bilert [(4)] - Susan Scollie [(1)]

University of Western Ontario, National Centre for Audiology, London, Canada [(1)] – WS Audiology, Hearing and Fitting Solutions, Lynge, Denmark [(2)] – WS Audiology, Signal Processing Algorithmic Research & Neural Networks, Erlangen, Germany [(3)] – WS Audiology, Sound and Fitting Platform, Erlangen, Germany [(4)]

Purpose: An evaluation of two different beamforming strategies in a real-world food court environment in a busy mall using participant reports of conversational success.
Research Question: Does the intervention strategy provide different conversational success than the comparison strategy during a group conversation as rated by the participants in a real-world environment?
Methods: Participants: Twenty experienced hearing aid wearers with sensorineural hearing loss (age range: 61-84 years) were fitted in the lab with binaural receiver-in-the-canal style hearing aids programmed with two settings, one for each beamforming strategy. The intervention setting was based on a new commercially available multibeam processing technology that uses a rear-facing beam to reduce background noise and multiple front-facing beams steered to different directions that contain speech. The comparison setting was created by deactivating the multibeam processing, so it included a rear-facing beam to reduce background noise and an adaptive monaural beamformer activated by speech signals arising from the front.
The participant and two researchers met in a moderately noisy and reverberant food court at a local mall which is a documented NORC (Naturally Occurring Retirement Community) where the participant was asked to listen to a conversation between the two researchers. Participants rated the extent of their agreement with ten positively worded statements specific to the conversation twice, once for each setting. Participants then provided program-preference ratings for seven different aspects of a conversation during which the programs were switched back and forth by the researcher so that participants were unaware of the condition to which they were listening. Participants provided per setting as well as preference ratings on dimensions such as understanding, clarity, focus, listening effort, sound quality, loudness and background noise awareness.
Results**:** Real-world subjective ratings for all domains resulted in positive values on average for both beamforming strategies. Pairwise comparisons indicated that the intervention algorithm had higher absolute ratings on five of the ten criteria including understanding, clarity, focus, listening effort and background noise. Ratings for preference between strategies indicated a significant preference for the intervention algorithm for all seven criteria.
Conclusion**:** In a real-world setting, both beamforming strategies provided positive subjective ratings following a turn-taking group conversation. However, the adaptive multi-beam processing technology that accounts for the locations of interlocutors and the natural head turning that occurs during a conversation significantly influenced preference for all aspects rated for this group of older adult hearing aid wears.

Keywords: Adult, Hearing Aids, Hearing Loss, Conversation, Beamforming, Directional microphones, Ecological Validity

P01.3

87 - The use of the Multidimensional Fatigue Scale (PedsQL) to evaluate hearing fatigue in children/adolescents with unilateral hearing loss

Amanda Scheffer [(1)] - Heloisa de Miranda Cantuária Alves [(1)] - Maria Fernanda Capoani Garcia Mondelli [(1)]
University of São Paulo, Audiology and Speech Therapy, Bauru, Brazil [(1)]

Introduction: Fatigue is a common symptom in our society, however some individuals, especially those with disabilities can feel it more sharply and severely. Thus, it is believed that children with unilateral hearing loss also experience fatigue, since their binaural signals are reduced, which may affect areas such as education, speech recognition in noise, cognitive and language skills.
Objective: this study aimed to compare the responses of children with unilateral sensorineural hearing loss and their parents regarding auditory effort and to verify whether, if present, this effort is improved by the use of hearing aids.
Materials and methods: 13 patients, aged 7 to 16 years, diagnosed with unilateral sensorineural hearing loss, of severe and profound degree and their relatives, were invited to answer the PedsQL ™ 4.0 scale before and after hearing aid fitting. All children were already hearing aid users, however, to participate in the research, a new selection and adaptation of devices were performed with the algorithm -Speech Guard- in order to favor speech recognition in noise.
Results: There were no significant differences between groups according to statistical analysis. Conclusion: It was possible to observe that although the children reported more pre-adaptation fatigue than their parents, they observed greater improvement after the adaptation of the hearing aid.

Keywords: Unilateral hearing loss; Hearing Fatigue; Questionnaire, Children, Parents.

P01.4

142 - Harmony in Hearing: Unveiling the Revolutionary Bimodal Nucleus Smart App for an Enhanced Auditory Experience

Amanda Speers [(1)] - Nicola Willmot [(1)] - Megan Quilter [(2)] - Nikki Mutter [(3)] - Kate Pick [(4)]
Belfast Auditory Implant Centre, Clinical Cochlear Implant, Belfast, Ireland [(1)] - GN Hearing A/S, Global Audiology, Ballerup, Denmark [(2)] - GN ReSound, Medical Channels, Minneapolis, United States [(3)] - GN Hearing, NW EU, Nordic Region, Belfast, Ireland [(4)]

Introduction
This research project aims to explore the user interaction dynamics with the recently introduced Bimodal control within the Cochlear™ Nucleus® Smart app (NSA). The primary focus lies in gaining comprehensive insights into end users' experiences, emphasizing the ease of navigation and the optimization of bimodal amplification. By employing qualitative and quantitative research methods, the study seeks to unravel user preferences, challenges, and overall satisfaction levels associated with the novel bimodal control within the NSA. The findings from this research endeavor are expected to inform advancements in user-centric design and contribute to the ongoing enhancement of bimodal hearing technologies, ultimately fostering an improved auditory experience for individuals with cochlear implants and hearing aids.
Methods:

- A cohort of 10-20 experienced bimodal users are recruited for the trial. Encompassing individuals who have prior familiarity with bimodal hearing systems and have not used the new Bimodal control within the NSA.
- Clinicians are introduced to the Bimodal control within the NSA to-solicit initial feedback on functionality and usability.
- Participants are guided through an orientation process, introducing them to Bimodal control. Participants are provided with the necessary information about the app's features and functionality. Following the orientation, participants will install the app on their smartphones and initiate.
- Participants engage with the Bimodal control for a duration of 2-3 weeks in their daily lives. During which, they are encouraged to incorporate the app into their regular bimodal amplification routines.
- Upon completion of the trial period, participants are administered a survey to gather comprehensive feedback. The survey encompass' questions regarding their experiences with the Bimodal control including comparisons to prior experiences without the app.
- The study will conclude after the 3-week app utilization period.

Results
Data is in the process of being collected from all survey responses, and the analysis will identify patterns, preferences, and challenges faced by participants. The insights obtained will contribute to the understanding of user interactions with the Bimodal control within the NSA, facilitating the refinement of the app and informing future developments in bimodal hearing technology.
Conclusions
In summary, while this study is ongoing and data collection is underway, we anticipate that the insights gathered from the participants will provide valuable information and positive feedback on the usability and impact of the Bimodal control within the NSA. As the study progresses, we look forward to utilizing these findings to enhance the user experience and functionality of the app. The anticipated contributions include not only an improved understanding of user interactions with the Bimodal control within the NSA but also valuable insights that will guide future developments in bimodal hearing technology.
It is important to note that this conclusion marks a temporary point in the study, and ongoing efforts will lead to a more comprehensive understanding of the app's impact. We express our gratitude to
the participants for their involvement and eagerly anticipate the study's culmination, which will further enrich our understanding of bimodal hearing technology.

Key words: bimodal, hearing aids, hearing, smartphone apps, cochlear implant

P01.5

151 - The effect of Dynamic Noise Cancellation on listening effort, speech recognition and sound quality among adults with severe to profound hearing loss

Xin Tian [(1)] - Ruijuan Dong [(2)] - Jing Zhang [(1)] - Bernadette Fulton [(3)] - Jingjing Guan [(1)] - Shuo Wang [(4)]
Sonova China, Innovation Center Shanghai, Shanghai, China [(1)] - Beijing Tongren Hospital, Capital Medical University, Department of Otorhinolaryngology Head and Neck Surgery, Beijing, China [(2)] - Sonova Communication AG, Hearing solutions, Murten, Switzerland [(3)] - Beijing Tongren Hospital, Capital Medical University, Beijing Institute of Otolaryngology, Beijing, China [(4)]

Background**:** Audiologists face uncertainty when activating noise reduction algorithms in hearing aids for adults with severe to profound hearing loss (StP). Anecdotally individual preferences for noise reduction are highly variable for StP, but little data is available. This presentation will preview results of a new study examining the benefit of spatial noise cancellation for adults with severe to profound hearing loss.
Single-channel noise reduction (NR) algorithms have been integrated into modern digital hearing aids to reduce noise annoyance and improve signal-to-noise ratio. However, the effectiveness of single-channel noise reduction is reduced when the interfering noise is non-stationary. To address this problem, a novel noise canceller (Dynamic Noise Canceller, DNC) that exploits spatial information from the output of the beamformer is implemented in hearing aids to accommodate more dynamic noise. This study aims to evaluate the efficacy of such a spatial noise canceller among Mandarin-speaking hearing aid users with StP.
Methods**:** Seventeen adults with severe-to-profound bilateral sensorineural hearing loss participated in the study. They were asked to wear a pair of BTE-UP hearing aids* in a sound booth to complete the following tasks at three DNC strengths (DNC_{off}, $DNC_{moderate}$ and DNC_{strong}) within a manual Speech in Loud Noise (SpiLN) program in a counterbalanced order.
Listening effort was measured through Adaptive Categorical Listening Effort Scaling (ACALES) in diffused cafeteria noise plus two dynamic noise sources from 120° and 240° azimuth. The total noise level was set at 68 dB A. SNRs for 13 scaling points from “no effort” to “extreme effort” and one additional “only noise” point were determined using an adaptive scheme.
Speech reception threshold (SRT) was measured by CMN Matrix Sentence Test (CMNmatrix) with the same noise setup as that in the listening effort test.
Sound quality in noise was assessed by asking the participant to rate the quality of the speech signal in terms of listening comfort, noise suppression, speech clarity and satisfaction.
Results**:**
Listening effort. The individual rated listening effort (N=17) was fitted as a two-slope function of the SNR. The SNR_{cut} values at the midpoint of the scaling (point 7, moderate effort) for each participant and condition were extracted. One-way repeated measures ANOVA analysis on SNRs at “moderate effort” suggested a significant effect of DNC strength ($F[2,32] = 33.967$, $p < .001$). Post hoc comparison revealed significant differences between DNC_{off} and $DNC_{moderate}$ ($t[16] = -7.499$, $p < .001$), DNC_{off} and DNC_{strong} ($t[16] = -6.042$, $p < .001$), but no significant difference between $DNC_{moderate}$ and DNC_{strong} ($t[16] = 1.386$, $p = .554$). This indicates that compared to conditions where DNC was turned on, better SNRs were required for participants to reach “moderate effort” when DNC was turned off.
Speech recognition in noise. SRT_{50} data were obtained from 15 participants. Lower SRTs were observed for $DNC_{moderate}$ (*Mean* = -2.7 dB, *SD* = 5.2) and DNC_{strong} (*Mean* = -2.4 dB, *SD* = 5.0) than DNC_{off} (*Mean* = 1.7 dB, *SD* = 5.4), but statistical analysis revealed no significant effect of DNC strength on speech recognition in noise.
Sound quality. Sound quality rating data (N=17) showed better scores for two DNC on conditions compared to DNC_{off} in all the four dimensions (listening comfort: $DNC_{off} < DNC_{moderate}$ ($p = .008$) and DNC_{strong} ($p = .014$); noise suppression: $DNC_{off} < DNC_{moderate}$ ($p = .033$) and DNC_{strong} ($p = .019$); speech clarity: $DNC_{off} < DNC_{strong}$ ($p = .013$); satisfaction: $DNC_{off} < DNC_{moderate}$ ($p = .007$)). This indicates that DNC can improve subjective sound quality in noise.
Conclusions**:** Spatial noise cancellation as implemented in the DNC hearing aid algorithm can reduce listening effort and improve subjective sound quality in noise for hearing aid users with StP. Speech recognition in noise was stable, with DNC on or off. In conclusion, audiologists can improve the benefit of clients with StP by activating the DNC spatial noise reduction algorithm.
* Phonak Naida Paradise UP (675 zinc-air battery)

Keywords: Spatial noise canceller, subjective listening effort, speech intelligibility, severe-to-profound hearing loss

P01.6

210 - Mic Matters: Unveiling the Power of 2 vs 4 Microphone Beamformers in Hearing Aids

Megan Quilter [(1)] - Tao Cui [(1)]
GN Hearing A/S, Global Audiology, Ballerup, Denmark [(1)]

Introduction
The prominent challenge encountered by individuals wearing hearing aids is effectively discerning speech amidst background noise. The ability to perceive sound in noisy environments significantly influences satisfaction with hearing aids[1]. Directional microphone technology serves as a viable solution to address this issue. Directional microphones in hearing aids focus on capturing sound from a specific direction while reducing background noise from other directions. They enhance the clarity of speech and improve the user's ability to understand conversations, especially in noisy environments. Hearing aid devices are designed with either a 2-microphone or 4-microphone configuration to facilitate directional beamforming functionalities. The main difference between beamformers lies in their ability to capture and process sound from different directions. Two microphone beamformers use 2 microphones to determine the direction of incoming sound and adjust their settings accordingly. They provide directional enhancement and noise reduction, but their effectiveness may be limited, especially in complex listening environments. Additionally, a 4-microphone configuration often allows more precise beamforming compared to systems with fewer microphones, resulting in better performance in complex and dynamic acoustic environments. The aim of this investigation was to assess the effectiveness of hearing aids equipped with 2-microphone and 4-microphone beamforming technologies, particularly in demanding auditory scenarios.
Methods
To evaluate the directional performance from a technical perspective, hearing aids were fitted on an acoustic manikin in a binaural configuration with ear-to-ear connectivity. White noise was introduced at 0 degrees, while the mannequin rotated continuously at a rate of 7.2 degrees per second, completing a full 360-degree rotation to generate circular spectrograms.
Results
Circular spectrograms displayed how energy was distributed across different frequencies at each moment, allowing for the identification of distinct sound components and patterns. Spectrograms of 4-microphone beamforming systems exhibited heightened energy concentration in desired regions and demonstrated narrower beamwidths in contrast to their 2-microphone counterparts.
Discussion
This investigation aimed to evaluate the efficacy of hearing aids featuring 2-microphone and 4-microphone beamforming technologies, especially in challenging auditory conditions. Findings indicate that 4-microphone beamformers outperformed their 2-microphone counterparts, as evidenced by spectrogram energy analysis. This suggests that the additional microphones in the 4-microphone configuration contribute to enhanced beamforming capabilities, narrower beamwidths, and potentially exert influence in enhancing speech intelligibility amidst noisy environments.

References

1. Manchaiah V, Picou EM, Bailey A, Rodrigo H. Consumer Ratings of the Most Desirable Hearing Aid Attributes. J Am Acad Audiol. 2021 Sep;32(8):537-546.

Key words: Hearing aids, directionality, beamformer

P01.7

217 - Digital interfaces in the hearing health of the elderly: hearing aid orientation and fitting program

Wanderleia Blasca [(1)] - Vivian Vespero [(1)] - Lucas Neri [(1)] - Bianca Antonelli [(1)] - Fabiana Azenha [(1)] - Adriana Lacerda [(2)] - Thais Angelo [(1)]
Universidade de São Paulo, Audiology and Speech Patology, Bauru, Brazil [(1)] - Universidade de Montreal, Audiology, Montreal, Canada [(2)]

Brazil is undergoing a demographic transition characterized by an increase in the elderly population. In this context, the Brazilian health system needs to be prepared to deal with this new population. Aging is a progressive, degenerative and inevitable process, comprising a series of physiological changes. Hearing loss is one of these changes which sometimes leads to difficulties in communication for the elderly, resulting in social isolation. The hearing aid becomes an important aid for the re-socialization of the elderly. This requires effective orientation and counseling, as well as the involvement of patients and their families throughout the process. An integrative literature review was therefore carried out to gain a better understanding of the reasons why elderly people with hearing loss do not adhere to treatment. The results showed: the difficulty of use and handling, the lack of adequate guidance from professionals, and the lack of a support network, consisting of family, friends and caregivers. The aim of this project was to create a digital interface for mobile devices, with an orientation and advice program on the hearing rehabilitation process, analyzing its benefits for the quality of life of the elderly. The project is being carried out in partnership with the Hearing and Aging Laboratory of the Research Center of the University Institute of Geriatrics of Montreal - Centre de Recherche de l'institute universitaire de gériatrie de Montréal - CRIUGM (Canada), drawing on the experience of these research centers in the area of aging. The work has covered the stages of creating the digital interface; the evaluation stage, firstly carried out by peers and then by elderly individuals with hearing impairment and communication partners. The results have shown the importance of developing easily accessible educational materials for the elderly population, as well as the importance of the communication partners' assistance in the rehabilitation process.

Keywords: elderly, hearing aid, counseling, orientation

P01.8

223 - Development of an instructional educational object for simulation otoplastic procedures

Wanderleia Quinhoneiro Blasca [(1)] - Lucas Ferreira Neri [(1)] - Maria Thereza Raab Forastieri Piccino [(1)] - Vivian Aparecido Vespero [(1)] - Bianca Caseiro Antonelli [(1)] - Deborah Viviane Ferrari [(1)]
FOB / USP - Faculdade de Odontologia de Bauru, Audiology, Bauru, Brazil [(1)]

Clinical simulation is a highly effective training method for healthcare professionals. It creates controlled clinical environments and enables practical experience in real-life scenarios. This approach is a game-changer in healthcare education. Printing the ear mold is considered a procedure of great importance in selecting and adapting hearing aids. However, although uncommon, complications may occur during the process that must be specified, as well as changes in the external ear, essential for knowledge. For this reason, ear mold printing can become a procedure that generates insecurity for the undergraduate student, which requires training and repetition to achieve satisfactory results. Because of this, it is essential to insert a second alternative that is not just for carrying out skills training among students or patients, but rather, the proposal of a simulation model that assists in the printing of ear molds, while enabling the student with greater preparation and confidence in facing real clinical situations. Therefore, this study aimed to construct and evaluate a simulation model of the anatomy of the external ear developed in three-dimensional (3D) printing for teaching and clinical learning about ear mold printing. The methodology of this study was divided into two parts, the first being aimed at building the simulation prototype in 3D printing and the second for evaluating the material by professional judges in Audiology. The construction of the simulation prototype was segmented into phases defined by the Double Diamond tool of the Design Thinking methodology called: production, testing, and usability evaluation, ranging from its ideation, 3D modeling, slicing, three-dimensional printing, gluing and finishing, mockup to final prototype solution, which together with the research team, can be built according to the suitability of material characteristics, scale and functionality. In the context of the evaluation, the questionnaire for judges was composed of 19 items on a Likert scale distributed across four evaluation domains: Objective, Usability, Design, and Printing Quality. In total, 10 professional judges from Audiology participated in this study. Data from the validation questionnaire were tabulated in the Microsoft Excel program and data analysis took place using the Content Validity Index (CVI). To avoid inconclusive answers, the levels of agreement and relevance of each item varied between odd numbers from 1 to 5 (1-completely disagree; 2-partially disagree; 3-indifferent; 4-partially agree and 5-completely agree). For each item of the questionnaire, a positive numerical value was assigned, where the options such as “partially agree” and “completely agree” were assigned respectively the values +4 and +5, for the option “Indifferent” the value was assigned 3 (three), as it is a partial option; and the options “completely disagree” and “partially disagree” were assigned the respective values of +1 and +2. From these values, the CVI was calculated. The Level Content Validity Index (I-CVI) was used to evaluate the level of agreement between judges for each item. The I-CVI was computed by the number of judges who evaluated the item as relevant and very relevant. The Scale-Level Content Validity Index, Universal Agreement (S-CVI/UA) was calculated using the proportion of scale items assessed as relevant and very relevant by each judge. Items with an index equal to or greater than 0.80 were considered validated. Regarding the results, the I-IVC calculated for the Objective and Usability domains, respectively, scored: 0.96 and 0.94. The other domains had scores of 1.00. Using the S-CVI/UA, it was possible to obtain agreement on 17 items among the 19 questions, presenting a result of 0.89. Only one question contained divergence in the Objective and Usability domains. The study achieved its proposed objectives; however, it needs improvement to evaluate its effectiveness in speech therapy undergraduate students.

Keywords: Simulation Training; User-Centered Design; Printing, Three-Dimensional

P01.9

247 - Analysis of auditory neuroplasticity using the P300 after 3 months and 6 months of Hearing Aid fitting

Natalia Ferrazoli [(1)] - Christiane Marques do Couto [(1)]
Faculty of Medical Sciences - UNICAMP, Department of Human Development and Rehabilitation, Campinas, Brazil [(1)]

Hearing impairment is a severely disabling disease, since hearing enables the detection, recognition, discrimination and understanding of speech sounds. Untreated hearing impairment harms the communicative needs and interpersonal relationships of human beings, in addition to be associated with the cognitive and functional decline of the elderly, causing changes in their life quality and even causing depression and social isolation. Hearing deprivation can cause damage to the entire auditory pathway, promoting changes in the functioning of the Central Auditory System and causing a significant reduction in auditory and cognitive performance. On the other hand, auditory rehabilitation can prevent auditory deprivation or cause positive plasticity. Auditory Evoked Potentials have been characterized as an important instrument in neuroscience, due to their objective nature, in evaluating the structural and functional integrity of the Central Auditory System, evaluating neuro-electrical activity in the auditory pathway from the auditory nerve to the cerebral cortex. The analysis of the latencies and amplitudes of Long Latency Auditory Evoked Potentials can be useful as biomarkers to verify the effects of sensory deprivation on the central auditory pathway and monitor changes in the cortical auditory pathway, after adaptation and use of Hearing Aid for amplification and/or cochlear implants. Objectively evaluate the adaptation process of individuals using Hearing Aids using the latency and amplitude variables of Long Latency Auditory Evoked Potentials and the effect of stimulation on the Central Auditory System throughout adaptation and use of the Hearing Aid, that is, neuronal plasticity can help in guiding guide the rehabilitation of these individuals. The P300 can be used in clinical practice to check and monitor patients during the acclimatization process and adaptation to the Hearing Aid. Therefore, the objective of this study is to characterize the change in the latency and amplitude variables of the P300 component of the Long Latency Evoked Potential in elderly people with acquired sensorineural hearing loss, post-adaptation of a Hearing Aid in the period of 3 months and 6 months. Methodology: clinical, longitudinal and prospective study. The study included 12 individuals aged between 60 and 92 years, with moderate to severe acquired bilateral sensorineural hearing loss, with symmetry between the ears. Before referral for adaptation of the hearing aid, individuals with no previous history of using or attempting to adapt an hearing aid were subjected to otorhinolaryngological evaluation, audiological and electrophysiological evaluation, in which the Long Latency Auditory Evoked Potential was performed – P300. They returned for a new electrophysiological evaluation in 3 months (T3) and 6 months (T6) after adaptation of the Hearing Aid, with the evaluation conditions being maintained. Results:. In the study of the latencies and amplitudes of the P300 component obtained, no statistically significant difference was observed between right and left ears. Therefore, ears were grouped to compare the latency and amplitude values. The average amplitude for T0 was 5.2ms, for T3 it was 5.4ms and for T6 it was 5.6ms, the differences being statistically significant. And the average latency for T0 was 427.9μV, for T3 it was 423.2μV and T6 it was 405.5μV, also statistically significant. Conclusion: Results highlighted that there was a decrease in latency and an increase in amplitude after 3 months and 6 months, however, the variation in the decrease in latency was greater after 6 months than after 3 months, which was not observed in the variation in amplitude, which was the same for 3 and 6 months.

P02 – AUDITORY PROCESSING DISORDERS

P02.1

93 - Impacts of Covid-19 on the peripheral and central auditory system of children and adolescents

Maria Francisca Colella-Santos [(1)] - Cauã Reis Gonçalves [(1)] - Julia Siqueira [(1)]
University of Campinas, Human Development and Rehabilitation, Campinas, Brazil [(1)]

Introduction**:** COVID-19 is an infectious disease caused by the SARS-CoV-2 virus, primarily transmitted through respiratory routes via the dispersion of droplets containing viral particles. With the global spread of the disease, it was declared a pandemic in March 2020, persisting until May 2023, when the conclusion of the International Health Regulations Emergency concerning COVID-19 was announced. Auditory and vestibular symptoms such as hearing loss, tinnitus, and dizziness have been reported during and after COVID-19, with studies indicating potential adverse effects of the SARS-CoV-2 virus on the audiovestibular and central auditory systems. This study aimed to investigate the impacts of COVID-19 on the peripheral and central auditory systems of children and adolescents post-acute COVID-19 phase, employing behavioral, electroacoustic, and electrophysiological audiological assessments.
Methods**:** A questionnaire was administered to gather data on child development, school history, and health records. Additionally, a battery of audiometric assessments, including pure-tone audiometry and high-frequency audiometry, immittance testing, transient otoacoustic emissions and distortion product otoacoustic emissions, Brainstem Auditory Evoked Potentials and Long Latency Auditory Evoked Potentials, Dichotic Digit Test, Sentence Identification Test, Dichotic Consonant Vowel Test, Frequency Pattern Test, and Gaps-In-Noise Test were conducted. These tests aimed to evaluate the peripheral and central auditory systems of 23 children and adolescents aged 8 to 15 years who had confirmed COVID-19 but did not report auditory or school-related complaints before the onset of COVID-19 (study group). The results were compared with pre-pandemic data from 23 children and adolescents without COVID-19 in the same age group, exhibiting normal peripheral and central hearing, and demonstrating good academic performance (control group).
Results**:** All participants in the study group exhibited auditory thresholds within normal limits, albeit with statistically significant higher values compared to the control group in both pure-tone audiometry and high-frequency audiometry. A prevalence of absent responses in high frequencies was identified in transient otoacoustic emissions and acoustic reflex testing. In the assessment of the central auditory system, a notable number of altered results were observed in the latency values of waves III and V of the Brainstem Auditory Evoked Potentials (BAEP), along with significant differences compared to the control group in the latency of waves I, III, and V of BAEP, as well as in the behavioral tests, Dichotic Digit Test, and Pediatric Sentence Identification Test.
Conclusion**:** Through the analysis of the obtained results, alterations in the auditory system were identified, spanning from the peripheral portion, specifically the outer hair cells of the cochlea, to the central structures. These findings suggest that these alterations may be attributed to the impact of COVID-19.

Keywords: Betacoronavirus; Hearing; Child; Adolescent.

P02.2

109 - Children and adolescents affected by stroke: performance in auditory skills

Maria Francisca Colella-Santos [(1)] - Nadia Giulian de Carvalho [(1)] - Thalita Ubiali [(1)] - Maria Isabel Ramos do Amaral [(1)]
University of Campinas, Human Development and Rehabilitation, Campinas, Brazil [(1)]

Introduction**:** Research on auditory skills in children and adolescents affected by stroke (cerebrovascular accident, CVA) is scarce in the specialized literature. Variability in etiology, as well as in the size and location of the lesion, complicates the comparison of results between studies. Understanding the performance of auditory skills in individuals who have suffered a stroke can contribute to the establishment of more assertive conducts, as well as enable more appropriate guidance to parents and schools. Objective**:** To analyze the performance of auditory skills of children and adolescents affected by stroke in screening and in the behavioral diagnosis of central auditory processing (CAP), including spatial processing. Method**:** This study, approved by the Ethics Committee of the institution (No. 50512010), involved nine subjects, with an average age of 11.33 ± 2.74 years, seven female and two male, right-handed, and diagnosed with CVA at the Hospital de Clínicas-UNICAMP, Brazil. Subjects with auditory thresholds within normal standards were included. The screening of auditory skills was performed using a battery called AudBility, including the self-perception questionnaire of the subjects (QAPAC) and tasks of sound localization (LS), Binaural integration (IB), Figure-Ground (FF), Temporal resolution (RT), and Temporal ordering of frequency (OT-F). The behavioral assessment was composed of the Dichotic Digits Test (TDD), the Ipsilateral Competitive Message Identification Test (S/R ratio -15) (PSI/SSI), Gaps in Noise Test (GIN), and Frequency Pattern Test (TPF). Finally, the evaluation of spatial auditory processing (PROSER) was conducted. The results were analyzed by ear (right ear - RE and left ear - LE), using descriptive statistics (mean and standard deviation). Results**:** Of the subjects evaluated, in the screening stage, six (66%) presented a risk for CAP disorder based on the QAPAC, with an average performance of 39.11 ± 10.41. After the application of auditory tasks, eight (88%) subjects were indicated at risk. The performance in the LS task was 84.44% ± 11.30. In the IB task, it was 88.89% ± 16.73 in the RE and 79.44% ± 16.67 in the LE. In the FF task, it was 83.33% ± 27.84 in the RE and 73.33% ± 23.98 in the LE. In the RT task, it was 3.78 ms ± 1.86. In the OT-F task, it was 40.0% ± 24.49 in the RE and 42.22% ± 25.39 in the LE. In the diagnosis, seven (77%) were classified with CAP considering two altered tests. The performance in the TDD was below expected in at least one ear in five subjects, with performance of 85.56% ± 15.25 in the RE and 88.06% ± 12.30 in the LE. In the PSI/SSI test, four subjects had performance below normality, with an average performance of 72.22% ± 26.35 in the RE and 61.11% ± 25.71 in the LE. In the GIN, five subjects had difficulties, with performance of 7.125 ms ± 4.01 in the RE and 5.875 ms ± 2.41 in the LE. In the TPF, all subjects showed performance below normality in temporal ordering ability, with performance of 30.78% ± 13.27 in the RE and 22.33% ± 9.30 in the LE. In the PROSER, the Speech Recognition Threshold (SRT) for different voices at ±90° was -10.96 ± 5.69 and at 0° was -2.196 ± 1.81. The SRT for the same voice at ±90° was -10.15 ± 5.85 and at 0° was -2.261 ± 2.22. Conclusion**:** The results confirmed the implications of stroke in children and adolescents regarding auditory skills of binaural integration, figure-ground, resolution, and temporal ordering. The results reinforce the need for screening and referral for specific auditory evaluations and targeted interventions for this population, aiming to improve their quality of life and school performance.

Keywords: Children; Hearing; Hearing tests; Auditory perception

P02.3

192 - The Effect of Music Training in Adulthood on Frequency Discrimination Ability

Leyla Jalilvand Karimi [(1)] - Mahboobeh Rahimi [(1)]
Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences, Audiology, Tehran, Iran (islamic Republic Of) [(1)]

Introduction**:** Frequency discrimination is a crucial skill in central auditory processing (CAP), playing a vital role in reading, writing, understanding speech, and music perception. Music training has been identified as a potential solution to enhance this skill. While most existing studies focus on the impact of music education during childhood and its effects in adulthood, there is growing interest in understanding whether music training initiated in adulthood can yield positive outcomes. If confirmed, this approach could be recommended for rehabilitating central auditory processing disorder (CAPD) in adults. Thus, the aim of this study was to investigate The effect of music training in adulthood on frequency discrimination ability.
Methods**:** This cross-sectional, non-interventional study was performed on 46 participants aged 20 to 45 years. The participants were divided into two groups: non-musicians (28 individuals) and musicians (18 individuals) who began music education in adulthood. Their frequency discrimination ability was assessed using three tests: Pitch Pattern Sequence Tests (PPST), Dichotic Consonant-vowel (DCV), and P300. Statistical analysis was performed using a two-way analysis of variance (ANOVA).
Results**:** The statistical analysis revealed significant differences in PPST test score (in both ears), DCV test score in the left ear and P300 latency between the two groups. However, no significant difference was observed for the DCV test score in the right ear as well as the P300 amplitude.
Conclusions**:** According to the results of the research, it can be stated that music education, even starting in adulthood, can have an effect on frequency discrimination and as a result speech understanding can be improved.

Keywords:Central auditory processing, Music training, Frequency discrimination

P03 –COMPUTATIONAL AUDIOLOGY

P03.1

114 - Assessing Array-Type Differences in current spread of cochlear implant users with the Panoramic ECAP Method

Charlotte Garcia [(1)] - Robert P Carlyon [(1)]
University of Cambridge, MRC Cognition & Brain Sciences Unit, Cambridge, United Kingdom [(1)]

Cochlear implant companies manufacture devices with different electrode array types. Some have a straight geometry, and some are designed to 'hug' the neurons. The Panoramic ECAP method (PECAP) provides detailed estimates of peripheral neural responsiveness and current spread for individual patients. We are collecting PECAP measures from a large number of patients with different electrode array types so as to (a) obtain normative data for different array types to enable clinicians to identify electrodes that produce unusually wide current spread, and (b) validate the ability of PECAP to discriminate different amounts of current spread by comparing estimates between groups of patients with different array types. We hypothesized that PECAP would show wider current spread for the straight arrays than the perimodiolar ones.
The PECAP measurement was collected for 92 users of Cochlear (c) implant devices with a mixture of perimodiolar arrays (n = 43), slim straight arrays (n = 35), and slim modiolar arrays (n = 14). The data was obtained across five different centres in the United Kingdom, Australia, and Germany. The PECAP method was applied to these datasets to estimate peripheral neural responsiveness and current spread for each electrode as per the method described in Garcia, et al., 2021. The current-spread estimate was then compared between array types for each electrode. Computed Tomography (CT) scans were available for 41 of these users as well, and electrode-modiolus distances were calculated for this subset of users.
An analysis of variance was computer on PECAP's current-spread estimate as the output with array type (3 levels) and electrode (22 levels) as factors. After multiple comparison corrections, significant main effects of array type ($F = 89.88$, $p < 0.0001$) and electrode ($F = 7.90$, $p = 0.0001$) were both found, as well as a significant interaction ($F = 2.74$, $p < 0.0001$) that suggested that the benefit of narrower current spread across the different array types was the strongest at the 2 most apical electrodes. A significant effect of array type was also found on the neural-responsiveness estimate ($F = 5.21$, $p = 0.0055$), but with very small effect sizes capturing only about 3 +/- 2% of the range of possible values. There was also a significant across-subject correlation between electrode-modiolus distance calculated from CT scans and the PECAP's estimate of current spread ($r = 0.52$, $p = 0.0006$). This effect seemed to be heavily influenced by array type.
This analysis suggests that there are differences in patterns of current spread between cochlear implant array geometries in Cochlear (c) devices. It is unsurprising that slim modiolar arrays show narrower current spread than straight arrays, as they are designed to hug the modiolus. It is perhaps most interesting that the benefit of the CI-32 and CI-12 arrays over the CI-22 arrays is greatest for the most apical electrodes. While the effects on current spread estimates are highly significant, are all post-hoc. A similar study is underway for cochlear implants manufactured by Advanced Bionics (n = 40), but no main effect of array type on current spread has yet been detected.

Keywords: Cochlear implant; current spread; neural activation patterns; electrode-neuron interface

References:
Garcia, C., Goehring, T., Cosentino, S. et al. The Panoramic ECAP Method: Estimating Patient-Specific Patterns of Current Spread and Neural Health in Cochlear Implant Users. JARO 22, 567–589 (2021). https://doi.org/10.1007/s10162-021-00795-2

P03.2

235 - Pinna Related Transfer Function and Auricular Motor Activity

Daniel J. Strauss [(1)] - Farah I. Corona- Strauss [(1)] - Leen J. N. Almasu [(1)]
Saarland University, Faculty of Medicine (Homburg/ Saar) & HTW SAAR (Saarbrücken), Systems Neuroscience and Neurotechnology Unit, Saarbrücken/ Homburg, Germany [(1)]

Sound source localization is fundamental to human interaction and safety. Monaural cues support the localization of elevation and depth distance which can be accomplished with one ear; these cues are generated by the reflection and diffraction of sound waves by the head, torso, and pinnae, which is described as the Head Related Transfer Function (HRTF). The aim of this study is to investigate the impact of the pinna on auditory perception, especially focusing on its role in the amplification and attenuation of auditory signals, thereby influencing the pinna's ability in sound localization. Pinna Related Transfer Functions (PRTF) were collected from 16 subjects while simultaneously collecting electromyography data from the Auricular muscles (Posterior Auricular Muscle, Superior Auricular Muscle). The Pinna Related Transfer Function signals, generated by linear chirp auditory stimuli (200Hz - 10KHz), were collected from two microphones: one placed inside the ear at the entrance of the ear canal and the other positioned outside the ear at the intersection between the top of the pulled pinna and the tragus. The ratio between their responses was then calculated. The experimental setup involved 15 speakers at various azimuth angles (0°, 45°, 90°, 135°, and 180°) and three elevation levels (+45°, 0°, and -45°) placed relative to participants' left ear. The setup implementation and the calibration of the devices ensured a controlled and reproducible environment for the measurements. The results of the PRTF revealed distinct data trends across different azimuth and elevation levels. Despite variations in individuals' pinna characteristics, common trends emerged among all subjects. Analysis of the data revealed noticeable Pinna Related Transfer Function (PRTF) effects beyond 3 kHz. Specifically, azimuth angles of 45° and 90° predominantly showed amplified effects approximately up to 15 dB, while angles of 0° and 180° predominantly exhibited attenuation effects approximately up to -15 dB, with angle 135° showcasing both effects, consistently occurring across all subjects in the same frequency ranges. Additionally, the pinna's impact on elevation was evident in the data, particularly at angles 0°, 135°, and 180°, where attenuation increased with a shift in notch frequency as elevation decreased from +45° to 0° to -45°.

Keywords: Pinna Related Transfer Function, Sound Source Localization, Pinna Characteristics, Auricular Muscles

P03.3

254 - Post-Auricular Muscle Activity Reflecting the Exogenous Capture of Attention

Laura Renz [(1)] - Maja Serman [(2)] - Sebastian Best [(2)] - Niels Jensen [(2)] - Cecil Wilson [(2)] - Jurek Foellmer [(2)] - Andreas Schroeer [(1)] - Adrian Mai [(1)] - Daniel Strauss [(1)] - Farah Corona-Strauss [(1)]
Saarland University, Faculty of Medicine (Homburg/Saar) & & HTW SAAR (Saarbruecken), Systems Neuroscience and Neurotechnology Unit, Saarbrücken, Germany [(1)] - WS Audiology, Scientific Research, Erlangen, Germany [(2)]

The human species evolutionary lost its ability to orient their pinnae towards a sound source at least 25 million years ago [1]. Though vestigial, the underlying neural circuit is still of great interest.
The Postauricular-Muscle (PAM)-Reflex is often reviewed in literature. It's a potential with a first peak latency between 12.5 and 15 milliseconds, evoked by acoustic stimuli, a mechanism meant for pulling the ear back and flattening it against the skull [2]. However, it was shown that the auriculomotor system goes beyond this first reflex-driven effect and that pinna-orientation is involved in both endogenous and exogenous attention tasks [3].
In this study, PAM electromyographic activity (EMG) was recorded in subjects listening to a complex multi-talker situation presented through 5 circular arranged loudspeakers and they had to solve two tasks. The first one was to follow a podcast presented in a frontal loudspeaker. The second one was to stay attentive and react to transient sentences that would appear at random intervals from any of the lateral loudspeakers. Participants had to listen carefully to those sentences and move a joystick in the direction they localized the transient sentences. Additionally, distracting podcasts were presented from the back loudspeakers and cafeteria noise on all lateral loudspeakers. Throughout the trials, the hearing aids they were wearing had different directionality algorithms.
The analysis on the EMG-activity-changes time-locked to acoustic edges in the presented speech, aim to shed light on the influence of conscious processing on exogenous attention.
Included in the analysis were 19 normal-hearing participants (m: 13, f:6), age 25.26 ±4.12 years. PAM-Data was down sampled, filtered and then root mean squared to extract the envelope. Normalization was done for each trial. Participants conducted 9 trials, each one including 12 minutes of auditory stimulation and 16 or 17 transient sentences.
For the acoustic edge detection, a gammatone filter bank was used to decompose speech into subbands and determine the points of maximum deviation in the speech envelope, following a method suggested by Mai et al. [4]. In all presented audio tracks, acoustic edges were identified and checked for an elicited PAM- EMG response. Averaging of single responses showed significant PAM-activity connected to the acoustic edges in the podcast in front and the distractors playing from the back loudspeakers.
To determine to what extent conscious perception of the stimuli has an influence on PAM-EMG activity, the second part of the analysis focused on the transient sentences. They were presented with a very low signal-to-noise ratio at unpredictable times. For these sentences, it was possible to retrace whether the participant perceived them based on whether they moved the joystick or not. The perceived transient sentences resulted in a significantly higher EMG-response than those which were not.
Using the acoustic edges as landmarks of attention in speech, we could confirm that PAM-EMG activity is modulated by exogenous attention and show its dependency on the conscious perception of stimuli. It should therefore be concluded as a parameter when considering PAM-response as a measure of exogenous attention.

[1] Hackley, S.A. (2015). Evidence for a vestigial pinna-orienting system in humans. Psychophysiology, 52 10, 1263-70 .
[2] O'Beirne, G.A., & Patuzzi, R.B. (1999). Basic properties of the sound-evoked post-auricular muscle response (PAMR). Hearing Research, 138, 115-132.
[3] Strauss, D.J., Corona-Strauss, F.I., Schroeer, A., Flotho, P., Hannemann, R., & Hackley, S.A. (2019). Vestigial auriculomotor activity indicates the direction of auditory attention in humans. eLife, 9.
[4] Mai, A., Hillyard, S.A., & Strauss, D.J. (2023). Linear modeling of brain activity during selective attention to continuous speech: the critical role of the N1 effect in event-related potentials to acoustic edges. bioRxiv.

Keywords: Auricular Muscles, Multi-talker situation, Hearing aids, Attention

P04 – EARLY IDENTIFICATION – NOVEL TECHNIQUES

P04.1

17 - Biphasic Effect of Apolipoprotein E ε4 Allele on Hearing Loss with Age: A Retrospective Multicenter Cohort Study

Kyoung Ho Park [(1)]
The Catholic University of Korea, Otolaryngology Head & Neck Surgery, Seoul, Korea, Republic Of [(1)]

Background**:** Both ε4 variant of Apolipoprotein E(ApoE) gene and hearing loss are well-known risk factors of Alzheimer's disease. Since previous studies have reported conflicting results regarding the association between ApoE genotypes and hearing level, this study aimed to investigate their relationship.
Methods**:** Data from a clinical data warehouse of seven affiliated hospitals under the Catholic Medical Center were used in this study. Clinical Data of 1162 subjects with records of ApoE genotypes, audiometric tests, and cognitive function tests were retrospectively collected and analyzed.
Results**:** In Cox proportional hazard analysis, ε4 carriers had a higher hazard ratio of hearing loss in all frequencies of pure tone audiometry than non-ε4 carriers. A biphasic effect was observed with a cut-off value of 75.5 years. Subgroup analysis based on age revealed that ε4 carriers had better hearing in early life and worse hearing in later life. There was no discernible sex-based disparity.
Conclusion**:** The results suggest that the ε4 allele may have a biphasic effect depending on age, with a cut-off value of 75.5 years. This finding provides a potential explanation for the divergent findings of previous studies. Further research is necessary to understand the underlying mechanisms.

Keywords: Apolipoprotein E, hearing loss, aging

P04.2

110 - Study of the correlation between Auditory Steady State Evoked Potential (NB CE CHIRP) and Auditory Brainstem Response in childhood audiological assessment

Maria Francisca Colella-Santos [(1)] - Laura Franco Chiriboga [(1)] - Karoline Sideri [(1)]
University of Campinas, Human Development and Rehabilitation, Campinas, Brazil [(1)]

Introduction: Hearing is fundamental for the development of language, speech, motor and cognitive aspects of the child, being responsible for the individual's integration into society that is predominantly oral. The Auditory Brainstem Response (ABR) with click stimulus remains the most used method to evaluate children's hearing objectively, although it does not present frequency-specific responses. A new technology, the Auditory Steady State Response (ASSR) with Narrow Band – CE chirp, allows multiple stimuli to be presented simultaneously, making it possible to obtain electrophysiological thresholds with frequency specificity. Objective: To analyze the findings obtained with the use of ASSR with NB CE-Chirp stimulus and compare them with the findings of click and tone burst (TB) ABR in the audiological assessment of children carried out under inhalation anesthesia. Methods: 71 children aged between 14 and 59 months were evaluated. The click ABR, TB-ABR and ASSR NB-CE chirp exams were performed in a single session by an experienced audiologist, accompanied by an anesthetist responsible for inhalation sedation. The total time varied between 40 and 60 minutes. To analyze the findings, the degree of agreement between the exams was analyzed with the Intraclass Correlation Coefficient (ICC), Pearson correlation coefficient and analysis of Bland-Altman graphs. Results: The best ICC degrees were found when comparing techniques using uncorrected thresholds. For the Click ABR x TB-ABR x PEAEE analysis, an excellent ICC was observed for all frequencies; in the TB-ABR x ASSR analysis, the ICC was excellent for the frequencies of 500 Hz, 2000 Hz and 4000 Hz. Considering the analysis with Pearson's correlation coefficient, the agreement observed was strong for all techniques, both for the thresholds without and with correction. In analysis of the Bland-Altman graphs, an agreement ≥ 95% was observed when comparing the TB-ABR and ASSR techniques for uncorrected thresholds at all frequencies analyzed. As for the thresholds with correction, agreement was ≥95% at frequencies of 1000 Hz, 2000 Hz and 4000 Hz. Regarding the influence of possible variables, it can be observed that sex and age did not interfere with the thresholds obtained in the Click ABR, TB-ABR and ASSR. On the other hand, the complaint presented to justify requesting the exam was shown to be related to the thresholds obtained in the evaluations, and for cases of suspected hearing loss, higher thresholds were observed in relation to the other complaints. Discussion: The results found in this study corroborate data from the scientific literature of studies that also evaluated the correlation between different hearing assessment techniques. The ASSR should not be performed as a single measure, but rather associated with the ABR. Conclusion: ASSR proved to be useful in predicting estimated hearing thresholds with frequency specificity in the pediatric population in exams performed under anesthesia and can be considered as a part of the audiological assessment battery.

Keywords: Evoked Potentials; Hearing; Child; Electrophysiology.

P04.3

139 - TEOAE Based Newborn Hearing Screening with MOCR Neural Assessment

Rafael Delgado [(1)] - Linda Hood [(2)] - Lauren Roberts [(2)]
Intelligent Hearing Systems Corp, Research and Software Development, Miami, United States [(1)] - Vanderbilt University Medical Center, Hearing and Speech Sciences, Nashville, United States [(2)]

Two new transient otoacoustic emission (OAE) (TEOAE) based hearing screening methods integrating measures of the medial olivocochlear reflex (MOCR) for neural function assessment are presented. The MOCR reflex has been shown to be abnormal in patients with hearing loss due to neural auditory disorders. Currently, standard OAE hearing screening systems only measure cochlear function missing neural forms of hearing loss. In particular, auditory neuropathy/auditory synaptopathy (AN/AS) is the most common auditory neural abnormality in infants and has been reported to be present in as many as 10% of newborns with hearing loss (Berlin et al., 2000; Lee et al., 2001; Rance et al., 1999; Sininger 2002). There are a number of underlying mechanisms and genes associated with this disorder. AN/AS is a form of auditory disorder that does not follow standard hearing loss characteristics and patients typically experience extraordinary difficulty understanding speech, both in quiet and especially in noise. Missing the early identification of an infant with AN/AS results in significant delays in speech and language development and academic risks. When an infant with or at risk for AN/AS is missed due to screening with current OAE technology, they may not be identified until 2-3 years later when speech and language delays are finally recognized.
The Auditory Brainstem Response (ABR), as a neural response, is sensitive to AN/AS and can accurately identify these infants at birth. The JCIH recommends ABR as the screening measure of choice for infants in the NICU where neural hearing loss occurs at a higher rate. However, it is critical to note that AN/AS also occurs in infants in well-baby nurseries and in infants with no family history of or risk factors for hearing loss. ABRs are often not routinely used in many newborn hearing screening settings due to the higher cost of equipment, disposables and training requirements. Therefore, there is a need for a simple and cost effective OAE-based screening method that incorporates a measure of neural auditory function.
Two novel TEOAE MOCR recording techniques are presented: 1) Spectrally Separated MOCR (SpecS-MOCR) and Temporally Separated MOCR (TempS-MOCR). In the SpecS-MOCR, a continuous low frequency (band-limited noise below 1500 Hz, -96 dB/octave) efferent activator stimulus is continuously presented and TEOAEs recorded using either a 4kHz toneburst or a click stimulus filtered above 1500 Hz. The response is separated from the background noise in the spectral domain. In the TempS-MOCR paradigm, a broad frequency white noise efferent activator is presented and the TEOAE recorded using a 75 us click that is presented during a 25 ms noise gap. Recording sequences with and without the efferent activator are interweaved and compared to determine the strength of the MOCR.
Infants were tested in the well-baby nursery and the neonatal intensive care unit (NICU). Most infants were evaluated with the SpecS paradigm with 106 infants meeting inclusion criteria based on TEOAE amplitude and noise levels in the without efferent activator condition. Sixty percent of these infants demonstrated MOCR amplitude of 1 dB or greater with mean amplitude of 2 dB. A subset of infants was evaluated with both SpecS and TempS methods. The recording time was approximately two minutes for each ear, compared to four minutes for the conventional forward masking MOCR technique used for diagnostic and research applications. The development of a time-efficient MOCR technique that provides a measure of neural function using OAE technology will significantly improve newborn hearing screening throughout the world.

Keywords: medial olivocochlear reflex (MOCR), transient otoacoustic emission (TEOAE), newborn hearing screening

References:

Berlin CI, Hood LJ, Morlet T, Den Z, Goforth L, Tedesco S, Buchler K, Keats B. 2000. The search for auditory neuropathy patients and connexin 26 patients in schools for the Deaf. *ARO Abstracts, 23*, 23.
Lee JSM, McPherson B, Yuen KCP, Wong LLN. 2001. Screening for auditory neuropathy in a school for hearing impaired children. *Internat J Pediatr Otolaryngol, 61*, 39-46.
Rance G, Beer DE, Cone-Wesson B, Shepherd RK, Dowell RC, King AM, Rickards FW, Clark GM. 1999. Clincial findings for a group of infants and young children with auditory neuropathy. *Ear Hear, 20,* 238-252.
Sininger YS. 2002. Auditory neuropathy in infants and children: Implications for early hearing detection and intervention programs. *Audiol Today, 14*, 16-21.

P04.4

228 - Impacts on the auditory system of infants with Covid-19-positive mothers during the gestational

Jheniffer Queiroz Raimundo [(1)] - Maria Francisca Colella dos Santos [(1)]
University of Campinas - UNICAMP, Program in Child and Adolescent Health, Valinhos, Brazil [(1)]

Introduction**:** COVID-19 is an infectious disease caused by the SARS-CoV-2 virus, a new member of the coronavirus family, which has become a global health crisis. Although respiratory transmission is the primary route, concerns have arisen regarding possible vertical transmission, involving the transmission of the virus from mother to fetus through the spread of viral particles in amniotic fluid. Viral infection of the fetus through placental transmission may influence the development of the auditory system, leading to congenital auditory disorders. Early detection of changes in a child's auditory development allows for prompt therapeutic intervention, contributing to the reduction of communication and social interaction impairments in the child. **Objective:** This study aimed to analyze the results obtained in electroacoustic, electrophysiological, and behavioral auditory tests of infants whose mothers had COVID-19 during gestation. Method**:** The project was approved by the Research Ethics Committee (CEP) of the State University of Campinas and is part of a larger project titled "Impacts of Covid-19 on the peripheral and central auditory system of children and adolescents," under opinion nº. 5.454.075. The study included an Experimental Group (EG) and a Control Group (CG). The EG comprised infants up to one year old whose mothers were infected with SARS-CoV-2, selected during neonatal auditory screening at the Prof. Dr. Aristodemo Pinotti Women's Hospital - CAISM/Unicamp/Brazil. The CG consisted of infants whose mothers became pregnant after the end of the pandemic, with a negative test for Covid-19 and no respiratory symptoms during gestation. To evaluate the auditory system of the EG and CG, behavioral observations for verbal and non-verbal sounds, Brainstem Auditory Evoked Potentials (BAEP), Tympanometry, Transient Evoked Otoacoustic Emissions (TEOAE), and Distortion Product Otoacoustic Emissions (DPOAE) were conducted. Results**:** A total of 18 infants were evaluated. It was observed that 16 children showed results within the normal range established for latency and amplitude in BAEP (click stimulus, duration of 40 microseconds (µs), 2,000 sweeps, rarefaction polarity, 80 decibels normalized hearing level (dB NAn) intensity, with a window of 10/15 milliseconds and a filter between 150 and 3,000 Hertz (Hz)). Two children showed increased latencies and delayed blockage of waves I, III, and V, indicating conductive hearing loss. However, this result was expected due to the higher likelihood of this type of hearing loss in this population and was likely unrelated to COVID-19. In tympanometry, 16 cases exhibited a bilateral Type A tympanometric curve, while the 2 cases of conductive hearing loss presented a Type B curve. No abnormalities were detected in TEOAE and DPOAE tests in 16 cases, and only in the 2 cases of conductive hearing loss, there was an absence of responses. Regarding the trimester in which the mother tested positive for the SARS-CoV-2 virus, gestational quarters varied, with 5 mothers testing positive during the third trimester, 9 during the second trimester, and 4 during the first trimester. One case was hypothesized as auditory neuropathy spectrum disorder but was excluded from the study due to the presence of multiple Risk Indicators for Hearing Loss (RIHL). Conclusion**:** The current findings do not indicate a correlation between vertical exposure to COVID-19 and impairments in the peripheral and central auditory system of children whose mothers tested positive for COVID-19 during the gestational period. However, further research with a larger number of cases is needed to explore potential long-term effects and the relationship between exposure to COVID-19 and auditory development in infants.

Keywords: COVID-19; Hearing loss; Newborn; Pregnancy.

P04.5

266 - AudBility: Performance of schoolchildren in a minimum screening protocol and in a behavioral assessment of auditory skills

Ana Carolina Lemos [(1)] - Nadia Giulian Carvalho [(1)] - Beatriz Ribeiro Carvalho [(1)] - Thalita Ubiali [(1)] - Maria Francisca Colella-Santos [(1)] - Maria Isabel Ramos Amaral [(1)]
Human Development and Rehabilitation, Campinas, Brazil [(1)]

Introduction**:** AudBility is an online hearing skills screening program developed in Brazil that had its initial and validation studies recently published. Based on the results, there is a proposal for a minimum battery for the program's tasks, aiming to reduce application time. This reduced battery has not yet been studied in terms of sensitivity and specificity.
Purpose**:** In a sample of children with and without school difficulties, the aim of the study was to describe and compare groups performance in a minimum battery of auditory skills screening and behavioral assessment of central auditory processing (PAC).
Methods**:** Descriptive, comparative and cross-sectional study, approved by the Institution's Ethics Committee (#6.216.032). The participants were 63 children, 30 boys and 33 girls, mean age of 7.78±0.65 years, native speakers of Brazilian Portuguese, without peripheral auditory alterations in the basic audiological assessment (audiometry, logoaudiometry and imitanciometry), without syndromes or disorders of neurodevelopment and with performance at least level III - average or above average intellectual capacity - on the Raven's Progressive Matrices Test (RPM). From the selection, procedures applied were: School Performance Test II (TDE II), a protocol based on the tasks of the AudBility program and PAC behavioral assessment. The AudBility screening minimun protocol consisted of a self-perception of auditory abilities questionnaire (QAPAC) and binaural integration (BI), temporal resolution (TR) and temporal ordering of frequency (OT-F) tasks. The program requires internet and was applied using a notebook coupled to noise-cancelling headphones. The module used is aimed at children in the study range, in which the activities do not depend on mastery of reading and writing. Before each task, a training screen is presented and the researcher assists in marking responses on the screen. Among the participants, 32 underwent the Behavioral Assessment, consisting of the tests below: Dichotic Digit (TDD), Random Gap Detection (RGDT), Frequency Pattern (TPF) and Pediatric Speech Intelligibility (PSI). Subsequently, based on the TDE -II performance, participants were divided into two groups: 48 children with good academic performance (Group 1 – G1) and 15 children with academic difficulties (Group 2 -G2). The results were analyzed using descriptive statistics and in relation to the pass/fail criteria for each auditory task, the questionnaire and performance in the CAP behavioral assessment. The diagnosis of Central Auditory Processing Disorder (CAPD) was based on at least two altered tests
Results In QAPAC, the average in G1 was above the risk score for CAPD occurrence of 45 points (45.04+5.93), while in G2 the average score was 40.53+8.38. Regarding performance in the minimum battery, in G1 the average of the BI task was 91,15%+7,38 in the right ear (RE) and 86,25%+8,66 in the left ear (LE), of the RT was 4ms and the OT-F was 90,42%+17,5 in the RE and 86,67%+17,18 in the LE. In G2, the average for the IB task was 85%+0,09 in the RE and 78,67%+0,21 in the LE, for RT was 4,13ms+0,51 and for OT-F was 85,33%+0,15 in the RE and 84%+0,21 in the LE. Considering at least one altered task in the minimum battery of the AudBility program, 26 students from G1 (54.16%) and 14 students from G2 (93.33%) were at risk for CAPD. After AudBility, 20 children from G1 and 12 from G2 underwent PAC behavioral assessment. In all tests applied, G2 showed worse average performance compared to G1, with TPF being the most altered test. Four children from G1 (20%) and four children from G2 (33.33%) were diagnosed with CAPD. Among these children, two from G1 and four from G2 had presented a risk for TPAC in the minimum battery.
Conclusion**:** Results indicate a difference between the groups studied, with worse performance in children with school difficulties, both in the screening protocol from AudBility program and in the CAP behavioral assessment. The validation of this auditory skills screening protocol is being carried out by increasing the sample and comparing it with the CAP diagnostic assessment aiming at the sensitivity and specificity of the minimum battery of the AudBility program

Keywords: Auditory Perceptual Disorders, school health, children, early diagnosis

P04.6

179 - Neuroimaging measures to find a causal link between age-related hearing loss and cognitive decline: a scoping review

Liam Collins-Jones [(1)] - Deborah Vickers [(1)]
University of Cambridge, Clinical Neurosciences, Cambridge, United Kingdom [(1)]

Background: Age-related hearing loss (ARHL) is a gradual loss in high-frequency hearing that begins to emerge in middle age. Population-level studies have pointed towards a link between ARHL and cognitive decline. However, no causal mechanisms have been definitively identified to explain this link. Published reviews on ARHL and cognitive decline/dementia in recent years have given some attention to neuroimaging measures, focussing primarily on structural magnetic resonance imaging (MRI) measures with little to no focus on measures obtained with functional MRI and other functional imaging modalities.
Aims: Our objectives in this work were to determine if there are structural and functional measures linking ARHL and cognitive decline/dementia across multiple neuroimaging modalities including MRI, electroencephalography, magnetoencephalography, functional near-infrared spectroscopy and positron emission tomography, (i) with a goal of identifying the functional measures that are typically collected and any associated functional changes that are observed due to ARHL, and (ii) with a goal of identifying the structural brain measures commonly shown to correlate with ARHL.
Results: On PubMed, 898 studies were found using the following search terms: "auditory" and ("hearing" or "hearing loss" or "deaf*") and (("cogniti*" and "impairment") or ("cogniti*" and "decline") or "age-related" or "older adults" or "ageing") and ("imaging" or "*imaging" or "neuroimaging" or "electro*" or "magneto*" or "magnetic resonance imaging" or "position emission tomography"). We are following PRISMA guidelines, and we are currently screening the results to see which studies fall under our inclusion criteria. Our scoping review is therefore currently ongoing and we look forward to presenting the final results at the conference.
Discussion: We are particularly focussed on understanding which functional measures are currently collected to inform our hypotheses for a causal mechanism linking ARHL to cognitive decline/dementia. Our long-term aim is to test such hypotheses using emerging neuroimaging modalities to investigate function in the ageing brain in naturalistic listening environments.

P05 – EPIDEMIOLOGY

P05.1

5 - Influence of umbilical cord pH on the outcome of otoacoustic emission hearing screening in healthy newborns

Jose Miguel Sequi-Sabater [(1)] - Marta Ibarra-Rodriguez [(2)] - Victor Aparisi-Climent [(3)] - Jose Ignacio Collar-Castillo [(4)] - Jose Miguel Sequi-Canet [(4)]
Rheumatologist, Alzira, Spain [(1)] - Family Doctor, ZBS La Carlota, Cordoba, Spain [(2)] - Data Manager, Fisabio, Gandia, Spain [(3)] - Pediatrician, Gandia, Spain [(4)]

Objective: The effect of hypoxia on the functioning of the outer hair cells of the cochlea, which are responsible for the response to otoacoustic emissions used in neonatal hearing screening, is well known. The aim of this study is to determine the influence of mild to moderate variations in umbilical cord pH at birth on the outcome of hearing screening with otoacoustic emission in healthy newborns without hearing risk factors.
Results: The sample is composed of 4536 healthy infants. The results show no significant differences in the hearing screening outcome between the asphyctic (<7.20) and normal pH group. Nor is a figure below 7.20 detected in the sample that is related to an alteration in the screening. When broken down into subgroups with known factors of variation in the screening result, such as gender or lactation, no significant differences in response were detected. Apgar ≤ 7 is significantly related to pH < 7.20.
Conclusions: Small decreases in cord blood pH reflecting mild-moderate perinatal asphyxia do not appear to be significant factors related to the pass rate of the TEOAE test in healthy newborns performed as part of neonatal hearing screening; however, further studies are needed to determine whether there are any slight effects on the amplitude of the response that are not significant enough to affect the passage rate or would affect frequencies not explored by the Echocheck OAE Screener®. It is not known whether this mild asphyxia has negative audiological consequences of late onset. As a secondary study, a 5-minute Apgar score <7 correlates well with a mild-moderate asphyxia pH score (<7.20).

Keywords: Otoacoustic emissions; Neonatal hearing screening; Cochlea; Outer hair cells; Hypoxia

P05.2

31 - Organizational aspects and results of a hearing screening program among first-grade children in the Mazovian region of Poland

Piotr H. Skarżyński [(1)] - Elżbieta Gos [(2)] - Natalia Czajka [(2)] - Henryk Skarżyński [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(3)]

Background
The purpose of this study is to describe and assess a hearing screening program of first-grade children in Poland. The program aimed to detect hearing disorders and increase awareness among parents of hearing problems.
Material and methods
A hearing screening program was conducted in all elementary schools of the biggest region in Poland. A total of 34,618 first-graders were screened. The hearing screening protocol included video otoscopy and pure-tone audiometry. The program also included an information campaign directed to the local community and educational meetings between parents and medical staff.
Results
The estimated prevalence of hearing loss was 11%. Unilateral hearing loss was more common than bilateral hearing loss. Mild hearing loss was more frequent than moderate (or worse) hearing loss. In otoscopy, the most common positive result was otitis media with effusion. Parents and medical staff took part in 1,608 educational meetings, broadening the parents' knowledge of how to care for hearing.
Conclusions
A hearing screening program not only provides data on the prevalence of childhood hearing problems but is also an avenue for providing the local community with valuable knowledge about how to care for hearing. This study demonstrated the importance for systematic monitoring of children's hearing status and of increasing awareness among parents and teachers of the significance of hearing loss. The hearing screening of children starting school should become a standard part of school health care programs.

Key words: hearing loss • hearing screening • children • epidemiology

P05.3

33 - Hearing screening in school-age children from Kyrgyzstan results of screening and follow-up

Piotr H. Skarżyński [(1)] - Elżbieta Gos [(2)] - Irina Pierzyńska [(3)] - Adam Walkowiak [(4)] - Katarzyna B. Cywka [(5)] - Kinga Wołujewicz [(5)] - Henryk Skarżyński [(5)]

World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - Centre of Hearing and Speech Medincus, World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Oto-Rhino-Laryngosurgery, Warsaw/Kajetany, Poland [(3)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Implants and Auditory Perception, Warsaw/Kajetany, Poland [(4)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Oto-Rhino-Laryngosurgery, Warsaw/Kajetany, Poland [(5)]

Background
According to WHO data, hearing disorders are common in school-age children. Screening for hearing loss is an important preventative tool, helping to avoid further complications. Expenditure that supports early child development can reduce future outlay on health care and social services; it can eliminate disability problems, education deficits, and social maladaptation in later adult life.
Material and methods
Pure-tone air-conduction hearing thresholds were obtained at 0.5–8 kHz. The results of the hearing screening examination were regarded as positive if pure-tone thresholds were higher than 20 dB HL in one or both ears at one or more of the test frequencies. Data were also obtained from follow-up visits of children who failed the initial screening.
Results
This study included 452 children aged 7–13 years old. Based on audiograms, screening showed that 123 (27.2%) of the children had hearing impairment.
Conclusions
The study has important implications for clinical practice and health policy. There is a need for systematic monitoring of hearing status among children of this age, and parents and educators need to be made aware of the significance of hearing loss.

Key words: hearing loss • hearing screening • prevalence • pure-tone audiometry • school screening

P05.4

85 - Pilot hearing screening in schoolchildren from Armenia, Russia, Kyrgyzstan and Azerbaijan

Piotr H. Skarżyński [1] - Tetiana Golubok [2] - Kinga Wołujewicz [3] - Roman Barylak [2] - Henryk Skarżyński [4] - Ewelina Bukato [5] - Rita Zdanowicz [5] - Natalia Czajka [5]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [1] - Centre of Hearing and Speech Medincus, Institute of Physiology and Pathology of Hearing, Department of Oto-Rhino-Laryngosurgery, Warsaw/Kajetany, Poland [2] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Oto-Rhino-Laryngosurgery, Warsaw/Kajetany, Poland [3] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [4] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [5]

Background
A number of pilot hearing screening programs have been started in various countries, promoting hearing-loss detection and treatment of communication disorders in school-age children. The aim of the study was to evaluate the hearing status of schoolchildren from selected schools in Armenia, Russia, Kyrgyzstan, and Azerbaijan.
Material and methods
Hearing screening was performed in 1022 children aged from 6 to 12 years in Armenia, Russia, Kyrgyzstan, and Azerbaijan. The study was carried out with the use of the Sensory Examination Platform. Pure-tone air-conduction hearing thresholds were obtained at 0.5–8 kHz. Hearing loss was defined as a loss of more than 20 dB in one or both ears in at least one of the following: high-frequency pure-tone average (HFPTA) and low-frequency pure-tone average (LFPTA) and others.
Results
Normal hearing was observed in 75.4% of children. Hearing loss was observed in 13.4% of the children unilaterally and 11.2% bilat-erally. Overall, the results of screening indicate higher incidence of LFHL in children than HFHL.
Conclusions
The high prevalence of hearing loss in children from the studied countries indicates the need to conduct further hearing screening programs in this part of the world. This would allow earlier diagnosis of hearing problems and enhance the options for introducing proper diagnostic and therapeutic approaches, leading to better outcomes.

Key words: screening programs • hearing • children • school-age • pure-tone audiometry

P05.5

123 - The early developmental profiles of deaf and hard-of-hearing children and their associated predictive factors

Natalie Zehnwirth [(1)] - Libby Smith [(2)] - Valerie Sung [(2)]
The Royal Children's Hospital, General Medicine, Parkville, Australia [(1)] - Murdoch Children's Research Institute, VicCHILD, Parkville, Australia [(2)]

Background:
Concomitant developmental disability is common in Deaf and Hard-of-Hearing (DHH) children. We describe the early developmental profiles of DHH children and explore the factors that are associated with these profiles.
Methods:
We report on data from DHH children aged 0-66 months who are participants of a longitudinal child hearing databank in Victoria, Australia. Developmental profiles were measured using the Ages and Stages Questionnaire (ASQ) across five domains (communication, gross motor, fine motor, personal-social and problem-solving). We reported descriptive statistics and used logistic regression to determine predictive factors associated with below cut-off ASQ scores.
Results:
Caregivers of 882 children aged 0-66 months completed the ASQ between 2012 and 2022. ASQ scores were below-cut off for a significant proportion of children (35% communication, 24% fine motor, 23% problem-solving, 21% gross motor, 20% personal-social). Children with a mild degree of hearing loss scored below cut-off ranging from 16-26% across the domains. Predictive factors for below cut-off development included: admission to neonatal intensive care, extreme prematurity, infection requiring intravenous antibiotics and having >1 comorbidity for all domains. Bilateral hearing laterality, use of a cochlear implant, jaundice requiring treatment and seizures were associated with communication delays. Cochlear implant use was a protective factor for gross motor development. Male sex was associated with below cut-off development for fine motor skills. Enrolment in early intervention services was a protective factor for communication, problem-solving and personal-social development.
Conclusion:
Early developmental screening is imperative for DHH children, as these children have multiple developmental needs. Degree of hearing loss does not predict overall development, however children with a mild degree of hearing loss can have developmental impairments. Children with mild hearing loss detected at universal hearing screening may still benefit from developmental monitoring. Early targeted intervention to support DHH children is imperative in maximising their functional abilities and wellbeing.

Key words: development, disability, early intervention, paediatric, childhood

P06 - HEARING LOSS, COMMUNICATION AND QUALITY OF LIFE

P06.1

116 - Child- and Parent-Reported Listening Fatigue in Children with Cochlear Implants and Children with Hearing Aids

Ellie Cooper [(1)] - Krystal Werfel [(2)]
University of St. Augustine, Speech-Language Pathology Program, Dallas, United States [(1)] - Boys Town National Research Hospital, Center for Childhood Deafness, Language and Learning, Omaha, United States [(2)]

Introduction**:** Previous research has highlighted the differences in listening fatigue in children who are deaf or hard of hearing (DHH) versus children who have typical hearing (TH), with children who are DHH reporting more fatigue than their peers (Bess et al., 2020; Hornsby et al., 2014). Despite advancements in hearing technology and early detection of hearing loss, children who are DHH, as a whole, are behind their typical hearing peers in language and literacy (Geers & Hayes, 2011; Werfel et al., 2023). Due to the gaps in this population, it is critical to understand what role fatigue plays when comparing measures of language and literacy in children who are DHH.
Werfel and Hendricks (2016) examined caregiver report of fatigue in children with cochlear implants (CI) and found that parents underestimate their child's level of fatigue; however, children with hearing aids (HA) and typical hearing were not included in this sample. Additional evidence comparing children who are DHH to children with TH suggests that parents reported higher levels of fatigue in children with bilateral and unilateral hearing loss when compared to children with TH, but the groups were not separated by hearing technology (Adams et al., 2023). The current study will examine children who use CIs, HAs, and children who have TH.
The purpose of this study was to measure subjective fatigue in first grade children who are DHH who use hearing aids and CIs compared to children with TH. Additionally, this study examined fatigue levels in child report fatigue levels vs caregiver report fatigue levels of their children for children who are DHH and children with TH. The results from this study will also examine literacy skills between these groups in related to fatigue.
Method**:** Participants included 144 total first graders with 89 children who were DHH and 55 children with TH. Children in this study were part of the larger Early Language and Literacy Acquisition in Children with Hearing Loss (ELLA) study, children who were DHH and used spoken language and amplification and children with TH completed a subjective fatigue measure, as well as measures of literacy, during the summer after first grade. Self-report of fatigue was compared across groups and across caregiver report.
Results**:** We have completed a preliminary analysis that included 47 children who were DHH and 35 children with TH. First grade children who are DHH reported substantially more fatigue than children with TH ($F = 2.342$, $t(90) = -11.377$, $p < .001$), however, parents of children who are DHH did not report more fatigue for their children than children with TH ($F = .082$, $t(60) = .198$, $p < .422$). Fatigue performance differed between all three groups with TH reporting the least amount of fatigue ($p < .001$), followed by HA users ($p < .001$), followed by CI users ($p < .001$).
When examining word reading, reading comprehension, and spelling for children with CIs, fatigue was strongly related ($r(27) = .492$, $p < .001$; $r(26) = .479$, $p < .001$; $r(26) = .530$, $p < .001$). For children with HAs, reading comprehension was strongly correlated ($r(16) = .493$, $p < .05$), but word reading and spelling were not. However, after controlling for language in the regression models, fatigue only predicted literacy in the children with CIs ($R^2 = .336$, $p < .017$). The final analysis will reflect the results with the full sample size of 144 children.
Conclusions**:** Consistent with prior work, children who are DHH reported substantially more fatigue than their peers with TH. Additionally, parents of children who are DHH did not report more fatigue in their children, although their children reported higher levels of fatigue. For children with CIs, fatigue was related to word reading, reading comprehension, and spelling but it was only related to reading comprehension for children with hearing aids. After controlling for language, fatigue predicts literacy only in children with CIs. These findings indicate that children with CIs report the highest amount of fatigue, followed by HA users, with TH reporting the least amount of fatigue. Further research should explore the directionality of this relation, and practitioners should consider the fatigue experienced by children who are DHH when planning literacy instruction.

Keywords: Listening fatigue, language and literacy skills

P06.2

57 - Effect of socioeconomic status on the changes in social relationships after use of hearing aids

Young Ho Kim [(1)]
Seoul National University College of Medicine, Boramae Medical Center, Otorhinolaryngology, Seoul, Korea, Republic Of [(1)]

Objectives**:** Hearing impairment affects physical health, social networks, depressive mood, cognitive function impairments, and socioeconomic status (SES). Hearing aids can improve these deficits, however, they may also be affected by various other factors. SES also influences social relationships, mood, and cognition. We conducted this study to identify how SES moderates the effects of hearing aids on social networks, depressive mood, and cognitive function.
Methods**:** The patients who had hearing impairments and required hearing aids were included. And, the patients were classified into two groups based on their SES; the low SES group and the medium to high SES group. Audiological examination, Lubben social network scale-18 (LSNS-18), Short form of Geriatric Depression Score (SGDS), Mini-Mental State Examination in the Korean version of the CERAD Assessment Packet (MMSE-KC), Abbreviated Profile of Hearing Aid Benefit (APHAB), and Korean version of International Outcome Inventory for Hearing Aids (K-IOI-HA) were conducted before and 6 months after wearing hearing aids.
Results**:** After wearing hearing aids, LSNS-18 scores were not improved in low SES group ($p = 0.664$). In contrast, the LSNS-18 scores were improved in the medium to high SES group ($p = 0.003$). And, low SES groups showed lower LSNS-18 scores ($p=0.020$) and their change ($p=0.042$) than the medium to high SES group. In addition, patients with depressive mood of the medium to high SES group showed improvements compared with those of the low SES group ($p = 0.048$). The effect of wearing hearing aids on the cognitive impairment is not different between two groups ($p = 0.332$), and the satisfaction with hearing aids was also not different in APHAB ($p = 0.887$) and K-IOI-HA ($p = 0.709$).
Conclusions**:** Hearing-impaired patients with low SES faced difficulties in obtaining sufficient benefits from hearing aids. Since hearing impairment negatively affects social relationship and depressive mood, it is important to provide comprehensive and multidirectional support for hearing rehabilitation to patients with low SES.

Keywords*:* hearing aids, low socioeconomic status, social networking, depression

P06.3

99 - Exploring Speech-in-Noise Intelligibility Deficit in Individuals with Poorly Controlled Type-2 Diabetes Mellitus

Mathieu Schué [(1)] - Véronique Baudoux [(1)] - Laura Breda [(1)] - Frédérique Défossé [(1)] - Hugo Laullier [(1)] - Sylvie Pucheu [(1)] - Hugo Vanacker [(1)] - Charles Vincent [(1)]
CILCARE, Clinical Sciences, Montpellier, France [(1)]

Hearing loss is more and more frequently reported, both at preclinical and clinical levels, as an additional complication of type-2 diabetes mellitus, similarly to retinopathy, nephropathy, and neuropathy (Giraudet et al., 2022; Lyu et al., 2021). The exact mechanism has not been fully elucidated but microangiopathy, systemic inflammation and auditory neuropathy have been proposed as possible main causes of this sensorineural deafness (Samocha-Bonet et al., 2021). As a result, guidelines recommending hearing evaluation in patients with diabetes on a yearly basis are starting to emerge. In order to strengthen this work and to accelerate the development of urgently needed therapeutics, observational clinical data would be extremely useful to precise which clinical audiological tests are the most suitable to detect hearing loss as early as possible and what added value they can bring in the hearing healthcare management of diabetic patients.
The work presented here is based on interim data analysis from an on-going observational clinical trial, aiming to phenotype hearing function in patients with type-2 diabetes mellitus. Two hundred and five patients aged form 25 to 70 years old, with glycated haemoglobin (HbA1c) value over 7% and with at least 2 years of type-2 diabetes duration were included and requested to answer a questionnaire on their perceived quality of hearing, medical history and quality of life. Biochemical data and concomitant treatments were also collected for subset analysis. In a second part, patients were administered a wide battery of audiological tests (including otoscopy, audiometry and impedancemetry) as well as electrophysiological tests (Auditory Brainstem Response (ABR) and electrocochleography (EcochG) in order to precisely evaluate the hearing function. Patients with asymmetric and conductive hearing loss were excluded from the study analysis.
From the data gathered on approximately half of the targeted sample size, we were able to investigate : (i) the prevalence of sensorineural hearing loss (SNHL), as defined at ear level by a pure-tone average (PTA) above 20 dBnHL over 0,5; 1; 2; 4 kHz and (ii) the prevalence of hidden hearing loss (HHL), as defined at ear level by a PTA below 20 dBnHL over 0,5; 1; 2; 4 kHz combined to at least 3dB SNR above the normative value of a validated speech-in-noise test. In our population, the prevalence of HHL was equivalent to the prevalence of SNHL, highlighting the fact that standard audiogram is not sufficient to detect hearing issues in diabetic patients, leaving one patient out of two undiagnosed. Main drivers of the distribution of patients in these categories were age, HbA1c, disease duration. Interestingly, the presence of other diabetes complication (retinopathy, nephropathy and neuropathy) strongly influenced the distribution of patients across the different categories. Initial data also supports the use of extended high-frequency audiometry testing to identify patients at risk of speech-in-noise intelligibility deficit.
The results presented here support the fact that patients with type-2 diabetes, especially with poor glycaemic control, are at higher risk of acquiring hearing loss, and that the first clinical manifestations are likely to involve speech-in-noise intelligibility deficit. Initial findings of the study are discussed in line with recently published clinical data and open the route for a more adequate and systematic hearing monitoring in relation to diabetes.

Key words: Type-2 diabetes ; hidden hearing loss, speech-in-noise intelligibility

Giraudet, F., Mulliez, A., de Resende, L.M., Beaud, L., Benichou, T., Brusseau, V., Tauveron, I., Avan, P., 2022. Impaired auditory neural performance, another dimension of hearing loss in type-2 diabetes mellitus. Diabetes & Metabolism 48, 101360. https://doi.org/10.1016/j.diabet.2022.101360
Lyu, A.-R., Kim, T.-H., Shin, S.-A., Kim, E.-H., Yu, Y., Gajbhiye, A., Kwon, H.-C., Je, A.R., Huh, Y.H., Park, M.J., Park, Y.-H., 2021. Hearing Impairment in a Mouse Model of Diabetes Is Associated with Mitochondrial Dysfunction, Synaptopathy, and Activation of the Intrinsic Apoptosis Pathway. IJMS 22, 8807. https://doi.org/10.3390/ijms22168807
Samocha-Bonet, D., Wu, B., Ryugo, D.K., 2021. Diabetes mellitus and hearing loss: A review. Ageing Research Reviews 71, 101423. https://doi.org/10.1016/j.arr.2021.101423

P06.4

172 - Impact of COVID-19 on deaf and hard-of-hearing children's learning: A mixed methods study

Rija Khanal [(1)] - Rona Weerasuriya [(2)] - Libby Smith [(1)] - Valerie Sung [(1)]
Royal Children's Hospital, Centre for Community Child Health, Melbourne, Australia [(1)] - Murdoch Children's Research Institute, Population Health, Melbourne, Australia [(2)]

Background: There have been significant changes to education modalities during the COVID-19 pandemic which have had particularly profound impacts for children who are deaf or hard of hearing (DHH).
Aim: To explore the impact of the COVID-19 pandemic on learning and education of DHH children.
Methods: A survey was sent out in May 2020 to participants in the Victorian Childhood Hearing Impartment Longitudinal Databank (VicCHILD) registry. VicCHILD is a longitudinal databank which is open to every child with congenital hearing loss in Victoria, Australia. Quantitative data was collected regarding changes to school enrolments, learning methods, enjoyability and engagement with learning. Furthermore, qualitative responses were recorded regarding families' learning experiences during this period. Phenomenological methodology was used to analyse this qualitative data using both inductive and deductive coding.
Results: A total of 497 families filled in the survey of whom 385 provided meaningful qualitative data in response to the question regarding impact on education during the pandemic. Families and children with DHH had quite varied learning experiences during the COVID-19 pandemic, while also sharing collective similarities in their insights. Most children (80.3%) had changes to their education during this period. Some families felt there was no impact to learning, whereas a large majority of families felt that the pandemic presented barriers to child learning and some families felt that the changes to learning during this period presented more positively as an enabler of child learning. Families mentioned factors such as hearing issues, learning space issues, technological factors and parental supports causing impacts to the education of children during the pandemic.
Conclusion: Although most DHH children included in this study expressed changes to their education during the COVID-19 pandemic, their lived experiences varied dramatically. While some children thrived in their learning, motivation and independence during this period, most families faced challenges with difficulty in engagement and increased distractibility leading to decrease in productivity. Hearing difficulties and technological challenges as well as lack of physical learning spaces posed as education barriers. Social isolation was also seen to be a major challenge to learning in this population.

Keywords: COVID-19; Deaf and hard-of-hearing; Education modalities

P06.5

175 - How does hearing impairment among older persons affect their communication partners' health, communication, and social activities?

Katja Anióse [(1)] - Elisabeth Ingo [(1)] - Henrik Danielsson [(1)] - Meg Wallhagen [(2)] - Rachel Ellis [(1)]
Linköping University, Behavioural Sciences and Learning, Disability Research Division, Linköping, Sweden [(1)] - University of California, Department of Physiological Nursing, UCSF Hartford Center of Gerontological Nursing Excellence, School of Nursing, San Francisco, United States [(2)]

Background
The impact of hearing impairment on communication partners has yet little attention. Most studies have found a negative effect on the communication partner: restricted social life, poorer relationship satisfaction and quality of life. These effects can be referred to as a third-party disability. Evidence suggests that there are gender differences where female communication partners of men with hearing impairment are more likely to be negatively affected and vice versa. Hearing aids may influence this gender effect, but sufficient evidence is lacking. Studies suggest that men are less likely than women to use their hearing aids regularly and more likely to use negative coping strategies to deal with their hearing impairment. Involving communication partners in hearing care and raising awareness about possible consequences for said partner has been suggested. Unfortunately, today's hearing rehabilitation does not address the far-reaching consequences of hearing impairment extending to the communication partner. Additional research is required to establish a foundation for incorporating the requirements of the communication partner into hearing rehabilitation efforts. To date, no study has investigated how communication partners are affected by their partners' hearing difficulties in a Swedish context.
Purpose
The study aims to investigate 1) what health implications older adults whose partners have hearing difficulties experience, 2) how the partner´s hearing difficulties impact the communication partner´s experiences of joint daily communication, use of communication strategies, and social activities, and 3) whether there are any differences based on: hearing aid use, gender, and dual hearing difficulty.
Method
The data collection will be finished in April, and the results will be presented at the conference. Participants must be 65 years or older, retired and living with a partner with hearing difficulties who is also 65 years or older and retired. The participants are recruited via social media and in newspapers to complete an online survey including study-specific questions and two questionnaires: RAND-36 measuring self-rated health, and the Significant other scale for hearing disability, SOS-HEAR (translated to Swedish by us) measuring third-party disability. The survey data is collected over three months. Group differences in questionnaire scores (overall and for each subscale) will be assessed using analyses of variance (ANOVA). Independent variables will be the use of hearing aids, gender, and hearing difficulties with communication partners. Demographic variables will also be included in the regression analyses.
Results
This study will address the existing gap in the scientific literature concerning the effects on the communication partner and endeavours to support the need to include the communication partner in auditory rehabilitation by demonstrating the impact of a partner's hearing difficulties. We expect to present how a partner's hearing difficulties affect health, communication, social activities and, thereby, quality of life among older adults in Sweden.
Clinical Significance/Implications
Findings from this research may strongly support integrating communication partners into audiological rehabilitation programs for improved hearing care, particularly when the communication partners' specific needs are considered. Furthermore, should we observe evidence of third-party disability, novel interventions would hopefully lead to improved communication-related psychosocial outcomes and increased participation in social activities for persons with hearing impairment and their communication partners.

Keywords: Hearing impairment, communication partner, communication, social activity, third-party disability.

P06.6

195 - Successful aging with hearing loss: how do hearing-related adaptive strategies relate to positive hearing outcomes in older adults?

Rosa-Linde Fischer [1] - Bettina Williger [2] - Stefan Kamin [3] - Lukas Graber [3] - Stephanie Schmitt-Rüth [4]
WS Audiology, Scientific Audiology, Erlangen, Germany [1] - University of Applied Sciences, Engineering Psychology, Landshut, Germany [2] - Fraunhofer, IIS, Nürnberg, Germany [3] - University of Applied Sciences, Business School, Amberg-Weiden, Germany [4]

In the perspective of successful aging, individuals have a proactive role in lifespan development. One prominent theory is the model of selective optimization with compensation (SOC; Baltes & Baltes, 1990) which describes adaptive strategies, namely selection, optimization, and compensation. By this, successful aging goes beyond the achievement of desirable outcomes (i.e. quality of life). It rather reflects on human capacities such as loss adaptation and mastery of changes over the life span, e.g., diagnosis of age-related hearing loss or hearing aid uptake (Filipp & Aymans, 2018). Based on the first application of the SOC model to hearing aid uptake and usage (Williger & Lang, 2014) and a literature analysis, a scale on hearing-related adaptive strategy use (AStra) has been developed (Fischer et al., 2022, 2023). The scale includes behavioral strategies regarding SOC, i.e. selection or optimization of listening situations and compensation by means of environmental and social support. The current work aims to study how these hearing-related adaptive strategies relate to positive hearing outcomes in older adults.
Self-report data were collected within a 6-months longitudinal field study which was administered via the proprietary research app “MyHearingExperience”. 87 participants (mean age 60.4 years, 59% female) with hearing difficulties participated in the study. Out of these, 46% were hearing aid users and 54% non-users. Hearing-related adaptive strategy use was measured via Astra scale. Positive hearing outcomes were defined as functionality (SPaRQ; Hefernan et al., 2017), self-perception (HDHS; Hallberg, 1998), and psychosocial effects (Göteburger Profile; Ringdahl et al., 1998).
Preliminary results show that hearing-related adaptive strategy use highly relates to positive hearing outcomes. Analyses on the differential effects of self-reported hearing loss and hearing aid use are ongoing.

Keywords: age-related hearing loss, adaptive strategies, successful aging, lifespan development

P06.7

244 - Understanding Cultural Variations in Stigma Related to Hearing Loss and Hearing Aid Use

Suhani Pattanshetti [(1)] - Charlotte Vercammen [(1)] - Gabrielle Saunders [(1)] - Samuel Couth [(1)]
University of Manchester, Division of Psychology, Communication and Human Neuroscience; Faculty of Biology, Medicine, and Health, Manchester, United Kingdom [(1)]

Stigma can influence morbidity, mortality, and health disparities, thereby affecting one's health and well-being. Someone who has close associations with people with a stigmatising condition (PwSC), such as family members or primary caregivers, may also experience stigma due to their association (known as associative stigma). When the stigmatising beliefs from associative stigma are internalised or endorsed by the family member or primary caregiver, it becomes known as 'affiliate stigma', thus making them the 'affiliate'. In a recent scoping review, we explored how affiliate stigma impacts the PwSC, themes uncovered were social isolation, reduced communication, and reduced health seeking behaviours, Additionally, we examined how this impact has been measured in previous research. One key finding was that cultural factors could exacerbate or mitigate affiliate stigma and its effect on PwSC. This finding suggests that the origins of health-related stigma, such as hearing loss stigma, and its impact on PwSC and affiliates, may vary between cultures.
Data from the UK Biobank have shown that South Asian individuals exhibit a higher likelihood of poorer hearing and lower adoption of hearing technology compared to White British individuals. However, the role of stigma was not examined. The aim of our study is to explore how hearing loss stigma differs between cultures within the UK and as a result of acculturation. We are investigating perceptions and experiences of stigma relating to hearing impairment and use of assistive devices (e.g. hearing aids), from 3 perspectives: those of people with normal hearing, people with hearing loss, and affiliates of people with hearing loss.
Data are being collected from White British and first and second generation South Asian individuals via an online survey. The survey assesses stigma linked to hearing loss (HL) and the adoption of hearing aids (HA) using subscales from validated questionnaires, and affiliate stigma within the context of hearing loss. Respondents also answer open ended questions regarding thoughts that come to mind when thinking about hearing loss, and views on other peoples' use of hearing aids. Participants also answer questions regarding their sociodemographic details (age, gender, nationality, and education level) and acculturation, assessed with questions related to i) generational status (first/second generation UK citizen), ii) length of residency in the UK, and iii) languages known and language majorly spoken/proficient in.
Data collection and analysis is ongoing. Preliminary findings will be discussed along with the implications for hearing care, such as the development of interventions to overcome the impact of hearing loss stigma within and across cultures.

Keywords: stigma, affiliate stigma, acculturation, , cultural influences, hearing loss

P06.8

30 - Personal music players use and other noise hazards among children 11 to 12 years old

Piotr H. Skarżyński [(1)] - Natalia Czajka [(2)] - Elżbieta Gos [(2)] - Henryk Skarżyński [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(3)]

Background**:** Exposure to loud music—due to widespread personal music players (PMPs) and noisy leisure activities—are major risk factors for noise induced hearing loss (NIHL) in adolescents. However, there is little evidence of the impact of noise on the hearing of younger children. This study aimed to explore an association between PMP use and hearing, and to identify other sources of noise among children.
Material and methods**:** The study sample consisted of 1032 children aged 11–12 years old. Hearing thresholds were determined from 0.5 to 8 kHz. PMP use and other noise exposures were evaluated using a survey.
Results**:** We found that 82% of the children had a PMP, and 78% were exposed to noise when playing computer games. An audiometric notch was documented in 1.3% of the children. Only 11.5% of the children ever used hearing protection while engaged in noisy activities.
Conclusions**:** We found no convincing evidence of an association between PMP use and hearing thresholds, although our results suggest that tinnitus may be an early sign of NIHL in young children. The study shows a need to provide children, their parents, and educators with knowledge of how to take care of hearing, including how to avoid and minimize noise exposure.

Key words: noise • noise induced hearing loss • personal music players • children

P06.9

41 - Subclinical effects of noise exposure in teenagers: A pre-registered longitudinal study

Hannah Guest [(1)] - Kevin Munro [(1)] - Carlyn Murray [(1)] - Garreth Prendergast [(1)] - Karolina Kluk [(1)] - Rebecca Millman [(1)] - Rebecca Dewey [(2)] - Chris Plack [(1)]
The University of Manchester, Manchester Centre for Audiology and Deafness, Manchester, United Kingdom [(1)] - University of Nottingham, Sir Peter Mansfield Imaging Centre, Nottingham, United Kingdom [(2)]

Background: Findings on the subclinical effects of noise exposure in young people have often been inconsistent and inconclusive, likely due to (a) small samples, (b) inaccurate retrospective estimates of noise exposure, (c) post-hoc data dredging, and (d) individual variability in outcome measures unrelated to noise exposure. The most persuasive evidence comes from studies with large samples, large differences in noise exposure, and within-subject difference measures. However, all are limited by their cross-sectional designs. Difference measures at a single timepoint are inevitably less powerful than differences in the same measure over time. Purely retrospective self-report of lifetime noise exposure can be problematic, even when participants with high and low exposure diverge greatly. None of the extant work has been pre-registered, leading to potential type I error from exploration of rich data sets.
Some longitudinal research over short time periods has been reported. However, studies spanning years and encompassing a substantial portion of lifetime noise exposure are required. In the UK, the optimal period includes the late teenage years, when concert and nightclub attendance become commonplace.
The present study on subclinical effects uses: a prospective approach with regular follow-ups (to improve estimates of noise exposure); repeated measures (to minimise between-subject variability); and pre-registration (to guard against data dredging).
Methods: A cohort of 220 teenagers with normal hearing, aged 16-17, underwent 3.5 hours of physiological, perceptual, and self-report measures. At age 19-20, the test battery will be repeated. The participants self-report noise exposure at 18-month intervals.
Planned analyses will test for relations between noise exposure and changes in: extended high-frequency audiometry; distortion-product otoacoustic emissions; auditory brainstem response wave I amplitude; and the middle-ear muscle reflex.
Exploratory analyses will incorporate: changes in speech perception and tinnitus; effects of sex and skin tone; effects of pattern of noise exposure; effects of nicotine, alcohol, and deprivation; and relations between personal characteristics, physiology, and perception.
Results: At the mid-point of the study, retention is high (95%). The sample skews male (56%) and is highly diverse in terms of skin tone, deprivation, and educational attainment.
The main research questions will be addressed in 2026, but baseline data are available. In particular, the initial homogeneity of the cohort (young, otologically normal, with little noise exposure) allows examination of extraneous variability in our measures.
Conclusions: A large-scale longitudinal study in this population is challenging but feasible. We will present baseline data, including non-auditory contributors to speech perception, and effects of sex, skin tone, and ear-canal size on auditory measures. Follow-up data will be analysed primarily in line with the pre-registered protocol, but extensive (and openly disclosed) exploration will also be possible. The data set will be shared openly, and our team welcomes suggestions and collaborations to support exploitation of the data.

Keywords: Noise exposure; Subclinical hearing; Adolescence; Longitudinal; Pre-registration

P07 - IMPROVING HEARING CARE AND SERVICES

P07.1

128 - CI Services Matter

Sue Archbold [1] - Connie Mayer [2] - Brian Lamb [1] - Imran Mulla [1]
CIICA.AISBL, Education, 1050 Bruxelles, Belgium [1] - York University, Education, Toronto, Canada [2]

This global study explored the expereinces of deaf and deafened adults with cochlear implants (CI) about their satisfaction with CI and the services they receive, in order to influence CI service provision.
A survey containing open and closed questions was piloted with CI users, and distributed globally online through the CIICA (CI International Community of Action) network. The survey was made available in 6 languages. The results of the open and closed questions were analysed and reported together. A report, CI Services Matter, and a policy briefing were made available for CI advocacy activities.
1076 adults from 40 countries responded to the survey; respondents were aged between 18-91 at the time of response, and were implanted between few months and 88 years. The findings include:

- When asked how much they wore their CI, 77% wore them all time, 20% most of the time, and 2% some of the time. 6 had stopped wearing their implant.
- There were high levels of satisfaction with the technology: 72% were very satisfied with their CI, 24 were satisfied and 4% were not satisfied.
- When asked about overall satisfaction with the services they received: 56% were very satisfied, 40% were satisfied and 4% were not satisfied, With regard to rehabilitation, 32% reported they had not received enough, with 27% reporting none. There was a very wide range of service provision.
- Ongoing funding was a major issue: 10% paid personally for fitting, 16% for rehabilitation. 49% paid for batteries by personal funding; 54% paid personally for accessories. 29% paid for repairs with personal funding. This is in addition to those who used Private Insurance. Finance was a major issue for spares, repairs, and upgrades and 11% had no spares at all. There were examples where people had stopped using their CI because of lack of funding.

The free responses conveyed high levels of satisfaction with CI but this led to a reliance on the functioning of CI for everyday communication. The major concerns were lack of rehabilitation for adults, daily concerns if the technology breaks down, and lack of funding for lifelong services.
Adults were more satisfied when they had regular appointments, ready access to technology support, upgrades, bilateral CI, spares, person centred care, including peer groups, CI groups, counselling services, and informal self-initiated therapy.
In conclusion, there were very high levels of satisfaction with CI and with overall services received, but major issues over lack of rehabilitation, funding and lifelong support. As two respondents commented:

You can save yourself the question: I'll be dependent on it for the rest of my life. (Germany)

No implant: no sound, no family life, no friends, no job (I am a nurse), no birds, no cat's purr, no wind in my ears, no sound of waves, no children's laughter…. Implants = life (France)

Lifelong funded CI Services clearly matter for adults and are a responsibility for all involved in delivering them.

Key words: Cochlear implants, CI Services, rehabilitation, funding, technology management, adults

P07.2

170 - Caring for Good Hearing – Evaluation of the Prevention Programme "Hearing and Communication in Long-term Care Facilities" in Bavaria, Germany

Carolin Gravel [(1)] - Naëmi Budke [(1)] - Karolin Schäfer [(1)]
University of Cologne, Department of Rehabilitation and Special Education - Education and Aural Rehabilitation for People with Hearing Loss, Cologne, Germany [(1)]

Introduction**:** An estimated 60% of people in Germany over the age of 60 are affected by age-related hearing loss, but only 15% of these people are actually provided with hearing aids (Hesse & Laubert, 2005). Elderly people living in long-term care facilities are particularly at risk of being affected by unrecognised hearing loss that are inadequately treated and cared for. This can influence their day-to-day functioning and increase the risk of isolation, communication deprivation and cognitive decline. According to the UN Sustainable Development Goal 3 (SDG3) *Good Health and Well-Being* and the recommendations of the WHO *World Report on Hearing*, ear and hearing care should be provided across the lifespan and therefore should not exclude older people.
The Institute for the Blind Würzburg started the prevention programme "Hearing and Communication in Long-term Care Facilities" (10/2021-09/2024) to address these aspects of ear health in higher age and raise awareness. The University of Cologne provides scientific support for the prevention programme and evaluates its components.
Methods**:** The data collection and implementation of the prevention programme in n=75 long-term care facilities in Bavaria, Germany is carried out by employees of the Institute for the Blind Würzburg. The mixed-methods design includes questionnaire surveys of all participants, room acoustics measurements and hearing screenings for elderly residents. The University of Cologne is analysing the data and evaluating the components. In addition, the University of Cologne conducted a qualitative interview study with 24 employees from six long-term care facilities. In these facilities, the prevention programme had been implemented at least six months previously. The research team conducted seven problem-centred group interviews between September 2023 and January 2024. The aim of the interview study was to identify sustainable changes, but also challenges in implementation.
Results**:** Data is already available (as of 02/2024) from 365 elderly residents from 55 long-term care facilities. The average age is almost 88 years (ø 87,9). Otoscopy revealed that the right or left ear was partially or completely blocked by cerumen in approx. 1/3 of the tested residents. The poster also presents the results of the hearing tests according to the WHO grades of hearing loss as well as the results on hearing-related quality of life of the elderly residents. The prevention team measured the reverberation time in 220 rooms in accordance with the DIN 18041 standard "Acoustic quality in rooms". This also included rooms in recently built facilities. Only three rooms met the standard so far. In addition, the poster provides an insight into the quantitative and qualitative feedback from employees on the training (quantitative questionnaires n= 1029). Among other things, 89 % of the employees agree or strongly agree that they feel well informed by the training.
Conclusion**:** The analysis of the data makes an important contribution to taking stock of the hearing health of older people with age-related hearing loss in Germany. It can already be stated that this topic is still not being given enough attention, particularly among older people living in long-term care facilities. Given that age-related hearing loss "poses the greatest societal and economic burden from hearing loss across the life course and is expected to increase with the current demographic shifts" (WHO, 2021, p. 28), a person-centred ear and hearing care should be provided especially in higher age. It seems that the prevention programme can be one component for improving ear and hearing health of residents living in long-term care facilities. For sustainable change and in accordance with the WHO's H.E.A.R.I.N.G. package (Hearing Screening and Intervention, Ear Disease Prevention and Management, Access to Technologies, Rehabilitation Services, Improved Communication, Noise Reduction, Greater Community Engagement), various stakeholders must work together.

Keywords: Age-related hearing loss, long-term care facilities, hearing-loss prevention, hearing care, high age

The project is funded by the Bavarian State Ministry of Health, Care and Prevention, Munich, Germany.

References**:** Hesse, G., Laubert, A. Hearing loss in old age - manifestation and localisation. In: German Medical Journal. 2005; 102(42), A. 2864-2868; World Report on Hearing. Geneva: World Health Organization. 2021.

P07.3

176 - The lived experience of hearing loss: a systematic narrative review of coping with hearing loss and its psychosocial implications

Helen Pryce [(1)] - Georgina Burns-O'Connell [(1)] - Sian Smith [(1)] - Rachel Shaw [(2)]
Aston University, Department of Audiology, Birmingham, United Kingdom [(1)] - Aston University, Aston Institute of Health and Neurodevelopment and School of Psychology, Birmingham, United Kingdom [(2)]

This is a piece of work within a larger study. The Hearing Loss and Patient Reported Experience (HeLP) study is a National Institute of Health Research Health Service and Delivery Research funded programme in the NHS in the UK (grant no NIHR 131597), sponsored by University Hospitals Bristol and Weston NHS Trust and delivered with Aston University and the University of Bristol.

Background: The repercussions of hearing loss can extend beyond the auditory realm and this can have a detrimental impact on all aspects of life, including communication, personal relationships, and psychosocial health. Historically, however, audiology research has primarily focussed on the investigation of hearing function.
Aim: The purpose of this review was to identify and synthesise findings about the lived experience of adults with hearing loss in published scientific research.
Design: The SPIDER framework (Sample, Phenomenon of Interest, Design, Evaluation and Research type) was used to develop our research question: What is the impact of hearing loss on people's lives and how has this been studied? A mixed-methods systematic review was conducted, using a search including six databases: Web of Science, PubMed, PsycINFO, Embase, Scopus, and CINAHL, reference chaining was used to ensure that all relevant articles were identified. There were no date restrictions applied to our searches. The Mixed Methods Appraisal Tool (MMAT) was used to assess the quality of all included studies. Included papers were classified a key paper, satisfactory, unsure, or poor. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement principles were followed in developing and reporting on this review.
Analysis: Principles of thematic analysis were used to identify the key themes in the included papers which provided a synthesis of the characteristics of the lived experience of hearing loss. To extract relevant characteristics about the included studies, a data extraction sheet was developed and used to facilitate the process of thematic synthesis.
Results: Of the 1,026 studies screened, 87 papers met the inclusion criteria. The included papers spanned over 40 years with most (71%, n=62) being published since 2010, indicating an increase in this area of research over the last decade. Four key themes were developed: (i) experiencing social (dis)connection, (ii) being displaced, (iii) doing the work of hearing loss, (iv) negotiating healthcare encounters.
Conclusion: The focus on the experience of hearing loss, beyond hearing function, is a growing area of research. Beyond the more traditional perspective which focuses on hearing function, research exploring the lived experience is an expanding area which takes a holistic perspective in exploring the intricacies of the experience of living with hearing loss. Insights derived from research which has taken a more holistic view, have the potential to inform and advance healthcare approaches tailored to the multifaceted dimensions of living with hearing loss.

Keywords: Hearing loss, adaptation, social stigma, psychosocial interventions, systematic review, lived experience

P07.4

222 - Hearing health intervention based on the principles of interactive education

Wanderleia Blasca [(1)] - Maria Thereza Piccino [(1)] - Vivian Vespero [(1)] - Lucas Neri [(1)] - Bianca Antonelli [(1)]
Universidade de São Paulo, Audiology and Speech Patology, Bauru, Brazil [(1)]

According to the World Health Organization, approximately 1.5 million young people have hearing loss caused by exposure to high sound pressure levels. Health promotion involves educational aspects, transforming habits and lifestyle. In this way, Health Education projects about exposure to high levels of sound pressure, which establish international partnerships, become paths for disseminating knowledge, through a methodology solidified by previous studies involving youth protagonism. In light of this, a hearing health intervention program was developed based on the principles of Interactive Education, using the dynamics of the Dangerous Decibels® program combined with the proposal of the Young Doctor Project. The study was carried out with 41 schoolchildren in 2 schools, one private and one public municipal, and in 1 Social Promotion Center in the interior of São Paulo-Brazil. The activities were developed in stages. Firstly, the young people participated in a face-to-face activity, using activities from the Dangerous Decibels® Brasil program. Then, the students produced educational materials that were presented in the Cultural Workshops held by them in each school, aiming to multiply knowledge for their colleagues. To evaluate the effectiveness of the intervention program, identical questionnaires were used in three situations: pre-intervention, post-intervention and after four months of carrying out the program. The results demonstrate that the intervention program was effective. Descriptive statistical analysis was performed. The effectiveness of the program was evaluated immediately after and 4 months later. It was observed that there is a statistically significant difference ($p < 0.001$) in the mean values between the groups, in the 3 situations. When evaluating the schools, a statistically significant difference ($p < 0.05$) was observed between the groups that differ from the others. Domains were also evaluated, it was possible to observe that for the “Knowledge”, “Behavior” and “Barrier” domains, there was an immediate increase in results, sustained after 4 months. It can be concluded that the program was effective, causing students to change their attitudes towards potentially dangerous sounds.

P07.5

236 - A Community-Based Experiential Learning Partnership to Provide Hearing Healthcare to Underserved Populations

Lisa Rickard [(1)]
University of Maryland College Park, Hearing and Speech Sciences, College Park, United States [(1)]

This poster describes an experiential learning community-based project between audiology graduate students and patients who are linguistically and culturally diverse and from historically underserved populations who receive care at the multidisciplinary Arlington Free Clinic near Washington, DC, USA

The personal and public health costs of untreated hearing loss are far-reaching. Research confirms that untreated hearing loss negatively impacts individual well-being as well as public health. Correlations between untreated hearing loss and cognitive decline, social isolation and depression, loss of income, and poorer health literacy and health resource utilization are well-documented (Pichora-Fuller et al. 2015) Treating hearing loss via the use of hearing aids may help to mitigate the negative impact of hearing loss (Lin, 2011).

Lack of access, prohibitive cost, and stigma create known barriers to hearing healthcare (Mahmoudi, E. et al. 2018). Hearing healthcare services are beyond the reach of many adults and families, especially the uninsured or those from underserved populations. Significant disparities exist in equitable access to and utilization of hearing healthcare services among underserved populations. Understanding the social determinants of health (SDH) as outlined by the World Health Organization (World Health Organization 2021b) may give insight into these disparities. SDH are known factors both inside and outside the home that impact one's access to quality healthcare access and overall health outcomes (Schuh and Bush, 2022).

The role of a public institution such as the University of Maryland is to foster deeper understanding in our students of the drivers behind disparities in healthcare access and the factors that allow these disparities to persist. Ideally, community-based, experiential learning opportunities such as this project will help students to imagine culturally intelligent and inclusive interventions to promote hearing health equity for all.

In February 2022, The Hearing and Speech Clinic (HESP) at the University of Maryland, College Park (UMCP) established a partnership with the Arlington Free Clinic (AFC) https://www.arlingtonfreeclinic.org in Arlington, Virginia to provide hearing healthcare services to its patients. AFC provides comprehensive preventative and specialty healthcare to low-income adults in a community setting. It leverages resources from healthcare volunteers and donors to provide care to its patients.

Beginning in September 2022, clinical faculty in Audiology and doctor of audiology students under their direct supervision began providing services to include diagnostic hearing evaluations and hearing aid fittings on site.

Community-based, experiential learning opportunities such as this project will help students to imagine culturally intelligent and inclusive interventions to promote hearing health equity for all.

The overarching goal of this community partnership is to create a mutually beneficial experience between graduate students in the HESP department and patients who receive care at the Arlington Free Clinic. This is an innovative model in that evidence-based diagnostic assessment and non-medical rehabilitation of hearing loss is provided in a multidisciplinary community health clinic to an underserved population at no cost to the individuals receiving care. The project encourages interprofessional collaboration with other health professionals that is not feasible within the traditional classroom setting. It also exposes students to alternate models of healthcare delivery that can be replicated in their future careers. Ideally it will inspire them to imagine solutions for a more equitable, sustainable, and resilient world.

This project:

- Invests in people and communities to support individuals' ability to fully participate and thrive in their community, state, and world
- Reimagines clinical education via the use of high-impact experiential learning to ensure that students have the opportunity to gain experience through public service and project-based experiences
- Encourages students to engage in work in support of the public good

This poster will address the rationale for this project, the logistics of implementing the project, and how success has been measured thus far for all stakeholders: students, patients, and leadership at the Arlington Free Clinic.

Reference list available upon request

Key Words: Community-based care; Underserved populations; Disparities in hearing healthcare access; Cultural and linguistic diversity

P07.6

39 - The accuracy of parental suspicion of hearing loss in children

Piotr H. Skarżyński [(1)] - Natalia Czajka [(2)] - Elżbieta Gos [(2)] - Henryk Skarżyński [(3)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(3)]

Background**:** Parental suspicion of hearing impairment in their children is generally inaccurate. Parents tend to underestimate hearing problems in their children. The aim of the study was to assess the accuracy of parental suspicion of hearing loss in their children.
Material and methods**:** This was a population-based, epidemiological study conducted in elementary schools in villages and small towns in Poland. The study sample was 64,750 children aged 6–13 years old. The children underwent hearing screening with pure-tone audiometry. The parents answered a question about hearing problems in their children. The outcome parameters were sensitivity, specificity, and predictive value of parental perception of hearing problems in their children. Parental suspicion of hearing problems was assessed by a questionnaire. Pure-tone air-conduction hearing thresholds were obtained from 0.5 to 8 kHz. Hearing loss was defined as a pure-tone average higher than 20 dB in one or both ears in at least one of the three following pure-tone averages: four-frequency pure-tone average, high-frequency pure-tone average, and low-frequency pure-tone average.
Results**:** Positive results of hearing screening were obtained in 16.3% of children. Hearing loss was detected in 6025 children (9.3%), of whom 1074 (17.8%) were correctly perceived by parents as having hearing problems. The degree of hearing loss was a significant factor which influenced the sensitivity of parental suspicion of HL in their children. Sensitivity of detecting hearing loss by parents reached about 20% for mild hearing loss and above 31% for moderate or worse hearing loss.
Conclusions**:** Parents underestimate hearing problems in their children, but they are more able to accurately detect hearing loss if it involves speech-related frequencies and is at least a moderate hearing loss or bilateral loss.

Key words: hearing • hearing screening • children

P07.7

206 - Students' self-perception about skills and competences in audiology

Vitória Luiza Thomé [(1)] - Christiane Marques do Couto [(1)]
Faculty of Medical Sciences / Universidade Estadual de Campinas - UNICAMP, Department of Human Development and Rehabilitation, Campinas, Brazil [(1)]

On March 11, 2020, COVID-19 was characterized as a pandemic. A reorganization of the way of life was necessary and social distancing was advocated. In March 2020, one of the Undergraduate Course in Speech and Hearing Therapy in Brazil adapted the activities of the contents of theoretical disciplines offering them in the format of Emergency Remote Teaching and the practical one that did not involve patient care was suspended. The aim of this research was to assess whether the absence of face-to-face practice in a specific course interfered with the level of confidence and self-perception of learning of undergraduate speech therapy students in performing the Basic Audiological Assessment. This is a descriptive exploratory study with a mixed-methods approach. The sample is made up of students entering in 2019, 2020 and 2021 of the Undergraduate Speech and Hearing Therapy Course. The material for analysis is the answers to an online questionnaire that included the participants' sociodemographic characteristics, as well as an investigation into the level of confidence and self-perception about the students' learning to perform the Basic Audiological Assessment. The sample consisted of 43 students. The results pointed to concerns/difficulties, positive and negative impacts of the COVID-19 pandemic on the teaching-learning process and that the absence of face-to-face practice in the course interfered with the level of confidence and self-perception about learning the tympanometry procedure and the ability to check the compatibility of the test with each other and with the patient's complaint and/or history.

Keywords: Higher Education; Audiology; COVID-19

P08 - INTERVENTION AND REHABILITATION – STRATEGIES AND METHODS

P08.1

4 - Congenital auricular atresia – audiological and aesthetic rehabilitation

Stephan Knipping [1]
Dessau Medical Center, ENT HNS Department, Plastic Surgery [1]

Introduction**:** Congenital auricular malformations occur very rarely. Combined malformations of the external and middle ear are somewhat more common than middle and inner ear dysplasia. These malformations represent a combination of aesthetic as well as functional problems, resulting in a significant decrease in quality of life.
Materials and methods**:** We present the case of a 26-year-old female patient presents with a conductive hearing disorder in combination with a grade III dysplasia. Due to the missing outer ear canal, the use of a conventional hearing aid was not possible. Furthermore, there were various problems with communication, especially in ambient noise, leading to difficult situations in professional and social capacities.
In this case we found an auricular dysplasia Type III with complete bony occlusion of the left outer ear canal.
CT-scans demonstrated a malformation of the petrous pars of the temporal bone, Grade III according to Altmann, with auditory canal atresia and decreased pneumatization as well as severe malformations of the middle ear according to Müller.
In the pure tone audiogram we could detected a pantonal conductive hearing loss of 60 dB on the left side.
The free field speech audiogram showed on the left side a 50% hearing loss for numbers at 72 dB. Furthermore, we were able to determine 35% audibility for monosyllables at 100 dB. In the Speech Audiogram in background noise there were 0% audibility on the left ear.
Results**:** During the reconstructive ear operation, the cartilage rudiments were resected and a mastoidectomy was performed under facial monitoring. After antrotomy posterior tympanotomy was performed with an atypically running facial nerve. However, round window could not be displayed in this way. The round window niche could then be exposed via a second posterior-caudal tympanotomy under the facial nerve and the Floating Mass Transducer (FMT) of the Vibrant Soundbrigde (VSB, Med-El, Austria) could be anchored using the Round Window (RW) - coupler. In addition, a titanium anchor for an epithesis was implanted. Postoperatively, the patient showed a grade V facial paralysis.
An anti-edematous therapy with prednisolone resulted in a complete recovery of the facial nerve function. 7 weeks later, the epithesis anchors were fitted with the abutments.
With the VSB, 85% intelligibility for monosyllables at 65 dB could be achieved in the speech audiogram. Due to the individual design and manufacturing of outer ear episthesis, it was possible to achieve an aesthetically attractive rehabilitation for the patient.
Conclusion**:** Congenital auricular malformation is a complex disorder of the external and middle ear and usually occurs sporadically and unilaterally. There is often an aberrant course of the facial nerve and a conductive hearing loss. A satisfactory rehabilitation is possible with modern surgical procedures such as epithetic treatment and implantation of a VSB.

Key Words: Congenital auricular atresia – audiological rehabilitation – Epithetic treatment

P08.2

67 - Multisensory Training intervention for hearing impaired children: a preliminary results of a pilot study

Maria Chiara Marini [(1)] - Matilde Maria Marulli [(1)]
CRC, Speech Therapy, Roma, Italy [(1)]

One of the most crucial and early objectives of the rehabilitative program for hearing-impaired children, is auditory perception education. The development of spoken language in children is directly linked to their auditory capacity. Most studies conducted on children with hearing loss indicate delayed development of verbal language, which might impact linguistic and communicative abilities into adulthood. This paper examines the influence of the Interactive Multisensory Environment (iMSE) on the hearing training of deaf children in comparison to traditional methods. According to some studies, a multisensory stimulation is more effective than monosensory protocols. This work focuses on a research project involving the experimentation of a multisensory multimedia room. This room is intended for perceptual training activities with hearing-impaired patients. Our study aims to investigate whether the use of this multisensory environment offers equal or better learning opportunities compared to perceptual training conducted in a traditional therapeutic setting. Over a 7-week duration, two groups of deaf children were evaluated and trained, one utilizing the iMSE (Experimental Group) and the other employing a traditional PC-based method (Control Group). The training encompassed four different thematic categories. The goal of these tests is to evaluate the child's abilities in detecting, categorizing, and distinguishing certain acoustic-perceptual properties that characterize verbal signals. These tests are administered under ideal listening conditions, with hearing aids or cochlear implants worn, and at conversation intensity. These initial findings suggest that the iMSE not only enhances children's motivation and engagement but also delivers improved results. The iMSE offered an immersive and dynamic learning experience. Results indicate that the iMSE yielded positive effects on the training outcomes of deaf children, as evidenced by improved performance and engagement. This research sheds light on the potential benefits of innovative multisensory technology in educational settings for children with hearing impairments, offering insights for future educational interventions.

Key Words: Interactive Smart Spaces, Deaf children, Perceptive skills, Perceptive training, Interactive Multisensory Environment, Human computer interaction (HCI); Accessibility technologies; Interactive learning environments.

P08.3

184 - Spatial Hearing Training for Young Bilateral Cochlear Implant Users: The BEARS approach

Bhavisha Parmar [1] - Marina Salorio-Corbetto [1] - Sandra Driver [2] - Merle Mahon [3] - Ruth Nightingale [3] - Fleur Corbett [4] - Lorenzo Picinali [5] - Dan Jiang [2] - Helen Cullington [6] - Deborah Vickers [1]
University of Cambridge, Sound Lab, Department of Clinical Neurosciences, Cambridge, United Kingdom [1] - Guys and St Thomas' NHS Foundation Trust, St Thomas' Hearing Implant Centre, London, United Kingdom [2] - University College London, Psychology and Language Sciences, Faculty of Brain Sciences, London, United Kingdom [3] - Imperial College London, Design Psychology Lab, Dyson School of Design Engineering, London, United Kingdom [4] - Imperial College London, Dyson School of Design Engineering, Design Engineering, London, United Kingdom [5] - University of Southampton, Auditory Implant Service, Auditory Implant Service, Southampton, United Kingdom [6]

Background information:
Although sound localization and speech-in-noise perception are better for people with bilateral cochlear implants (CIs) compared to those with a unilateral implant, these skills remain far below those of normally-hearing children (Sarant et al 2014; Sparreboom et al 2015). A large body of research demonstrates that sound localisation can improve with training, underpinned by plasticity-driven changes in the auditory pathways for children and adults (Firszt et al 2015; Mathew et al 2018). Children and teenagers are the largest groups of those bilaterally implanted and spend substantial time in noisy environments. They often describe everyday communication as being challenging and tiring due to the extra effort required, especially in noise. These difficulties put older children and teenagers with CIs at a greater risk of emotional and behavioural difficulties that impact on social relationships with their peers (Stevenson et al 2015). Despite these findings, there are no specific fitting protocols or rehabilitation processes to help children and young people hear well from both implants together, and to improve spatial hearing abilities.
Methods: The use of audio-visual stimuli helps with task familiarisation, and the gamification approach contributes to improving engagement and attainment, which is crucial for children and teenagers. The Both Ears (BEARS) programme set out to develop a spatial hearing training package using virtual reality. The programme aims are:

1. To develop the Both Ears (BEARS) training package, a set of virtual-reality games to train spatial hearing in young people with bilateral CIs through a series of PPIE workshops (Vickers et al 2021).
2. To develop the outcome measures needed to evaluate the effectiveness of the BEARS training package.
3. To conduct a large-scale confirmatory clinical trial to assess whether BEARS substantially improves hearing with two implants.
4. To understand the learning mechanism and process evaluation.

The BEARS programme follows the National Institute of Health Research (NIHR/MRC) framework on complex interventions to improve health (Skivington et al 2021). Based on the MRC framework, we have created a logic model for the BEARS intervention. The logic model considers not only the intervention and intended outcomes but also the characteristics of the target patient population, the external or environmental context in which the intervention will take place, the mechanism of change and the potential changes to healthcare if the intervention is found to be effective.
Results and conclusions
The BEARS outcome measures and intervention have been developed and the clinical trial launched in June 2023. This poster summarises the BEARS logical model, approach and next steps.
Key words: audio-visual, cochlear implants, rehabilitation, virtual reality, spatial hearing, auditory training

References

- Sarant J, Harris D, Bennet L, Bant S. Bilateral versus unilateral cochlear implants in children: A study of spoken language outcomes. Ear Hear. 2014;35(4):396–409. pmid:24557003,
- Sparreboom MA, Langereis MC, Snik FM, Mylanus AM. Long-term outcomes on spatial hearing, speech recognition and receptive vocabulary after sequential bilateral cochlear implantation in children. Research in Developm Disabil. 2015;36:328–337.,
- Firszt J. B., Reeder R. M., Dwyer N. Y., Burton H., Holden L. K. (2015) Localization training results in individuals with unilateral severe to profound hearing loss. Hearing Research 319: 48–55. doi:10.1016/j.heares.2014.11.005.
- Mathew, R., et al., Development of electrophysiological and behavioural measures of electrode discrimination in adult cochlear implant users. Hearing Research, 2018. 367: p. 74-87.
- Vickers, D., Salorio-Corbetto, M., Driver, S., Rocca, C., Levtov, Y., Sum, K., Parmar, B., Dritsakis, G., Albanell Flores, J., Jiang, D. and Mahon, M., 2021. Involving children and teenagers with bilateral cochlear implants in the design of the BEARS (both EARS) virtual reality training suite improves personalization. Frontiers in Digital Health, 3, p.759723.
- Stevenson, J., et al., Emotional and behavioural difficulties in children and adolescents with hearing impairment: a systematic review and meta-analysis. European Child & Adolescent Psychiatry, 2015. 24(5): p. 477-496.
- Skivington, K., et al., A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. BMJ, 2021. 374: p. n2061.

P08.4

70 - Focusing on Positive Listening Experiences Improves Hearing Aid Outcomes in First-Time Hearing Aid Users: A Randomized Controlled Trial

Dina Lelic [(1)] - Petra Herrlin [(2)] - Florian Wolters [(2)] - Line Louise Aaberg Nielsen [(3)] - Ceylan Tuncer [(3)] - Karolina Smeds [(2)]
WS Audiology, R&D, Lynge, Denmark [(1)] - ORCA Europe, WS Audiology, R&D, Stockholm, Sweden [(2)] - Odense University Hospital, Ear-Nose-Throat / Hearing Clinic, Odense, Denmark [(3)]

Negativity bias is a cognitive bias where negative events are perceptually more prominent than positive ones. In terms of hearing care, this means that hearing aid benefits can be affected by difficult experiences which can negatively influence one's hearing aid outcomes. Research has shown that sustaining focus on positive listening experiences can improve short-term hearing aid outcomes for experienced hearing aid users, and hence mitigate negativity bias. The purpose of the current study was to investigate whether focusing on positive listening experiences may improve hearing aid outcomes for new hearing aid users, both in the short- and longer- term.
Thirty-eight participants without prior hearing aid experience were randomly allocated to a control (N=20) or positive focus (PF; N=18) group. The study duration was six months and included three visits to the hearing clinic (the fitting visit and follow-ups at approximately 1 and 6 months). *Prior to hearing aid fitting*, all participants were asked to download and install an app, MyHearingExperience, on their phone and complete baseline questionnaires which comprised the Big-Five Inventory (BFI) personality, hearing-related lifestyle (HEARLI-Q), as well as hearing aid expectations and reason for help seeking. Additionally, the client-oriented scale of improvement (COSI) questionnaire was administered by the responsible audiologist, where participants were asked to identify up to five listening situations in which they wanted to improve their hearing. Participants were then fitted with Widex MOMENT 440 hearing aids. All participants were instructed that *for the next six months*, they would periodically be prompted by the app to answer questionnaires related to hearing aid benefit and satisfaction. In addition, *only* the PF group was subjected to the 'positive focus' intervention, that is, they were instructed to focus on and report good listening experiences via the app. At the *two follow-up visits*, the COSI follow-up questionnaire was administered, and hearing aid log data were captured.
The two groups were balanced on all the baseline characteristics. The PF group reported an average of 33 (range: 10-75) good listening experiences over the six months – most of the reports were submitted during the first five weeks after hearing aid fitting. The PF group scored higher than the control group on the app-administered hearing aid satisfaction and benefit questionnaires. The effect was seen already at two weeks and persisted throughout the six months. The degree of change and final ability for the COSI situations were also higher in the PF group. Hearing aid satisfaction and benefit scores were positively correlated with the number of submitted positive reports by the PF group. Further, the PF group tended to wear their hearing aids more hours per day.
These results point to the importance of asking new hearing aid users to focus on positive listening experiences and to reflect upon them. A potential consequence is improved short- and long- term hearing aid outcomes. Importantly, the improved outcomes persisted on longer term, even if the reporting was primarily done within the first few weeks after hearing aid fitting. This indicates that if the hearing aid user focuses on and reports their good listening experiences during the critical hearing aid onboarding period, it may be enough to sustain a long-term effect of the PF intervention.

Key words: hearing aid satisfaction, hearing aid benefit, positive focus, real-life hearing, new hearing aid users

P08.5

203 - Exploring Music Perception and Enjoyment Across a Lifetime in a Dual Sensory Impaired Cochlear Implant Listener

Cheuk Chee Cynthia Lam [(1)] - Deborah Vickers [(1)] - Bhavisha Parmar [(1)]
University of Cambridge, Sound Lab, Department of Clinical Neurosciences, Cambridge, United Kingdom [(1)]

Music plays an important role in human lives, allowing us to experience and express emotions, connect with others, and find solace in art (Koelsch, 2014). Nevertheless, for individuals with cochlear implants, it is often a challenge for them to appreciate music, due to the technological limitations of translating complex acoustic signals into electrical stimuli (Looi et al., 2008). The complexity of music, with its elements of timbre, pitch, rhythm, and melody, presents challenges for CI users, leading to varied and individualized experiences of music perception and enjoyment (Lam et al., 2022; Gfeller et al., 2008). Despite improvements in CI technology, users frequently report a diminished quality of musical sound, altered pitch, and a lack of fine tonal resolution (Lam et al., 2022; Gfeller et al., 2007). Consequently, these challenges significantly affect their enjoyment and participation in music. Additionally, pre-implant hearing, age-related factors and music-related experiences of CI users were found to be correlated to post-implant chord discrimination and enjoyment (Lam et al., 2022). This study aims to explore the experiences of a CI user with vision impairment, who is also a musician and a music therapist, offering insights to the lifelong journey of learning and performing music both in the context of the evolving auditory experience pre- and post- implant. A qualitative case study framework was employed, with an in-depth semi-structured interview with the participant providing a comprehensive overview of their musical engagement pre- and post-implantation, and how their auditory experience changed over the years along with their changed vision and hearing abilities. The participant's background as a professional musician and music therapist enriched the data especially with the ability to reflect on their strategies on overcoming challenges. Thematic analysis was conducted on the transcribed data to extract emergent themes, providing a detailed portrayal of the participant's musical journey (Braun and Clarke, 2006). The thematic analysis revealed four main themes that narrate the chronology of the participant's experiences, including 1) the emotional and psychology impact of music on individuals with sensory impairments, 2) the participant's journey of learning music and auditory experience before and after receiving the implant, 3) strategies to enhance music perception and enjoyment and 4) technological advancements and social support systems that underpin music listening experiences for CI users. Collectively, these themes highlight the participant's progressive and proactive approach to integrate CI-mediated auditory cues and the participant's extensive musical expertise, which is also augmented by audiologist support and various adaptive strategies. This case study provides a unique perspective on strategies that CI users can use. It also suggests that long-term musical engagement post-implantation may benefit from tailored auditory training or music-specific rehabilitation protocols (Driscoll et al., 2012). The findings advocate for a multidisciplinary approach to CI programming, which would help make the process of adapting to a CI more comprehensive and beneficial to those with different hearing or musical backgrounds.

Keywords: Adaptations, Cochlear Implant, Music Perception, Deaf-blind

References:

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.
Driscoll, V. D., Gfeller, K., Tan, X., See, R. L., Cheng, H., & Kanemitsu, M. (2012). Music perception in cochlear implant recipients and its relationship with psychosocial factors and speech perception. Journal of Cochlear Implants International, 13(2), 69-81.
Gfeller, K., Turner, C., Oleson, J., Zhang, X., Gantz, B., Froman, R., & Olszewski, C. (2007). Accuracy of cochlear implant recipients on pitch perception, melody recognition, and speech reception in noise. Ear and Hearing, 28(3), 412-423.
Lam C, Moore BCJ, Salorio-Corbetto M, Vickers DA. The Relationship Between Hearing Experiences, Music-Listening Behaviors, and Chord-Discrimination Abilities for Cochlear Implant Users. Trends in Hearing. 2022;26. doi:10.1177/23312165221143902
Looi, V., McDermott, H., McKay, C., & Hickson, L. (2008). Music perception of cochlear implant users compared with that of hearing aid users. Ear and Hearing, 29(3), 421-434.

P08.6

224 - Development and evaluation of educational multimedia in the rehabilitation of hearing impaired elderly and their communication partners

Vívian Aparecida Vespero [(1)] - Wanderleia Quinhoneiro Blasca [(1)] - Gabriela Zacante Santos [(1)] - Danielle Fernandes de Lemos [(1)] - Bianca Caseiro Antonelli [(1)] - Fabiana de Souza Pinto Azenha [(1)] - Thais Corina Said de Angelo [(1)] - Lucas Ferreira Néri [(1)]
Universidade de São Paulo, Audiology, Bauru, Brasil [(1)]

Brazil is undergoing changes in the demographic profile of its population. The decline of capacities from aging may lead to the inability to perform activities of daily living, affecting autonomy and negatively influencing the quality of life of the elderly. In this context, hearing loss is among the main consequences of the aging process, standing out as one of the three most prevalent chronic conditions. In order to avoid or minimize the impacts caused by hearing loss in the life of the elderly, it is necessary to select, indicate and adapt the Hearing Aids. However, in the literature, difficulties are listed regarding the handling of the hearing aids, such as difficulties in relation to the connection of the hook with the tube, battery handling, difficulty in inserting and removing the mold, among others. Thus, the orientation and counseling work performed in the selection and adaptation periods will influence the success of the entire process, emphasizing the need for more care and, consequently, cognitive decline that affects the elderly population for a prolonged period of time. Besides emphasizing all stages, it is crucial to emphasize communication strategies and the involvement of communication partners in auditory rehabilitation of the elderly. This study developed and evaluated a video educational material on the use, care and handling of hearing aids and communication strategies for guidance of the elderly with hearing impairment and their communication partners. The methodology of this divided into five stages: the elaboration of the script based on the themes found in the literature, which divided the contents into two areas: "use and handling of hearing aid" and "communication strategies", the latter subdivided into "communication partners" and "users of hearing aids". The second stage included selecting images used on platforms with "royalty-free" and recording the filming and narrations of the research group members. The third stage was edited in the Movavi Editor 2023 Software, providing the sequencing of images and filming, size, color, subtitle speed and narration appropriate to the target audience. The outcome of this process was the production of 28 videos on the "use and handling of hearing aids", and 14 videos on "communication strategies". The next step was to evaluate educational material through two online formats, one focused on the theme - for the videos of this areas: "Use and handling of hearing aid" and another for "Communication Strategies". The forms were constructed in "Google Forms" from the Likert Scale (1932) with four dimensions: Objective, Language, Design/ Layout and Content. In total, nine judges participated in this stage: three audiologists from the amplification area and, three from the auditory rehabilitation area and three Designers. The data were tabulated in the Microsoft Excel program, and the analysis of the data were analyzed using the Content Validity Index (CVI) method, being validated the intense ones that reached a score of 0.8 as level of agreement between the judges. In relation to the videos that cover the "use and handling of hearing aids", the Layout criterion reached the coefficient of 0.77 in the IVC, being necessary to undergo modifications in relation to the standardization of the layout between the videos and reduction of the information presented textually. The videos on "Communication Strategies" received coefficients above the minimum acceptable value. The judges considered certain aspects, for instance, images with more representation, video title changes, and subtitle changes. The final stage of the study involved assessing the adequacy of the contents based on the changes scored in the evaluation after all the assessments and considerations. The educational material in question has the potential to positively aid the process of auditory rehabilitation of the elderly with hearing loss, empowering the user of hearing aids and their communication partner about communication strategies, use and handling, helping to continue the use of hearing aids daily.

Keywords: Aged, Hearing Aids, Multimedia.

P09 - PATIENTS WITH COMPLEX CONDITIONS

P09.1

29 - Intratemporal Facial Nerve Neurofibroma Causing Facial Paralysis in an Infant: Case Report and Review of the Literature

Emma West [(1)] - Graham Pingree [(1)] - Rajanya Petersson [(1)] - Daniel Coelho [(1)]
Virginia Commonwealth University Health System, Otolaryngology, Richmond, United States [(1)]

Introduction: Facial nerve neurofibromas are uncommon nerve sheath tumors, particularly within the intratemporal region. There have only been 12 case series/reports of intratemporal neurofibroma previously reported, and none pediatric population. This report describes the presentation and management of congenital intratemporal facial nerufibroma causing recurrent unilateral facial palsy in 12-month-old male. Additionally, a literature review was performed to better elucidate the interventions and outcomes for other similar patients.
Case Description: A 12 month old male presented to our pediatric otolaryngology clinic for recurrent right facial nerve palsy. He initially developed right-sided weakness at 4 months old and was treated with a high-dose prednisone taper, improving symptoms without complete resolution. Magnetic resonance imaging (MRI) at the time revealed no abnormalities. At 12 months, the weakness acutely worsened. High resolution CT and MRI revealed an ovoid structure within the right temporal bone along the course of the mastoid segment of the facial nerve. Right mastoidectomy, facial nerve decompression, and excision of facial nerve tumor was performed at 14 months. Final surgical pathology revealed a diagnosis of neurofibroma, staining positive for S100, CD34. Postoperatively, the patient's facial function improved from House-Brackmann (HB) IV to III. The patient subsequently underwent an additional more extensive facial nerve decompression 7 months following the initial procedure due to persistent T2 hyperintensity on MRI within the temporal bone. This revealed a small mass adjacent to the semicircular canals that was pathologically consistent with fibrous tissue. Following the second procedure, facial function remaind stable at HB III.
Discussion: Nurofibromas are benign tumors of the nerve sheath that occur anywhere in the obdy. Intracranial tumors are rare, and intratemporal neurofibromas affecting the facial nerve are rarer still. Literature review revealed 12 case reports/case series of intratemporal neurofibromas, reflecting a total of 37 patients with average age of presentation at 29.1 years. Symptoms at presentation included facial paralysis, otalgia, hearing loss, vertigo, and pulsatile tinnitus. 36 of 37 underwent surgical excision and postoperatively there was some improvement in HB for the majority of patients.
Conclusion: We performed a literature review of intratemporal neurofibromas and describe the first case of facial neruofibroma affecting a male infant. A high degree of suspicion for facial neruofibroma is warranted in a child with unilateral faical nerve paralysis, after ruling out other more common etiologies of facial nerve palsy. Work up with imaging such as CT and MRI is warranted if conservative measures do not lead to resolution. Based on imaging, if facial nerve decompression can be performed, this may improve symptoms as well as providing tissue for pathologic diagnosis. Genetic work up and monitoring for recurrence postoperatively is advised.

Keywords: Neurofibroma, intratemporal lesion, facial palsy

P09.2

81 - Complete Spontaneous Hearing Loss Recovery in a Pediatric Chemotherapy Patient – a Case Report

Mihai Bentan [(1)] - Meghan Nemeth [(1)] - Daniel Coelho [(1)]
Virginia Commonwealth University, Otolaryngology - Head & Neck Surgery, Richmond, United States [(1)]

Introduction**:** Despite its therapeutic importance, the side effects of chemotherapy are well-known, with permanent ototoxicity being a notable concern. We report a rare case of delayed complete resolution of chemotherapy-induced high-frequency sensorineural hearing loss (HF SNHL) in a pediatric patient with anaplastic ependymoma. This study is notable due to the patient's spontaneous delayed complete recovery 45 months after the cessation of chemotherapy, challenging the common belief that chemotherapy-induced auditory damage is often permanent. Methods**:** A retrospective chart review was performed. Parental consent was obtained for publication. This study was considered IRB exempt.
Results**:** A previously healthy 18-month-old female presented to the emergency department in November 2018 after right eye and mouth twitching, and decreased typical responsiveness, raising concerns for seizure-like activity. Imaging demonstrated a large, left-sided supratentorial fronto-parietal mass without spinal metastasis. Total gross resection confirmed the diagnosis of anaplastic ependymoma, grade III. Post resection, the patient presented to our hospital to begin Grundy's protocol for primary postoperative chemotherapy without radiotherapy for intracranial ependymoma in children. This protocol includes seven cycles, each with four courses of various combinations of Vincristine, Carboplatin, Methotrexate, Cyclophosphamide, and Cisplatin. Baseline audiology testing (December 2018) demonstrated normal bilateral Distortion Product Otoacoustic Emissions (DPOAE) and Visual Reinforcement Audiometry (VRA) responses. Alongside Speech Awareness Thresholds (SAT) at 15 decibels, these pre-chemotherapy results suggested normal hearing bilaterally. Subsequent audiologic tests in March, June, and September 2019 yielded similarly normal results. In December 2019, after completing 23 courses of chemotherapy, diagnostic DPOAEs were absent bilaterally (Left: response present 2000-7000 Hertz (Hz), absent 8-10kHz, Right: response present 2-4kHz, absent 5-10kHz), with VRA showing minimum age-appropriate response for at least 1 ear. In April 2020, given parental concerns raised by the growing COVID-19 pandemic and the patient's immunocompromised state, alongside no evidence of residual or recurring malignancy, Grundy's chemotherapy protocol was terminated prematurely (25 of 28 courses were completed). By July 2020 (3 months post-chemotherapy), VRA with inserts revealed a mild HF SNHL bilaterally (Left: normal hearing 250-4000Hz sloping to mild hearing loss at 8000Hz, Right: normal hearing 250-2000Hz sloping to mild hearing loss from 4000-8000Hz), which progressively worsened through June 2023 (Left: normal hearing 250-2000Hz sloping to moderate/moderately severe HF SNHL from 4000-8000Hz, Right: normal hearing 250-4000Hz sloping to moderate/moderately severe HF SNHL from 6000-8000Hz). Remarkably, her most recent audiogram in December 2023 (45 months post-chemotherapy) revealed complete normalization of hearing across 250-8000Hz bilaterally, despite absent screening 3-5kHz DPOAEs bilaterally. Speech Recognition Threshold testing, alongside excellent speech discrimination, confirmed this recovery. Conclusion**:** The permanence of chemotherapy-induced HF SNHL is well known, though spontaneous partial recovery has been documented. However, no literature has demonstrated a complete delayed spontaneous recovery. The uniqueness of this case lies in the temporal pattern of auditory decline and subsequent spontaneous complete recovery, contrasting the widely accepted permanence of chemotherapy-induced ototoxicity. Several hypotheses for recovery may exist. One includes the activation of endogenous repair mechanisms within the cochlea, augmented by the absence of ongoing chemotherapeutic insult, therein suggesting a delayed response to ototoxic injury potentially involving compensatory neural plasticity. Given her young age, neural adaptability could explain the recovery. The absence of DPOAE despite a normal pure tone audiometry could suggest more central adaptation mechanisms occurring at the level of the auditory nerve (or proximally) rather than actual hair cell recovery or growth. Furthermore, individual genetic variability in susceptibility to and recovery from ototoxicity may account for the patient's unique audiological trajectory. This case emphasizes the need for continued audiologic monitoring of pediatric chemotherapy patients, as changes can occur well after the treatment. The potential for late recovery necessitates a cautious approach to rehabilitative interventions. Failure to recognize improvement may result in overamplification by conventional hearing aids and further damage to the cochlea. This is particularly important if cochlear implantation is being considered. Clinically, this case report offers new hope for recovery from chemotherapy-induced HF SNHL; academically, it challenges the notion of irreversible ototoxicity and encourages further investigation into cochlear damage and healing processes. The implications for patient counseling by the medical team (oncologists, audiologists, and otolaryngologists) are self-evident. Ultimately, this narrative enriches the discourse on chemotherapy's ototoxic effects and advocates for a more discerning approach to managing ototoxicity in the field of pediatric oncology.

P09.3

276 - Long-term Outcomes of Cochlear Implantation in Usher Syndrome

Mirthe L.A. Fehrmann [(1)] - Chris P. Lanting [(1)] - Lonneke Haer-Wigman [(2)] - Emmanuel A.M. Mylanus [(1)] - Wendy J. Huinck [(1)] - Ronald J.E. Pennings [(1)]
Radboud University Medical Center, Department of Otorhinolaryngology and Donders Institute for Brain, Cognition and Behaviour, Nijmegen, The Netherlands [(1)] - Radboud University Medical Center, Department of Clinical Genetics, Nijmegen, The Netherlands [(2)]

Objectives
Usher syndrome (USH), characterized by bilateral sensorineural hearing loss (SNHL) and retinitis pigmentosa (RP), prompts increased reliance on hearing due to progressive visual deterioration. Previous studies evaluating CI outcomes in individuals with USH used varying or short follow-up durations, while others did not evaluate outcomes for each subtype separately. This study aims to evaluate long-term cochlear implant (CI) performance in Dutch subjects with Usher syndrome, at both short-term and long-term, considering each subtype separately.
Design
In this retrospective, observational, cohort study, 36 CI recipients (53 ears) were identified and categorized in four different groups: early-implanted USH1 (first CI at ≤7 years of age), late-implanted USH1 (first CI at ≥8 years of age), USH2 and USH3. Phoneme scores at 65 dB SPL with CI were evaluated at one year, ≥2 years (mid-term), and ≥5 years post-implantation (long-term). Each subtype was analysed separately due to the significant variability in phenotype observed among the three subtypes.
Results
Early-implanted USH1-subjects (N=23 ears) achieved excellent long-term phoneme scores (100% (IQR 95-100)), with younger age at implantation significantly correlating with better CI outcomes. There was no significant difference in binaural aided phoneme scores between the simultaneous implanted subjects (N=7) and sequential implanted subjects (N=2, p=0.056). Nevertheless, one early implanted subject, who received a sequential implanted second CI at the age of eight, became a non-user for this second CI. Late-implanted USH1-subjects (N=3 ears) used CI solely for sound detection and showed a mean phoneme discrimination score of only 12% (IQR 0-12), while still expressing satisfaction with ambient sound detection. In the USH2-group (N=23 ears) a long-term mean phoneme score of 85% (IQR 81-95) was found. Better outcomes were associated with younger age at implantation and higher pre-implantation speech perception scores. USH3-subjects (N=7 ears) achieved a mean post-implantation phoneme score of 71% (IQR 45-91).
Conclusions
This study is currently one of the largest, and most comprehensive studies evaluating CI outcomes in individuals with Usher syndrome, demonstrating that overall, individuals with USH benefit from CI, at both short- and long-term follow-up. Due to the considerable variability in phonotype observed among the three subtypes, each subtype was analysed separately, although this resulted in smaller sample sizes. For USH1-subjects, optimal CI outcomes are expected with early simultaneous bilateral implantation. Late implantation in USH1 provides signalling function, but achieved speech recognition is insufficient for oral communication. In USH2 and USH3, favourable CI outcomes are to be expected, especially if individuals exhibit sufficient speech recognition with hearing aids and receive ample auditory stimulation pre-implantation. Early implantation is recommended for USH2, given the progressive nature of hearing loss and concomitant severe visual impairment. In comparison with USH2, predicting outcomes in USH3 remains challenging due to the variability found. Counselling for USH2 and USH3 should highlight early implantation benefits and encourage hearing aid use.

Key-words: Usher syndrome, Cochlear implantation outcomes, Genetics, Clinical decision-making, Hearing rehabilitation.

P10 – SPEECH AND LANGUAGE

P10.1

197 - Expressive Vocabulary and Working Memory in Children with Cochlear Implants: Exploring the Role of Phonological Working Memory

Kristina Burum [(1)] - Björn Lyxell [(1)] - Simon Sundström [(1)]
University of Oslo, Department of Special Needs Education, Oslo, Norway [(1)]

Deafness in children poses significant challenges to spoken language and cognitive development. Cochlear implants (CIs) provide access to speech sounds, improving spoken language acquisition and overall child development. However, children with CIs often experience delays in expressive vocabulary compared to their typically developing (TD) peers (Lund, 2016). They also have been shown to demonstrate poorer cognitive skills, including working memory, which are important for language development (Lyxell, 2008). Although cochlear implantation alone is insufficient to bridge the developmental gap, early access to sound and language through early implantation and intervention can contribute positively to expressive vocabulary and overall language and cognitive abilities.
This study aimed to compare the performance of children with CI and TD children on measures of expressive vocabulary, phonological working memory (PWM), and general working memory (GWM). It further investigated how expressive vocabulary relates to PWM and GWM in the two groups of participants.
Twelve 8–12-year-old children, who received CIs at the mean age of 9 months, participated in the study. Ten of them received early intervention (data missing for one participant). The control group comprised 22 TD peers. All participants completed tests evaluating expressive language, PWM and GWM.
Preliminary analyses revealed that children with CIs performed comparably to their TD peers on expressive vocabulary and GWM, but not on PWM. There was no correlation between expressive vocabulary and PWM or GWM in either group.
The preliminary results are in line with previous studies (e.g. May-Mederake, 2012) that found age-appropriate language outcomes in early implanted children. This indicates that early implantation and intervention might have had a positive role in the participants' linguistic development. However, PWM remained impaired in children with CI, regardless of their early access to speech sound. Early experiences play a significant role in shaping phonological development, influencing PWM not only through the timing of those experiences but also through the quality and quantity of language input (Pierce et al., 2017). Despite advances in CI technology, these devices offer a somewhat reduced auditory signal when compared to typical hearing. This degraded spectral-temporal information limits rehabilitative improvement, potentially impacting PWM.
While PWM has been suggested to play a significant role in vocabulary development (Baddeley, 2003), the preliminary findings raise questions about how children with CIs are able to achieve adequate vocabulary despite limited PWM skills. Melby-Lervåg et al. (2012) questioned the role of PWM in vocabulary development as they did not find evidence of any influence of nonword-repetition ability on later vocabulary knowledge. Gathercole et al. (1992) proposed that once vocabulary is adequately developed, PWM capacity may play a less dominant role in further vocabulary acquisition. Persistently poor phonological memory skills do not seem to significantly hinder language acquisition during the early school years. GWM may have a more important role at that stage, although our preliminary results did not confirm this. An alternative explanation is that other factors, such as conceptual abilities and exposure to print, may contribute more strongly to vocabulary learning by middle childhood (Stanovich & Cunningham, 1993).

Keywords: expressive vocabulary, working memory, cochlear implants, deaf children

P10.2

199 - Theory of mind and its relationship with language and working memory in early implanted school-aged children

Kristina Burum [(1)] - Björn Lyxell [(1)] - Simon Sundström [(1)]
University of Oslo, Department of Special Needs Education, Oslo, Norway [(1)]

Theory of mind (ToM) refers to the ability to understand and take into account one's own and others' mental states, including beliefs, intentions, and emotions (Gallese & Sinigaglia, 2011). Understanding and considering others' mental states is vital for successful social functioning and interpersonal relationships (Hughes & Devine, 2015). Yet, ToM begins to develop through early interactions with caregivers (Taumoepeau & Ruffman, 2008), making early communication and language experiences important for its acquisition. This places children with cochlear implants (CI) at risk of facing challenges in developing ToM. Although research on ToM has primarily focused on its development in the preschool years, there is growing recognition that ToM continues to develop throughout middle childhood and adolescence, with children acquiring a more complex understanding of mental life.
This study compared ToM in school-aged Norwegian-speaking children with CI and typically developing (TD) children. It further focused on investigating how ToM is related to expressive language, working memory (WM), implantation age and hearing age.
The study included 12 children aged 8-12 years, who received CIs at an average age of 9 months. Ten of them received early intervention (data for one of the participants was missing). The control group consisted of 22 TD peers. All participants underwent testing to assess their expressive language, phonological working memory (PWM), and general working memory (GWM).
Children with CIs demonstrated similar performance to their TD peers on both cognitive and affective ToM tasks. Among the TD children, both cognitive and affective ToM showed associations with expressive language and GWM. Furthermore, cognitive ToM was found to be related to PWM. However, in children with CI, cognitive ToM did not correlate with any variable. On the other hand, affective ToM showed a positive correlation with PWM and GWM, and a negative correlation with the age of implantation. There were no correlations found between hearing age and either cognitive or affective ToM.
Children in this study had early access to spoken language through early implantation and intervention, enabling them to participate in early social interactions with their caregivers and other family members. The results indicate that such early access and engagement in social interactions could have potentially had a beneficial impact on their ToM development.
A positive correlation between affective ToM and both general and phonological WM was observed in children with CI. According to Lecce & Bianco (2018), WM enables children to consider diverse perspectives of a situation and integrate them, resulting in a coherent understanding of the situation. It is important to note that the absence of a relationship between ToM and expressive language in children with CI does not necessarily imply that they are unrelated. Previous research suggests a weaker association between ToM and language in school-aged children than in preschoolers (Lecce et al., 2018). Moreover, the limited sample size of children with CI in this study may have impacted the detection of correlations.

Keywords: theory of mind, early implantation, deaf children, working memory, language

P10.3

281 - Fostering language growth in conversations between children with cochlear implant and teachers in preschool

Nadia Akinshina [(1)]
STATPED, Department for Hearing Impairment, Oslo, Norway [(1)]

This cross-sectional study focused on language interaction between teachers and prelingually deaf children with Cochlear Implant (CI). The present study sought to explore the details in conversations between teachers and children with CI, which potentially can give children opportunities to further develop their language skills. The objectives of the present study were to investigate to what extent did children with CI experience the use of language in the promotion of growth and development in conversations with their teachers in preschool, or kindergarten, and whether teachers' use of language correlate with children's language skills.
12 transcribed conversations from video observations amounting 1379 teachers' utterances was studied. Data from conversations between children and teachers during play was quantitively analysed. Structural analysis and descriptive statistics were used. The teachers' utterances in conversations with children were divided into six categories that earlier studies had shown to be effective for language growth, such as learning new words, responsive communication, challenging questions, modelling grammatic and lexical structures, and cognitive scaffolding and extensions.
The results show that children with CI have varied exposure to frequency of language-use, that promote growth and development in conversations with their teachers. There is a number of significant correlations between teachers' use of language and children's language skills. The basic conditions for scaffolding language-learning were present in all cases. Use of cognitive scaffolding strategies was low or not present in some cases. The results show also that children's vocabulary correlate significantly with teachers' use of challenging questions and language modelling, both grammatic and lexical. Children's grammatical skills have significant correlation with teacher initiatives to introduce new words, asking challenging questions and modelling language.
The study suggests that language-use by teachers can have implications on the children's grammar skills and vocabulary.

The present project was a sub-project in the main study on Audioverbal habilitation of prelingually deaf children with cochlear implants from the age of 5-18 months at Oslo Universitetssykehus/CI-team and University of Oslo/Child Language and Learning project.

P11 - SPEECH PERCEPTION / DISCRIMINATION

P11.1

120 - The Speech Perception of English Consonant Clusters in Monolingual and Bilingual Individuals in Age-Related Hearing Loss Simulation

Eri Iwagami [(1)] - Stuart Rosen [(1)] - Tim Green [(1)]
University College London, Speech, Hearing & Phonetic Sciences, London, United Kingdom [(1)]

Age-related hearing loss is widespread and is a significant risk factor for dementia and social isolation. However, many individuals either refrain from utilising or discontinue the use of hearing aids due to perceived inefficiencies in performance. Addressing this issue, we emphasise the need to improve hearing prostheses through examining speech perception patterns to identify acoustic features that can enhance intelligibility in the future.

Vowel energy has been found to play a critical role in speech perception in older individuals, particularly as vowels also contain consonant information by Kewley-Port et al (2017). Iwagami et al (2020) investigated the perception of English words with consonant clusters in noise to identify perception patterns in older individuals; however, the white noise used in that study could not adequately mask all frequencies. This study investigated perception of English consonant clusters, examining both monolingual and bilingual individuals within a hearing loss simulation. The goals were to identify perception patterns associated with age-related hearing loss and reveal any differences between monolingual and bilingual individuals in how consonant cluster patterns influence speech perception.

The experiment involved two word-types: English words (real words) and nonsense words (non-words), aiming to investigate potential top-down processing effects. Real words, each containing one of a wide range of consonant clusters, were selected as target words. For each real word, a non-word containing the identical consonant cluster was generated. Consonant clusters were in either onset or offset positions, such as 'still'/'stod' and 'ask'/'hosk', respectively. Moreover, the experiment addressed not only words originally containing consonant clusters (referred to as cluster words) but also those that could exhibit such clusters due to the phenomenon of weak vowels being deleted (vowel deletion) in colloquial speech (referred to as deletion words). For instance, the real word 'police' /pˈliːs/ has a corresponding non-word pair 'pulord' /plɔːd/. To compare the perception patterns of deletion words and the same words without vowel deletion (non-deletion words), the speech stimuli also included non-deletion words, such as 'police' /pəˈliːs/ and 'pulord' /pəlɔːd/.

Speech stimuli were recorded by a male British native speaker with a Southern Standard British English accent. A hearing loss simulator, as employed in Nejime & Moore (1998), was used to diminish speech intelligibility in participants with normal hearing. The impaired audiogram used for the simulation was a high-frequency steeply-sloping audiogram, typical of age-related hearing loss. Testing was conducted both with and without the hearing-loss simulation (simulated and non-simulated conditions).

Participants consisted of 30 British English monolingual speakers, and 10 bilingual individuals, whose first language was not English, aged 18-45 years. All participants had normal audiometric hearing and were presented with stimuli in both the simulated and non-simulated conditions.

Participants' responses were scored based on the accurate identification of the cluster in a word. The results revealed increased rates of misperception particularly of non-words in the simulated condition compared to the non-simulated condition, in both monolingual and bilingual individuals. This outcome implies the successful simulation of age-related hearing loss in this experiment. Additionally, the observed poorer performance for non-words suggests the presence of top-down processing when individuals with age-related hearing loss encounter real words, which may help compensate to some extent for their elevated hearing thresholds. However, consequently, despite the activation of the top-down effect in monolingual individuals with age-related hearing loss, there may still be challenges in speech understanding even for real words, particularly in noisy or reverberant environments.

Furthermore, the performance of both groups for nonsense cluster and deletion words was inferior to that for non-deletion words, especially in the simulated condition. However, in bilingual individuals, their performance for real cluster and deletion words in the simulated condition was poorer compared to that of monolinguals. This indicates that bilinguals with age-related hearing loss, whose first language is not English, may face greater challenges in understanding words lacking vowel energy, while they can recognise those words without elevated hearing thresholds.

P11.2

194 - Signal Processing Strategy for Cochlear Implant Based on Feature Extraction to Improve Outcomes

Behnam Molaee-Ardekani [(1)] - Julian Felding [(2)] - Aswin Wijetillake [(2)] - Kai Dang [(1)] - Yue Zhang [(1)] - Marianna Vatti [(2)] - Rafael Attili Chiea [(1)] - Manuel Segovia-Martinez [(1)]
Oticon Medical, Research and Technology Department, Vallauris, France [(1)] - Oticon, Audiology, Copenhagen, Denmark [(2)]

CI signal processing performs time-frequency analysis of acoustic sound and encodes it into a series of information to be conveyed through electrical impulses directly in the cochlea so that hearing sensations are partly recovered. CIs thus only require simple signal processing, mostly able to extract envelope information from a few numbers of frequency bands (typically 12 to 22, depending on the manufacturer), of which the most energetic will convey information to auditory nerve fibers though intracochlear electrodes. CI users usually benefit from medium to good speech understanding. It is however well known that these performances suffer from high variability among subjects and drop when CI users are placed in more complex (e.g., noisy) environment. Their perception and enjoyment of musical sounds remains poor. Furthermore, because the CI provides degraded sound information, listening requires explicit and maintained cognitive resources allocation (high listening effort) that leads to mental fatigue after daily use of the device. These limitations are closely related with the core design of CI signal processing, affected by poor frequency selectivity due to the spectral smearing on the signal processing, and poor pitch transmission.

This presentation aims to present *SFE* strategy which is a CIS stimulation strategy preceded by a feature extraction-based signal processing. Most modern CI stimulation strategies are derived from the Continuous Interleaved Sampling (CIS), which avoids undesired channel interactions from simultaneous stimulations. The standard procedure spectrally decomposes the acoustic sounds by bandpass filtering the input signals, each band representing the theoretical frequency coded by intra-cochlear electrodes. The bands are usually full-wave rectified, low-pass filtered and used as patterns to amplitude-modulated and fixed-rate pulse trains. Each pulse train is stimulating the cochlea following the tonotopic axis. The CIS is part of a wider group of strategy (the Waveform group), which code information present in the temporal waveform of the acoustic input signal. Older stimulation protocols used another group of strategy based on the extraction of signal's feature where one or more speech characteristics are extracted from the acoustic signal (e.g., F0, F1, F2). Then the feature(s) is(are) used either to modulate the stimulation frequency or to choose which electrode will stimulate. Improving on the two types of signal processing strategies, the *SFE* is a feature-oriented signal processing strategy that could be included either in a waveform, a feature or a hybrid encoding.
SFE aims to select the most salient signal features avoiding the spread of information observed on the bandpass filtering approaches. Spectrally accurate signal processing is expected to improve phoneme discrimination, speech understanding and reduce cognitive load. SFE allows full frequency allocation flexibility and thus allows the electrode contacts to match the cochlear tonotopy using standard theoretical frequency allocation maps (e.g., Greenwood). It has been shown that a reduced frequency mismatch provides better pitch perception and slightly increased speech performance on monaural CI hearing. Correcting frequency allocations may provide even more benefits in bimodal or binaural situations, in which patients suffer from medium to poor lateralization capabilities. Accordingly, we will show both simulation and CI patients outcomes to compare SFE with current clinical CI strategy. Electrodogram and objective measure comparisons showed that SFE delivered better spectrum analysis and higher objective measure outcome than the current clinical strategy. Clinical comparison showed that CI users' speech performance were similar with SFE as with their current clinical strategy. However, longer accustomization times may be required to reveal the full potential of feature extraction.

Keywords: Cochlear Implant, signal processing strategy, speech perception

P11.3

201 - Linguistic Prediction as a Compensatory Mechanism for Hearing Impairment

Matthias Reiner [(1)] - Petra Hendriks [(1)] - Esther Ruigendijk [(2)]
University of Groningen, Center for Language and Cognition, Groningen, Netherlands [(1)] - Carl von Ossietzky Universität Oldenburg, Dutch Studies, Oldenburg, Germany [(2)]

Background Prediction plays a central role in most cognitive domains and refers to any act of 'looking into the future', such as preparation, anticipation, or expectations. Language is also strongly reliant on predictive processing. To keep up with the fast rate of speech, language users constantly make predictions. These linguistic predictions consist of expectations about the words and structures that the speaker is most likely to use, based on what has been said and the context of the utterance.
While linguistic predictions generally support language comprehension in discourse, evidence points to it being especially important for elderly listeners and for people with hearing impairments (HI). We hypothesize that this importance is due to a cognitive compensatory mechanism: HI-listeners use predictions to compensate for and fill gaps in the acoustic signal caused by their impairment. However, little research has been done investigating how HI-listeners use predictive processing as a compensatory mechanism and what type of linguistic information generates these predictions. Methods In our study, we therefore examine the role of context as well as grammatical information in generating linguistic predictions and how these predictions compensate for reduced speech perception. In our design, participants listen to two kinds of questions, (1) subject questions (acting entity as first noun), and (2) object questions (entity acted upon as first noun):

1) Welch**er** NOM Frosch SG sieht SG die Vögel PL?
   Which frog sees the birds?
2) Welch**en** ACC Frosch SG sehen PL die Vögel PL?
   Which frog do the birds see?

Simultaneously, they see two pictures, portraying both possible interpretations (e.g.: the frog seeing the birds, and the birds seeing the frog). Participants must choose which interpretation is correct by pressing a button. Participant's gaze data is recorded via eye-tracking.
To interpret whether the frog or the birds are the subject (who is acting), participants must rely on two possible grammatical cues, which typically have a low salience and are thus difficult to perceive for HI-listeners(Cintrón-Valentín & Ellis, 2016): subject-verb agreement (subject and verb must agree in number, i.e. singular or plural) and case (nominative and accusative → welch**ER** in 1) and welch**EN** in 2)).
Contextual information like discourse topic also informs predictions: the topic of conversation is commonly interpreted as the subject. Discourse topic and therefore prediction of the subject role are manipulated through short preceding sentences, for example:

a) The frog sits at a lake.
b) The birds sit in a garden.
c) The sun shines on a hill.

Context sentence a) preceding question 1) correctly predicts the frog as subject. The same sentence a) preceding question 2) however leads to a false prediction. This false prediction needs to be revised through grammatical cues. For context sentence b) it would be the other way around, and context sentence c) is neutral.
We analyze participants' accuracy, response time, and gaze data. The latter will give insight into the process of prediction and revision, whether their prediction is correct and if not, how quickly they revise.
Our experimental group consists of 30 native German speakers (age range 40-70) with moderate HI. Age-matched adults with normal hearing (NH) serve as controls.
Results Preliminary analysis of the behavioural data of a control group subset (8 out of 30) revealed that NH-adults had significantly more difficulties with object questions than subject questions and were more sensitive to case information than subject-verb agreement. There was no evidence that they relied on contextual information for interpretation. Overall, NH-adults rely on grammatical cues with low salience that HI-listeners might not have access to. We expect that the HI-group will instead more strongly rely on predictions informed by contextual information to compensate for missing grammatical information due to their hearing impairment. We are currently finalizing data collection of the control group (22 of 30 tested) and scheduling the HI-group. Experimental design and data analysis is identical between groups.
Implications Understanding the cognitive processes that help HI-listeners compensate for their impairment is essential. With a better understanding of the underlying processes, intervention can complement and utilize the brain's own compensatory mechanisms.

Keywords: Hearing Impairment, Cognition, Predictive Processing, Psycholinguistics, Cognitive Compensation

P11.4

221 - Hearing loops: old school for current communication issues

Clara B. Iplinsky [(1)] - Adriane L.M. Moret [(2)] - Natália B. Frederigue-Lopes [(1)] - Deborah V. Ferrari [(1)] - Rafael B. Diman [(3)] - Ralf F. Dworak [(3)] - Regina T.S. Jacob [(1)]

Bauru School of Dentistry - University of São Paulo, Department of SLP-Audiology, Bauru, Brazil [(1)] - Bauru School of Dentistry - University of São Paulo, V Department of SLP-Audiology, Bauru, Brazil [(2)] - FATEC - Faculdade de Tecnologia de Bauru, Technology, Bauru, Brazil [(3)]

Assistive Listening Devices (ALD) are products, instruments, or equipment designed to improve the functionality of hearing aids (HA) devices for people with hearing loss (HL) by improving the signal-to-noise ratio (SNR). Among these assistive equipment, the hearing loop has been used for a long time in countries such as the United States of America (http://www.hearingloop.org/index.htm) and others in Europe. In Brazil, this technology is not available in public spaces, and there are limited options for commercialization. In Brazil, this technology is not easily available in public spaces and commercialization options are limited.
According to the Brazilian Law of Inclusion (Law No. 13,146, of 7/6/2015), accessibility is a right of any person, with or without disabilities. It means everybody can access places, information, services, or products freely. Adverse listening environments are an obstacle for HA users to access public spaces. Therefore, the hearing loop is a mechanism that promotes social inclusion.
However, in 2020, the Consumer's Guide to Hearing Aids publication highlighted a decrease in the offer of telecoils in hearing loss devices. Due to brand merging, there is a reduction in sales competition and, consequently, less competition for offering resources or technologies (FRAZIER, 2020). In 2022, the MarkeTrack 2022 publication registered an increase in the fitting of HA with telecoil.
Research has demonstrated that hard-of-hearing listeners may require an increase in the signal-to-noise ratio of more than 10 dB, some as high as 25 dB, to achieve the same word recognition as a normal-hearing person in the same situation.
Furthermore, during the COVID-19 pandemic, the use of masks, social distancing, and other health needs, such as plastic glass in attending public, became mandatory to reduce the virus's transmission levels. Studies have already shown the communicative deficits caused by the opacity of the mask. It is prejudicial for people with and without HL due to reduced voice intensity and the absence of visual cues that contribute to speech understanding (Thibodeau et al., 2021).
This study aims to evaluate the benefit of the hearing loop for the HA user in a public environment. Design: Tests for measuring speech perception in noise for HA users with and without using a hearing loop in a reception of a Hearing Health Service. The Assistive Technology Validation (ATV) Protocol (Morris and Thibodeau, 2018) was adopted. The Hearing in Noise Test Brazil (HINT) was applied with a fixed signal-to-noise ratio of -10dBSNR and a five-question satisfaction poll. The test sentences were displayed on a speaker (JBL GO 2) positioned in front of the participant (0°) at a five feet distance with a fixed intensity of 65dBNPS for both situations. A restaurant noise (people talking) (Sunville Sounds, 2016) was displayed in a second Bluetooth speaker (JBL Jr POP) positioned two feet behind the participant (180°) at 75dBNPS.
The examiner used a sound level meter (DEC-500/INSTRUTHERM) to check the signal-to-noise -10dBSR throughout all participant's exams, 65 dBSR for speech, and 75 dBSR for noise. For the second situation (hearing loop and telecoil program activated), the speaker was positioned at 0,3 feet from the hearing loop microphone, keeping a distance of 5 feet from the participant.
The participants' evaluation was based on counting the number of words repeated correctly, based on the word recognition index proposed by Valente (1998). Only the words that were pronounced completely were considered correct. At the end of each situation, the participant answered a satisfaction poll. Scores follow the motivation tool " The Line", with a value of 0 corresponding to "not at all" and a value of 10 as "very much" (Ida Institute, 2013).
Results: There was a performance improvement in all participants when using the hearing loop, and all of them rated this condition as satisfactory. Therefore, scientific evidence shows that the benefits of the hearing loop can support the development of public policies and support audiologists in the counseling process and HA user's decision options.
Conclusion: The hearing loop has demonstrated benefits for speech perception in noise for people with HL, improved communication comfort and confidence with the use of this ALD.

Keywords: Assistive Listening Devices; Hearing loop; Accessibility; Hearing aids

P11.5

233 - Assessing the impact of cognitive status on audio-visual benefit

Marina Salorio-Corbetto [(1)] - Edwin Koubeh [(1)] - Deborah Vickers [(1)]
University of Cambridge, Clinical Neurosciences, Cambridge, United Kingdom [(1)]

Background: Everyday communication relies on multi-sensory inputs. Most commonly, we use visual information (mainly lipreading) to support speech-in-noise understanding (Tye-Murray et al., 2007). However, individuals vary in the benefit they obtain from visual information, even when performance for visual-alone presentation is accounted for, and in the perceptual weight that they assign to one or the other type of cue depending on their usability (Peelle and Sommers, 2015). Audio-visual performance is crucial for real-life benefit from hearing devices. Increased engagement of language-processing areas on presentation of visual speech (Paul et al., 2022; Fullerton et al., 2023) or manual gestures (Drijvers et al., 2017) is associated with better performance in speech tasks, and has been linked to better outcomes with cochlear implants (Paul et al., 2022; Fullerton et al., 2023). One of these language-processing areas, the posterior portion of the superior temporal sulcus (STS), receives both visual and auditory inputs (Peelle and Sommers, 2015). The activity and connectivity of the STS is modulated by the quality of visual or auditory information (Nath and Beauchamp, 2011; McGettigan et al., 2012). The impact of cognitive status on audio-visual benefit is not clearly understood. In the first stage of this project, the effect of cognitive status on the recognition of audio-visual speech for adults with typical hearing will be assessed.
Methods: Twenty adults with normal hearing will complete a battery of cognitive tests capturing fluid intelligence. This battery comprises the Digit Span Test (Terman, 1925), the Trial-Making Test (Reitan, 1958), the Stroop Test (Stroop, 1935). Additionally, participants will complete a sentence-recognition task where the presentation of the stimuli will be either auditory alone, visual alone, or audio-visual. The stimuli are adapted from those used by McGettigan et al. (2012).
In order to investigate how increasingly degrading either the audio or visual component of this task impacts performance, we will present two conditions of degraded speech and two conditions of visual degradation in addition to undegraded stimuli, with two levels of linguistic predictability. The relationships between cognitive status, auditory degradation, visual degradation, and linguistic predictability will be explored.
Results: The outcomes of this project will be relevant to understanding how cognition influences audio-visual benefit. This is of interest for users of hearing devices.

Keywords: audiovisual, audiovisual benefit, cognition, linguistic predictability, speech recognition

References:
Drijvers, L., Özyürek, A., Jensen, O. (2018). Hearing and seeing meaning in noise: Alpha, beta, and gamma oscillations predict gestural enhancement of degraded speech comprehension. Human Brain Mapping, 39(5), p.2075–2087.
Fullerton, A.M., Vickers, D.A., Luke, R., Billing, A.N., McAlpine, D., et al. (2023). Cross-modal functional connectivity supports speech understanding in cochlear implant users. Cerebral Cortex, 33(7), p.3350–3371.
McGettigan, C., Faulkner, A., Altarelli, I., Obleser, J., Baverstock, H., et al. (2012). Speech comprehension aided by multiple modalities: behavioural and neural interactions. Neuropsychologia, 50(5), p.762–776.
Nath, A.R., Beauchamp, M.S. (2011). Dynamic changes in superior temporal sulcus connectivity during perception of noisy audiovisual speech. Journal of Neuroscience, 31(5), p.1704–1714.
Paul, B.T., Bajin, M.D., Uzelac, M., et al. (2022). Evidence of visual crossmodal reorganization positively relates to speech outcomes in cochlear implant users. *Scientific Reports*, 12, 17749. Available at: https://doi.org/10.1038/s41598-022-22117-z.
Peelle, J.E., Sommers, M.S. (2015). Prediction and constraint in audiovisual speech perception. Cortex, 68, p.169–181.
Reitan, R.M. (1958). Validity of the Trail Making Test as an Indicator of Organic Brain Damage. *Percept Mot Skills*, 8, 271–276. Available at: https://doi.org/10.2466/pms.1958.8.3.271 [Accessed August 30, 2022].
Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of experimental psychology*, 18, 643.
Terman, L.M. (1925). *The measurement of intelligence: An explanation of and a complete guide for the use of the Stanford revision and extension of the Binet-Simon intelligence scale*, Harrap.
Tye-Murray, N., Sommers, M.S., Spehar, B. (2007). Audiovisual Integration and Lipreading Abilities of Older Adults with Normal and Impaired Hearing. Ear and Hearing, 28(5).

P11.6

234 - Pitch perception and frequency discrimination in CI users: The impact of pulse rate, electrode location and cross-channel interaction

Yue Zhang [(1)] - Behnam Molaee-Ardekani [(1)] - Rafael Attili Chiea [(1)] - Bradford Backus [(1)] - Manuel Segovia-Martinez [(1)]
Oticon Medical, Research and Technology Department, Vallauris, France [(1)]

Most commercial cochlear implants (CI) presently utilize continuous interleaved sampling (CIS) strategies to convert acoustic inputs into electrical stimulation for conveying sound to CI users. In the CIS strategy, the input sound signal is typically divided into frequency bands, and the variations in envelope within these bands are extracted. These envelopes then modulate trains of electric pulses, presented at a fixed rate and in a non-overlapping sequence. The pulses stimulate different electrodes in the cochlea according to the tonotopic pattern in the auditory nerve. While this envelope-based approach effectively conveys temporal pitch, it struggles to accurately transmit the fundamental frequency of speech and other low-frequency components, crucial for providing a distinct pitch sensation and sensitive frequency discrimination. Hence, we propose a series of clinical studies to investigate improving pitch perception by adjusting pulse rate, electrode location, pulse jittering, and cross-channel interaction.

The first study targets pitch perception and sensitivity by altering pulse rates in a single electrode. The literature indicates that integrating stimulation place and rate could deliver more differences in sensations to CI users; therefore, akin to Landsberger et al. (2015), we reproduce the pitch perception map by varying pulse rate and electrode location, aiming to make it clear if all differences in behavioral responses stem from enhanced pitch sensitivity. To address this, we refine the previous design by incorporating multi-dimensional scaling (MDS) and an adaptive track to determine the just-noticeable-difference in pitch resulting from combined place and rate cues.

In the second study we investigate how the configuration of the stimulating pulses affect pitch sensation and discrimination. We propose 3 different pulse jittering strategies to modify the rate cues by manipulating the inter-pulse duration. An MDS study is designed to analyze the effect of jittering pattern and average pulse rate in pitch sensation.

The last study investigates pitch perception and frequency modulation detection when multiple electrodes are activated simultaneously. Channel interactions, influenced by current spread in the cochlea significantly impact CI users. It's uncertain how these interactions affect pitch saliency and frequency modulation sensitivity. In traditional CIS, detection of spectral modulation across time is restricted due to cross-channel interaction. It's unclear if this limitation persists when delivering frequency modulation with rate and place cues. The study presents pulses at adjacent electrodes. These pulses are characterized by either having two identical rates separated by a predetermined delay or featuring two distinct constant rates. This is to examine the spatial and temporal masking effects between the electrodes and their effect on pitch perception and discrimination. The study proposes an MDS and a pitch ranking procedure to do so. Results aim to elucidate how channel interaction affects the efficiency of frequency information transmission in CI users, providing insights into improving pitch perception and modulation sensitivity.

We plan to enlist 15 CI participants for the three experiments. Using the Oticon Medical Research Platform (OMRP) and Oticon Medical Experiment Platform (OMEXP), stimuli will be directly delivered to the patients letting us for custom psychoacoustic experiments. Data collection starts in April 2024. In summary, our research aims to enhance pitch sensation and sensitivity by integrating place and rate cues, paving the way for improved stimulation strategies in realistic acoustic environments.

Keywords: Cochlear implant, signal processing, temporal find structure, pitch perception

P11.7

259 - Auditory function in children with speech delay

Mariia Markova [1]
Russian Medical Academy of Continuous Professional Education, Research Institute of Experimental and Clinical Audiology, Audiology, Moscow, Russian Federation [1]

Early diagnosis of hearing impairment is crucial in a child's development. Literature data show that children with mild to moderate hearing loss may have speech disorders due to insufficient perception of information. Speech is the most important psychological process formed in the first years of life. speech delay is the strongest pathological factor that has an extremely negative impact on the child's mental, emotional, cognitive and social development. The reasons are many-sided. Pediatricians, neurologists, and speech therapists actively refer children with speech delay for examination by otorhinolaryngologists and audiologists to exclude pathology from the auditory system as one of the possible causes of speech pathology.
In the period of 2022-2023, we performed the outpatient examinations of 72 patients aged from 2 to 4 years, who were referred by a pediatrician, neurologist or speech therapist to an otorhinolaryngologist with speech delay to rule out hearing impairment. All 72 children (100%) underwent tympanometry, otoacoustic emission and auditory evoked potentials registration. Despite the fact that 22 children (30%) had normal hearing, in the majority - 45 children (63%) a conductive component of hearing loss was detected due to the presence of concomitant pathology of the lymphopharyngeal ring with the usual formation of auditory tube dysfunction or the presence of otitis media with effusion, and 5 children (7%) were sent for hearing aid fitting.
Thus, an interdisciplinary approach to the management of children with speech delay using generally accepted algorithms for examining patients with suspected hearing impairment is necessary to detect hearing loss and deafness, as well as concomitant pathology of ENT. At the same time, thanks to modern and timely methods of hearing screening, it is possible to start early speech rehabilitation in patients who do not need the supervision of an ENT specialist.

P12 - SPEECH-IN-NOISE TESTING WITH DIGITS-IN-NOISE

P12.1

46 - Arabic Digits-In-Noise: Relations to hearing loss, reliability, and comparison of antiphasic and diotic versions

Hannah Guest [(1)] - Adnan Shehabi [(2)] - Chris Plack [(1)]
The University of Manchester, Manchester Centre for Audiology and Deafness, Manchester, United Kingdom [(1)] - Birzeit University, Department of Audiology & Speech Therapy, Birzeit, Palestinian Territory [(2)]

Background: The World Health Organization estimates that half a billion people suffer from disabling hearing impairment. The burden of unaddressed hearing loss is greatest in low- and middle-income countries, including many Arabic-speaking Middle Eastern and North African nations. Limited access to hearing healthcare is a crucial contributor, suggesting an important role for remote hearing screening. The Digits-In-Noise (DIN) test is used widely for this purpose, in a variety of world languages.
Browser-based DIN software developed at the University of Manchester allows remote testing in Arabic. Listeners use their own device and headphones/earphones and are not required to install an app; the DIN test runs instantly in their web browser. The software has been used widely in research, but careful validation is required before it can be used to screen for hearing loss.
In 2022, the software underwent initial validation, comparing Arabic and English DIN thresholds in bilingual listeners and by comparing results obtained in the lab (gold-standard) with those obtained at home (using the listener's own equipment). Arabic DIN thesholds were higher than English DIN thresholds. Test environment had only a marginal effect on performance. Test-retest differences were low for both languages and both test environments.
The present study is intended to provide more comprehensive validation, by testing the capacity of the Arabic DIN to predict pure-tone audiometric (PTA) thresholds in audiology patients, and by determining its test-retest reliability. It also compares results for two versions of the DIN: diotic (simple and widely used) and antiphasic (suggested to provide superior hearing-screening performance).
Methods: At the time of abstract submission, recruitment is almost complete. The sample includes 153 native Arabic speakers, ranging widely in age (18 to 83 years) and 4-frequency PTA average (-4 to 101 dB HL). All completed diotic and antiphasic versions of an adaptive DIN test, involving standard-Arabic digit triplets and a speech-shaped-noise masker. In the antiphasic condition, the phase of the digits was inverted between the ears. A subset of 52 participants returned on a separate day for repeat DIN testing.
Partial correlations and ROC curve analyses are used to interrogate relations between DIN and poorer-ear PTA thresholds. Intra-class correlation coefficients are used to determine test-retest reliability. Results for the diotic and antiphasic versions of the DIN are compared.
Results: In all comparisons, the antiphasic DIN appears to surpass the diotic version: stronger partial correlations with PTA thresholds (after controlling for age); greater area under the ROC curve (i.e., superior diagnostic ability); and greater test-retest reliability. In interim analysis, the antiphasic Arabic DIN predicts hearing loss >25 dB HL with 72% sensitivity and 80% specificity (using a DIN threshold cutoff of -13.5 dB). Results are highly reliable, with an intra-class correlation coefficient of 0.82 (95% CI 0.69-0.89).
Conclusions: Findings may alter as the final data are collected, but currently support the browser-based Arabic DIN as a valid and reliable hearing screening tool. The antiphasic version appears preferable to the diotic version for hearing screening purposes. Given limited access to in-person hearing healthcare in many parts of the Arab world, findings could support beneficial public-health measures. Work to convert the DIN software into a free screening tool for use in the Palestinian Territories is underway.

Keywords: Speech perception; Digits-In-Noise; Antiphasic; Hearing screening; Remote care

P13 - TELEAUDIOLOGY

P13.1

19 - Industry 4.0 and project management in audiology and speech terapy: a SWOT analysis

Guilherme Ribeiro Telli Manoel [(1)] - Amanda Scheffer [(2)] - Maria Fernanda Capoani Garcia Mondelli [(2)]
University of São Paulo, Economics, Administration and sociology, Piracicaba, Brazil [(1)] - University of São Paulo, Audiology, Bauru, Brazil [(2)]

Objective: to find data to formulate a SWOT analysis, in order to provide the strengths, weaknesses, opportunities and threats in the area of audiology and speech therapy.
Materials and Methods: The study was conducted by applying a form with 10 questions, aimed at professionals and students in the field of speech therapy and audiology, to investigate the knowledge of this population in relation to industry 4.0 and project management, followed by carrying out the SWOT analysis.
Results: It was possible to verify that in the population studied, despite the vast majority not being aware of the concept of industry 4.0 and project management, they make use of tools such as Excel, Trello and MS Project. As for the SWOT analysis, it was possible to map the main strengths and weaknesses, opportunities and threats.
Conclusion: despite the lack of familiarity with the topic studied on the part of the research participants, speech therapy and audiologist professionals already use many of the resources belonging to these areas. Furthermore, the SWOT analysis enabled knowledge about the strengths, weaknesses, opportunities and threats found in the area, helping to improve the performance of the speech therapy sector.

Keywords: Speech therapy, Project management, Industry 4.0, SWOT Matrix.

P13.2

186 - Developing and validating virtual-audio clinical tools for assessing spatial-listening skills for children with bilateral cochlear implants

Bhavisha Parmar [(1)] - Marina Salorio-Corbetto [(1)] - Jennifer Bizley [(2)] - Stuart Rosen [(3)] - Lorenzo Picinali [(4)] - Deborah Vickers [(1)]
University of Cambridge, SOUND lab, Department of Clinical Neurosciences, Cambridge, United Kingdom [(1)] - University College London, Ear Institute, London, United Kingdom [(2)] - University College London, Speech, Hearing and Phonetic Sciences, London, United Kingdom [(3)] - Imperial College London, Audio Experience Design Group, London, United Kingdom [(4)]

Background: Clinical tests for the assessment of spatial listening require multi-speaker arrays rarely available in clinical settings. A virtual-audio version of the Spatial Speech in Noise Test (SSiN; Bizley et al., 2015) leads to similar performance across spatial locations for loudspeaker arrays with normal-hearing listeners (Salorio-Corbetto et al., 2022).
The aim of this work is to determine whether the virtual-audio versions of the SSiN and the Adaptive Sentence List (ASL; (MacLeod & Summerfield, 1990) using a spatial release from masking test configuration test yield comparable results than their loudspeaker versions for children with bilateral cochlear implants. Additionally, the efficacy of a centralisation app to identify the degree of balance between the ears was explored together with the findings from the virtual speech tests. The purpose of this work is to validate virtual assessments for use in a clinical trial with virtual reality spatial training games.
Method: A participatory-design approach was used to develop and finalise the virtual-audio implementations of the tests (Vickers et al., 2021). Ten children and young adults who wear bilateral cochlear implants and ten age-matched normal-hearing participants, will perform each test (SSiN and Spatial ASLs) in each implementation (virtual-audio or loudspeaker). The order of the tests and implementations were counterbalanced across participants. The participants also completed the centralisation task (i-balance app) using narrow-band noise and wide-band stimuli consisting of speech-shaped noise and a non-language specific speech-like stimulus (Holube et al., 2010). The interaural level differences for these stimuli were varied by the children using a visual/tactile interface so that the sound was perceived in the midline. Children were asked to show where they located or heard the sound relative to their head by colouring a drawing.
Results: So far, the virtual-audio applications were finalised. Eight participants with cochlear implants and ten with normal hearing have completed the tests. Our outcomes will allow us to determine whether the virtual-audio versions of the tests have potential for clinical use, provide the validation for use in the clinical trial and determine whether the results from the centralisation task used in the i-balance app are informative in terms of spatial hearing abilities for children with bilateral cochlear implants.

Key words: audio-visual, speech test, cochlear implants, rehabilitation, virtual reality, spatial hearing, auditory training

References:

- Bizley, J.K., Elliott, N., Wood, K.C., Vickers, D.A., 2015. Simultaneous assessment of speech identification and spatial discrimination: A potential testing approach for bilateral cochlear implant users? Trends in Hearing, 19, p.2331216515619573. doi:10.1177/2331216515619573.
- Holube, I., Fredelake, S., Vlaming, M., Kollmeier, B., 2010. Development and analysis of an International Speech Test Signal (ISTS). International Journal of Audiology, 49(12), p.891–903. doi:10.3109/14992027.2010.506889.
- MacLeod, A., Summerfield, Q., 1990. A procedure for measuring auditory and audio-visual speech-reception thresholds for sentences in noise: rationale, evaluation, and recommendations for use. British Journal of Audiology, 24, p.29–43.
- Salorio-Corbetto, M., Williges, B., Lamping, W., Picinali, L., Vickers, D.A., 2022. Evaluating Spatial Hearing using a Dual-Task Approach in a Virtual Acoustics Environment. Frontiers in Neuroscience, p.46.
- Vickers, D.A., Salorio-Corbetto, M., Driver, S., Rocca, C., Levtov, Y., et al, 2021. Involving children and teenagers with bilateral cochlear implants in the design of the BEARS (Both EARS) virtual reality training suite improves personalization of the intervention. Frontiers in Digital Health, p.156.

P13.3

122 - Development and implementation of a distributed web-based AEP and OAE testing system

Rafael Delgado [1]
Intelligent Hearing Systems Corp, Research and Software Development, Miami, United States [1]

Telemedicine, or the use of telecommunication technology to provide healthcare services remotely, has significant potential in the field of audiology: 1) Increased Access to Care: Telemedicine can increase access to care for individuals living in remote or underserved areas. It allows patients to receive testing without having to travel to a clinic, which can be especially beneficial for individuals with mobility issues or transportation challenges in remote and rural regions. 2) Cost-effective: Telemedicine can reduce costs associated with travel, lodging and other expenses related to in-person testing. Additionally, telemedicine can also reduce costs for healthcare providers by reducing the need for additional staff and equipment. 3) Improved Quality of Care: Telemedicine allows healthcare providers to share patient information and collaborate on treatment plans in real-time. This can improve the quality of care for patients and lead to better outcomes. 4) Increased Efficiency: Telemedicine can increase testing efficiency by reducing wait times for appointments and decreasing the amount of time needed to complete the testing process. This can help to reduce patient anxiety and improve overall patient satisfaction.

Currently, telemedicine testing in audiology is conducted on a limited basis using commercial teleconferencing and remote control applications such as Windows Remote Desktop Connection (RDC) tool. Although these methods have been used, they do not provide an integrated cost effective solution. In addition, telemedicine solutions must adhere to patient privacy and security regulations, particularly regarding the transmission and storage of patient data, which might not be provided by off-the-shelf commercial teleconferencing application. This poster describes the development and implementation of a distributed web-based auditory evoked potential (AEP) and otoacoustic emission (OAE) system. A distributed system, is a collection of independent computer and hardware components located on different systems and locations, communicating in order to operate together and improve efficiency.

The system developed is composed of a central “Server” that controls the testing and handles all data storage, and multiple “Client” devices connected to the testing hardware. Unlike currently used teleconferencing solution, the developed system software integrates telecommunication components to communicate directly between the Server and Clients. The testing devices used were the cost effective Aria platform (by Intelligent Hearing Systems Corp., Miami, Florida USA) with AEP and OAE testing capabilities connected to a mini-PC computer. Mini-PC computers have a very small form factor (typically around 100 X 100 X 18 mm), are extremely cost effective (< US $150) and are used to run the testing applications and provide web connectivity. The entire testing device, including the Aria, Mini-PC computer and transducers fit in a small case 27 X 20 X 9 cm which can be easily shipped to a remote location. The Mini-PC is mapped to a web-drive for remote data storage and accessing the testing applications. The software installed on the Mini-PC only provides the initial access to the web-based Server and no patient information or data is stored locally. Since all the software is remotely accessed, the remote testing systems always run the latest version of the testing applications without the need to update each device. The control and testing software use an integrated encrypted communication protocol to transfer information. The Server user can operate the Client testing device seamlessly without the need of third party teleconferencing or remote control applications. Data acquired is automatically stored and displayed on the Server computer screen. There is no theoretical limit to the number of client devices that can be connected and controlled by a single Server.

The system developed has a wide range of potential applications in telemedicine, for remote testing, and simultaneous testing at one or multiple locations, for newborn hearing screening and pharmaceutical research animal high frequency testing applications.

Keywords: Telemedicine, Auditory Evoked Potentials, Otoacoustic Emissions, New Born Hearing Screening

P14 - TINNITUS

P14.1

18 - Photobiomodulation Therapy in Aspects Related to Hearing: an Integrative Bibliometric Study

Amanda Scheffer [1] - Maria Fernanda Capoani Garcia Mondelli [1] - Renata da Silva Cardoso Rocha Tavares [2]

University of São Paulo, Audiology, Bauru, Brasil [1] - Federal University of São Paulo, Audiology, São José do Rio Preto, Brasil [2]

Introduction: In recent decades, cases of inner ear disorders have increased, including hearing loss, tinnitus and vertigo, thus the demand for new treatments has been growing, with low-level laser therapy (LLL) being a targeted treatment due to its non-invasive nature.
Objectives: The present study aims to investigate the studies of low-level laser and audiology in recent years. Materials and Methods: The quantitative bibliometric study was carried out by searching for scientific articles in the Web of Science - Clarivate Analytics database. The association of the words “low level laser therapy” and “hearing” was used to construct the sample. Results: The recurrent objectives analyzed the action of LLL in terms of its effectiveness, with predominantly positive results in the effectiveness of the treatment of hearing problems such as hearing loss, tinnitus and vertigo.
Conclusions: LLL is a great tool for professionals who care for human hearing, helping to recover patients with hearing problems in a non-invasive or medicinal way, thus improving the functions in which LLL is applied.

Keywords: Tinnitus; Audiology; Low-intensity laser therapy; Hearing Disorders; Bibliometrics.

P14.2

35 - Prevalence of tinnitus in a sample of 43,064 children in Warsaw, Poland

Piotr H. Skarżyński [(1)] - Danuta Raj-Koziak [(2)] - Natalia Czajka [(3)] - Henryk Skarżyński [(4)]
World Hearing Center, Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(1)] - Institute of Physiology and Pathology of Hearing, Department of Audiology and Phoniatrics, Tinnitus Clinic, Warsaw/Kajetany, Poland [(2)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Department of Teleaudiology and Screening, Warsaw/Kajetany, Poland [(3)] - World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland [(4)]

Background**:** Tinnitus affects both adults and children. Children rarely complain spontaneously of tinnitus,and their parents are not aware of the condition. The prevalence of tinnitus in children differs consider-ably between studies, and large studies are needed to reliably estimate how many children experiencetinnitus symptoms. The goal of the study was to estimate the prevalence of tinnitus in a large sample of school children.
Material and methods**:** This study was population-based, epidemiological research, conducted in the general, paediatricpopulation of school-age children in Warsaw, Poland. Pure-tone audiometric testing was done, and hear-ing thresholds were determined from 0.5 to 8 kHz. Both the children and parents answered questionsabout the presence of tinnitus in the child. Results from 43,064 children aged 11 to 13 years old, as well as their parents,were collected.
Results**:** The study showed that tinnitus affected 3.1% of the children, but it was significantly more fre-quent (9%) in children with hearing loss. We found that 1.4% of the parents were aware of the presenceof tinnitus in their children.
Conclusions**:** Children should be routinely asked whether they experience tinnitus and if so, they shouldbe included in the thorough assessment and management of the condition.

Key words: tinnitus • prevalence • children • epidemiology

Author index

A

Aaberg Nielsen Line Louise 237
Abdelatif Khaled....95
Abdukayumov A.A....44
Adkins David.... 32; 129; 155; 156
Aguera Pierre-Emmanuel....54
Akçakaya Hatice....63
Akinshina Nadia....245
Alenezi Eman....135
Alfakir Razan....140
AlMakadma Hammam....82
Almansour Yasser....29
Almasu Leen J. N....205
Altamini Ali....135
Altin Sibel....61
am Zehnhoff-Dinnesen Antoinette....61
Amaral Maria Isabel Ramos....211
Amirkhanova Margarita....15
Anderson Sean....17
Andin Josefine....126
Andric Filipovic Snezana....87
Angelo Thais....198
Angonese Giulia....177
Anióse Katja....222
Anne Samantha....69
Antonelli Bianca....198; 230
Aparisi-Climent Victor....213
Archbold Sue....149; 150; 227
Ardenkjær-Husted Regitze....18
Arras Tine....28
Artyushkin Sergey....106; 182
Assaf Ranny....110
Atlas Marcus....117
Attili Chiea Rafael....247; 251
Auberger Fabien....184
Azenha Fabiana....198

B

Babu Seilesh....29
Backus Bradford....251
Bailey Abram....180
Bakhshinyan Vigen....14; 114; 190
Banai Karen....21
Banks Jonathan....171
Barbieri Riccardo....90; 92
Barker Brittan....169
Barker Melinda....138
Barr Layla....63
Barry Johanna....45
Barylak Roman....216
Başkent Deniz....163
Baudonck Nele....96; 116
Baudoux Véronique....220
Bavin Edith L.....35
Bedoin Nathalie....54
Bellekom Sandra....117
Bellnier Laura....32
Benard Michel R.....118
Benard Ruben....163
Bendykowska Maria....81
Bennett Bec....176
Bentan Mihai....153; 241
Bernabei Greta....158; 159
Bernard Jate....129
Best Lidia....151; 161; 172
Best Sebastian....206
Best Stephanie....175
Beswick Rachael....39
Betz Joshua....5; 75
Beukes Eldre....68
Bijnens Tine....74
Bilert Sascha....193
Birkenhäger Ralf....13
Bizley Jennifer....255
Blanco Borja....48
Blanco-Trejo Sergio....94
Blasca Wanderleia....198; 230
Blinka Marcela....76
Blue Christian....66
Board Ryleigh....155
Boboshko Maria....78
Boerboom Ralf....145
Boisvert Isabelle....122
Bojrab Dennis....29
Bonora Chiara....91
Bothe Ellen....176
Bramsløw Lars....178
Brannath Werner....61
Brasen Brændgaard Louise....109
Breda Laura....220
Brennan-Jones Chris....135; 158; 159
Brunelli Nicola....91
Brzoska Tina....110
Brzozowska Natalia....81
Buchhold Britta....110
Budke Naëmi....228
Buhl Mareike....177
Bukato Ewelina....80; 216
Bulgarelli Chiara....48
Burns-O'Connell Georgina121; 147; 170; 171; 229
Burum Kristina....243; 244
Busch Chia-Jung....110
Bush Matthew....32; 129; 155; 156
Bysted Peter Asbjørn Leer....178

C

Caclin Anne....54
Callejón-Leblic Amparo....94; 98
Capoani Garcia Mondelli Maria Fernanda....194; 254; 257
Carew Peter....35; 36; 183
Carlyon Robert P....204
Carvalho Beatriz Ribeiro....211

Carvalho Nadia Giulian 211
Casali John 160
Caseiro Antonelli Bianca 199; 239
Casey Brett 39
Cayé-Thomasen Per 109
Cayley Tanisha 158
Cebulla Mario 38
Ceuleers Dorien 96; 116
Chadha Shelly 3
Chan Yi-Chih 164
Chang Shu-Ting 164
Chang Yi-Ping 164
Cheah Nicole 30
Chen Pin-Chun 164
Ching Teresa 39
Cho Ryan Wei Yang 73
Christie Michelle 154
Ciorba Andrea 91
Cline Trey 155; 156
Coco Laura 165
Coelho Daniel 153; 240; 241
Colella-Santos Maria Francisca 201; 202; 208; 210; 211
Collar-Castillo Jose Ignacio 213
Collins-Jones Liam 48; 212
Conway Robert 29
Cooper Ellie 218
Cooper Robert 48
Corbett Fleur 236
Corina Said de Angelo Thais 239
Corona-Strauss Farah I. 93; 205; 206
Couth Samuel 224
Crow Sarah 69
Cui Tao 197
Cullington Helen 236
Cushing Sharon 20; 23
Cyrzan Alicja 81
Cywka Katarzyna B. 215
Czajka Natalia 55; 56; 80; 81; 136; 168; 214; 216; 225; 232; 258

D

da Cruz Melville 105
da Silva Cardoso Rocha Tavares Renata 257
Dąbrowski Piotr 133; 134
Dahlin-Redfors Ylva 166
Dang Kai 247
Danielsson Henrik 222
Darche Patricia 77
Dashti Ghazaleh 138
Dau Torsten 18
Davis Adrian C. 127
Dawes Piers 176
de Geus Eco 11
de Graaff Feike 103
de Graaff-Korf Karin 34
de Kock Tersia 4
de Laat Jan A.P.M. 119
de Miranda Cantuária Alves Heloisa 194
de Souza Pinto Azenha Fabiana 239
Défossé Frédérique 220
Degeest Sofie 96
Delgado Rafael 209; 256
Delmarcel Laura 74
Demir Muhittin 61
Demps Katandria 141
Demps Keith 141
Denys Sam 45; 79
Der Carolina 3
Desloovere Christian 28
Desmedt Loes 79
Dettman Shani 39
Dewey Rebecca 226
Dhanda Nisha 144; 170
Dhooge Ingeborg 96; 116
Dieieva Yuliia 15
Diekmann Sandra 61
Dillard Lauren 3; 162
Diman Rafael 249
Ding Maureen 83
Dirks Evelien 163
Dodson Kelley 66
Donders Rogier 26; 145
Dong Ruijuan 196
Downie Lilian 146
Driver Sandra 236
Dubno Judy 162
Duchesneau Patricia 31
Duncan Liz 68
Duobaitė Nida 48
Duquette-Laplante Fauve 77
Duval Jérémie 77
Dvoryanchikov Vladimir 182
Dworak Ralf 249
Dwyer Noel 27

E

Edmunds Melinda 158
Eikelboom Robert 63; 107; 117; 123; 135
Ekberg Katie 10
Elliott Kayla 39
Ellis Rachel 126; 222
Engdahl Bo 127
Erscoi Lelia 98
Eskofier Björn 181
Everdell Nicholas 48

F

Fan Jia-Shin 164
Farabbi Andrea 90; 92
Fehrmann Mirthe L.A. 242
Felding Julian 247
Feltham Georgia 19
Fenton Mark 130; 131
Ferguson Melanie 176
Ferm Inga 101
Fernandes de Lemos Danielle 239
Ferrari Deborah 249

Ferrazoli Natalia....200
Ferreira Néri Lucas....199; 239
Filip Jasmin....61
Firszt Jill....27
Fischer Rosa-Linde....223
Flanagan Sheila....19; 47
Flicker Leon....63
Foellmer Jurek....206
Folkeard Paula....193
Fornoni Lesly....54
Francis Kate....138
Franco Chiriboga Laura....208
Fraysse Bernard....115
Frederigue-Lopes Natália....249
Frijns Johan....145
Frisby Caitlin....4
Fu Manjia....83
Fu Xinxing....63
Fuente Adrian....77
Fulton Bernadette....196

G

Gabrielczyk Fiona....19; 47
Gagnon Erika....113
Gans Jennifer....167
Gao Esther Yanxin....73
Garbaruk Ekaterina....78
Garcia Charlotte....204
Garcia Morales Emmanuel....5; 75
Gardner-Berry Kirsty....39
Garnett Hannah....40; 41
George Erwin....145
Gietmann Corinna....61
Gillespie Alanna....42
Giulian de Carvalho Nadia....202
Glazenburg Berend....119
Goderie Thadé....124; 125
Goeleven Ann....79
Golubok Tetiana....15; 216
Goodhew Amanda....186
Gopinath Bamini....127
Gordon Karen....20; 23
Gornall Patrick....138
Gos Elżbieta....81; 214; 215; 225; 232
Gossé Louisa....48
Gößwein Jonathan A....177
Goswami Usha....19; 47
Goverts Theo....103
Graber Lukas....223
Gravel Carolin....228
Gray Amy....148
Gray Zara....148
Greczka Grażyna....133; 134
Green Tim....246
Greenwood Rosemary....171
Greer Caitlin....82
Grønborg Sandvej Matilde....109
Gross Joachim....19
Guan Jingjing....196
Gudnason Vilmundur....127
Guest Hannah....226; 253

H

Haaijer Kelly....88
Hackley Steven A....93
Haer-Wigman Lonneke....242
Hall Amanda....71; 170; 171
Han Hae-Ra....5; 75
Hannemann Ronny....93; 181
Hare Julie....111
Harkus Samantha....39
Havtorn Lena....8
Haywood Nicholas....24
Helleman Hiske....84
Heltsley Caroline....129
Hendriks Petra....248
Hermann Ruben....54
Hernvig Lotte....187
Herrlin Petra....237
Heussner Sophia....69
Hibbert Jane....40; 41
Hickson Louise....10
Hildebrandt Andrea....177
Hitos Kerry....105
Ho Cyrus Su Hui....112
Ho Roger....112
Hoarau Caliani....54
Hodgson Jan....42
Hoffman Howard J....127
Höhne Philip-Hendrik....61
Holden Laura....27
Holden Tim....27
Holmes Corrie....167
Holst Jenn....167
Hong Robert....29
Hood Linda....209
Hope Peter....76
Howe Madison....139
Howell Tegan....35
Hughes Sarah....122
Huinck Wendy....26; 53; 104; 145; 242
Huizinga Nicole....11
Hung Yu-Chen....164
Hunter Michael....123
Hussain Saira....71; 121; 144; 147; 157; 170; 171
Husted Baungaard Line....109
Huysmans Elke....103
Hynes Charlene....130

I

Ibarra-Rodriguez Marta....213
Ileperuma Dinukshi....63
Ingo Elisabeth....126; 222
Innes-Brown Hamish....49
Inoyatova F.I....44; 173
Iplinsky Clara....249

Iseli Claire....39
Ishiyama Akira....190
Iwagami Eri....246

J

Jacob Regina....249
Jagger Alison....138
Jalilvand Karimi Leyla....203
Jankovic Vincent....61
Jansen Lotte A.....125
Janssen Arno....26
Jayakody Dona....63; 107
Jensen Jesper....178
Jensen Niels....206
Jensen Soffi Skovlund....8
Jiang Dan....236
Jones Cheryl....42
Jones Emily....48
Jones Linor....143
Jönsson Radi....166
Jutras Benoît....77

K

Kaandorp Marre....145
Kamerer Aryn....169
Kamin Stefan....223
Kamkar Parsi Homayoun....193
Kanaan Oliver....61
Kang Joshua....153
Kaplan Emily....69
Karlsson Charlotte....130
Kawar Khaloob....51; 52
Kazuko Nishino Lucia....192
Keim Ralph....38
Kek Tze Ling....83
Kekez Damir....63
Keppler Hannah....96; 116
Kestens Katrien....96; 116
Keur-Huizinga Laura....11
Keyes Karen....65
Khalass Nouri....119
Khan Qais....149
Khanal Rija....221
Khandanyan Gegham....190
Kim Young Ho....219
Kinealy Brian....155
Kishon-Rabin Liat....51
Kluk Karolina....39; 226
Knibb Rebecca....170; 171
Knipping Stephan....234
Kochanek Krzysztof....136
Kollmeier Birger....59; 60; 177
Kołodziejak Aleksandra....80; 168
Kong Kelvin....39
Koprowska Aleksandra....8
Koubeh Edwin....250
Kral Andrej....57
Kramer Sophia....11; 63; 103; 124; 125; 179
Kuthubutheen Jafri....158
Kyhne Hestbæk Marianne....109

L

Lacerda Adriana....198
Lalayants Mariia....14; 114
Lam Cheuk Chee Cynthia....238
Lamb Brian....149; 150; 227
Lammers Rick....124
Lang-Roth Ruth....61
Lanting Chris P.....242
Laullier Hugo.....220
Launer Stefan....9
Laureyns Mark....74; 161; 172
Lavie Limor....21
Lee Paul....76
Lees Helen....39
Leigh Jaime....30
Leigh Greg....39; 175
Lelic Dina....237
Lemke Ulrike....125
Lemos Ana Carolina....211
Lenarz Thomas....59
Lettieri Sandra....30
Levy Cilmara....192
Lewis Sharon....146
Li Chuan-Ming....127
Lickess Sian....170
Liddle Karen....39
Lim Chee Yit....73
Lim Magdalene....83
Lim Rachel....20; 23
Lin Frank....5; 75
Lin Michelle....35
Lissenberg-Witte Birgit....124; 125
Liu Xue Zhong....12
Lo Ming....164
Loh Woei Shyang....102; 112
Loo Jenny....83
Luiken Lieke....84
Lyxell Björn....243; 244

M

MacFarlane Cassidy....169
Macnaughton Jane....68
Magee Catherine....40; 41
Mahairas Anthony....32; 129
Mahmudov M.U. 44
Mahomed-Asmail Faheema....63
Mahon Merle....236
Mai Adrian....206
Manchaiah Vinaya....4; 180
Mandke Kanad....19; 47
Manente Matteo....100

Manford Claire 67
Mao Yinan 123
Marini Maria Chiara 235
Markova Mariia 252
Markova Tatyana 14
Marques do Couto Christiane 200; 233
Marrone Nicole 5; 75
Martin Patti 139
Marulli Matilde Maria 235
Mateusen Limme 74
Mathmann Philipp 61
Mattsson Tone Stokkereit 43
Mavaddat Nahal 63
May Elbar 72
May Tobias 49
Mayer Connie 149; 152; 227
McHugh Lauren 39
McIlhiney Paul 107
McMahon Catherine 39; 127
McRackan Theodore 162
Meadows Makenzie 169
Meijer Annerenee 163
Meister Hartmut 95
Merchant Reshma Aziz 112
Merkus Paul 103
Mesiano Paolo 49
Meyer Carly 10
Migliorelli Andrea 91
Migliorini Enrico 53
Millman Rebecca 226
Mishra Srikanta 62
Molaee-Ardekani Behnam 247; 251
Mollura Maximiliano 90; 92
Moore Brian 47
Moore David 4; 45
Moret Adriane 249
Mothemela Bopane 4
Moulin Annie 54
Mulla Imran 227
Munro Kevin 226
Murray Carlyn 226
Mutter Nikki 185; 195
Myers Bronwyn 176
Mylanus Emmanuel 26; 53; 104; 145; 242

N

Nadjimutdinova N.Sh. 44
Naghipur Awa 61
Naylor Graham 120
Neal Katie 122
Negandhi Jaina 20; 23
Negossi Laura 91
Nemeth Meghan 241
Neri Lucas 198; 230
Neumann Anja 61
Neumann Katrin 61
Ng Faye Yu Ci 102
Ng Li Shia 102; 112
Nickbakht Mansoureh 10
Nielsen Claus 8
Nieman Carrie 5; 75; 76
Nightingale Ruth 236
Nijmeijer Hugo 104; 145
Nilsen Ann Helen 43
Nix Evan 155
Nixon-Hill Reuben 48
Noble Sian 171
Nordqvist Peter 126
Norman Gary 130; 131; 132
Nowrojee Kayla 146

O

Oh Esther 75; 76
Oliver Janette 122
Ong Benedict Ding Chao 73
Ong Jun Jean 37
Overmark Mathilde Marie 109

P

Paglialonga Alessia 89; 90; 92
Pajk Darja 108
Pankowska Zuzanna 80
Papsin Blake 20; 23
Park Kyoung Ho 207
Park Lisa 22; 113
Parkinson Bonny 39
Parmar Bhavisha 236; 238; 255
Patel Mit 32
Pattanshetti Suhani 224
Pauli Nina 166
Pelletier Marie-Pier 77
Pennings Ronald J.E 242
Percy-Smith Lone 109
Petersson Rajanya 66; 240
Philips Birgit 28; 53; 104
Philpott Nikki 26; 53; 104; 145
Phuong Anthea 156
Picazo-Reina Ana 94; 98
Piccino Maria Thereza 230
Picinali Lorenzo 255; 255
Pick Kate 195
Pierzyńska Irina 215
Pingree Graham 240
Plack Chris 226; 253
Polo Edoardo Maria 89; 90; 92
Polspoel Sigrid 179
Polyakov Alexander 14
Pontoppidan Niels Henrik 8
Porps Sandy 29
Porter Ann 39
Poulakis Zeffie 39; 42; 138
Powell Samuel 48
Pralus Agathe 54
Prein Lukas 61

Prendergast Garreth 226
Pretto Aneesha 33
Primako V. 44; 173
Prodi Nicola 91
Pryce Helen 71; 121; 147; 170; 171; 229
Pucheu Sylvie 220
Pullens Wieske 74

Q

Quail Teresa 68
Quilter Megan 185; 195; 197
Quinhoneiro Blasca Wanderleia 199; 239

R

Raab Forastieri Piccino Maria Thereza 199
Rahimi Mahboobeh 203
Raimundo Jheniffer Queiroz 210
Rajasingam Saima 68
Raj-Koziak Danuta 81; 258
Ramos do Amaral Maria Isabel 202
Rance Gary 46; 99
Reeder Ruth 27
Reheis Johanna 33
Rehman Hamna 105
Reilly Sheena 35
Reiner Matthias 248
Reis Gonçalves Cauã 201
Renz Laura 206
Rhebergen Koen 84
Ribeiro Telli Manoel Guilherme 254
Rich Jaimee 158
Richmond Peter 158
Rickard Lisa 231
Rijntjes Evert 119
Rizaev J.A. 173
Roberst Gehan 37
Roberts Lauren 209
Rodrigo Hansapani 180
Rodrigues Talarico Thais 192
Rodriguez Chris 165
Roman Aaron 97
Rosemann Stephanie 58
Rosen Stuart 246; 255
Rosenhouse Judith 52
Ruigendijk Esther 248

S

Sabin Andrew 180
Salorio-Corbetto Marina 24; 236; 250; 255
Sanchez Gabriela 165
Sánchez Serafin 98
Sánchez-Gómez Serafín 94
Santarelli Rosamaria 91
Santos Silva Ribeiro do Val Bello Thamirez 192
Sapp Caitlin 22; 113
Sargent Tim 48
Sargsyan Gayane 190
Saunders Gabrielle 224
Scarinci Nerina 10
Schäfer Karolin 61; 228
Scharpenberg Martin 61
Scheffer Amanda 194; 254; 257
Schell-Majoor Lena 60
Schinkel-Bielefeld Nadja 7
Schjerlund Derya Ceylan 187
Schlierenkamp sarah 61
Schmitt-Rüth Stephanie 223
Schotenröhr Anna 61
Schroeer Andreas 93; 206
Schué Mathieu 220
Schwalen Anna Sophia 61
Schwarze Katharina 61
Scimemi Pietro 91
Scollie Susan 193
Sear Tracey 111
Segal Osnat 51
Segovia-Martinez Manuel 98; 247; 251
Seifer Ann-Kristin 181
Sequi-Canet Jose Miguel 213
Sequi-Sabater Jose Miguel 213
Serman Maja 206
Serrano Andrea 63
Shah Haisam 105
Shahnaz Navid 72
Shatokhina Olga 14
Shaw Rachel 121; 147; 170; 171; 229
Shechter-Shvartzman Liat 21
Sheehan Jane 138; 175
Shehabi Adnan 253
Shehata-Dieler Wafaa 38
Shepherd Daisy 35; 36; 37; 39; 85
Sherman Kerry 176
Shinn Jennifer 155; 156
Siddiqui Maheen 48
Sideri Karoline 208
Siemann Ietske 26
Silva Cysneiros Helena Renata 70
Simcock Peter 68
Simeone Davide 92
Siqueira Julia 201
Skarżyński Henryk .. 55; 56; 80; 81; 136; 168; 214; 215; 216; 225; 232; 258
Skarżyński Piotr H... 55; 56; 80; 81; 136; 168; 214; 215; 216; 225; 232; 258
Skipper James 48
Smeds Karolina 237
Smeele Yvonne 26
Smit Adriana 123
Smith Greg 48
Smith Libby 35; 36; 37; 39; 85; 146; 148; 183; 217; 221
Smith Sian 121; 147; 171; 229
Smits Cas 88; 103; 179
Snan Lulia 20; 23

Søgaard Jensen Niels....193
Soh Qi Rui....36
Song Harris Jun Jie Muhammad Danial .. 102; 112
Sørensen Anna Josefine Munch....8
Soto Enrique....16
Speers Amanda....195
Spruyt Roxanna....65
Stegeman Inge....123
Stenner Hansen Mie....109
Stotijn Marc....119
Straus Jean....121; 147; 170; 171
Strauss Daniel J....93; 205; 206
Strobel Kaja....181
Stroud-Dunn Elizabeth....30
Stuhrmann Nicole....61
Sucher Catherine....107; 117
Suen Jonathan....5; 6; 75
Sun Kang....8
Sundström Simon....243; 244
Sung Valerie 35; 36; 37; 39; 42; 85; 138; 146; 148; 175; 183; 217; 221
Swanepoel De Wet....4; 123; 180
Swift Valerie....137; 158
Swinnen Freya....96; 116
Szanton Sarah....5; 75
Szatmari Tiberiu-Ioan....8
Szydłowski Jarosław....133; 134

T

Taddei Steve....180
Talarek Małgorzata....80
Tan Benjamin Kye Jyn....73; 102; 112
Tan Nicole Kye Wen....102
Tan Vanessa Yee Jueen....73
Tavartkiladze George....14; 25; 114;190
Temple Marisa....22
Thai Stephanie....183
Thapliyal Mihika....69
Theelen Femke....88
Themann Christa L. 127
Thiel Christiane....58
Thieren Sandrien....118
Thomé Vitória Luiza....233
Tian Xin....196
Tillmann Barbara....54
Timmer Barbra....10; 176
Toh Emma Min Shuen....112
Tomlin Dani....46
Tran Vivian....183
Travers Joanne....142
Trezek Beverly....152
Trumbo Jami....5; 75
Truy Eric....54
Tu Bella....76
Tufatulin Gaziz....106; 174; 182
Tuncer Ceylan....237
Turton Laura....170

U

Ubiali Thalita....202; 211
Uhler Kristin....17
Uilenburg Noëlle....86

V

Valayannopoulos Vassili....189
Van Buynder Patricia....39
van de Berg Raymond....125
Van de Ven Sjors....11
Van den Bosch Lion....86
Van der Mast Olmo....86
Van der Ploeg Kitty....86
van der Wilt Gert Jan....145
van Dijk Bas....53
van Dommelen Paula....34; 118
Van Eeckhoutte Maaike....18
van Straaten Henrica L.M....34
van Wier Marieke F. 124; 125
van Wieringen Astrid....28; 45; 79
Vanacker Hugo....220
Vasconcelos Santos Marcia Marcelle....70
Vatti Marianna....247
Veeranna Sangamnatha....63
Vega Rosario....16
Vercammen Charlotte....9; 224
Verhaert Nicolas....45; 79
Verkerk Paul....34; 86
Vernimmen Freek....125
Versfeld Niek....11
Veselinovic Tamara....137; 158
Vespero Vívian Aparecida....198; 199; 230; 239
Vickers Deborah .24; 111; 212; 236; 238; 250; 255
Vidal-Rosas Ernesto....48
Vikhnina Sofya....78
Vincent Charles....220
Visentin Chiara....91
Viviane Ferrai Deborah....199
Vollmer Marcus....110

W

Wächtler Moritz....95
Waite Monique....10
Wake Melissa....35; 39
Walkowiak Adam....215
Wallhagen Meg....222
Wang Natalie....76
Wang Shangqiguo....50
Wang Shuo....196
Ward Melanie....170
Warmuth Julia....181
Warner-Czyz Andrea....17; 69
Wasmann Jan-Willem....53
Wasmuth Susanne....61

Watson Glen 105
Webb Emma 42
Weerasuriya Rona 221
Wendy J. Huinck 119
Wennberg Siri 43
Werfel Krystal 218
West Emma 240
Whiteway Jen 122
Widney Molly 22
Wijetillake Aswin 247
Wilding Michael 40; 41
Wilkes Claire 144; 157
Wilkins Katherine 85
Willgruber Abbigayle 155
Williger Bettina 223
Williges Ben 24
Willmot Nicola 195
Wilson Angela M. 19
Wilson Anji 47
Wilson Cecil 206
Winter Isa Samira 95
Wiseman Kathryn 113
Wolters Florian 237
Wołujewicz Kinga 215; 216
Wong Hayley 175
Wong Janis 42
Wong Lena L. N. 50
Wong Stephanie 66
Woonink Aart 163
Wouters Jan 28
Wright Neil 185

X

Xu Jessica 37; 85
Xue Yuning 105

Y

Yanov Yuri 182
Yasar Sevil 76
Yen Ng Z 150
Yeo Brian Sheng Yep 73; 112

Z

Zaar Johannes 49
Zacante Santos Gabriela 239
Zanin Julien 99
Zdanowicz Rita 80; 216
Zehnwirth Natalie 217
Zeitler Daniel 155
Zekveld Adriana 11
Zhang Jing 196
Zhang Yue 94; 98; 247; 251
Zhao Chunlong 18
Zielonkowski Susanna 61
Zoth Peter 100
Zych Monika 133; 134