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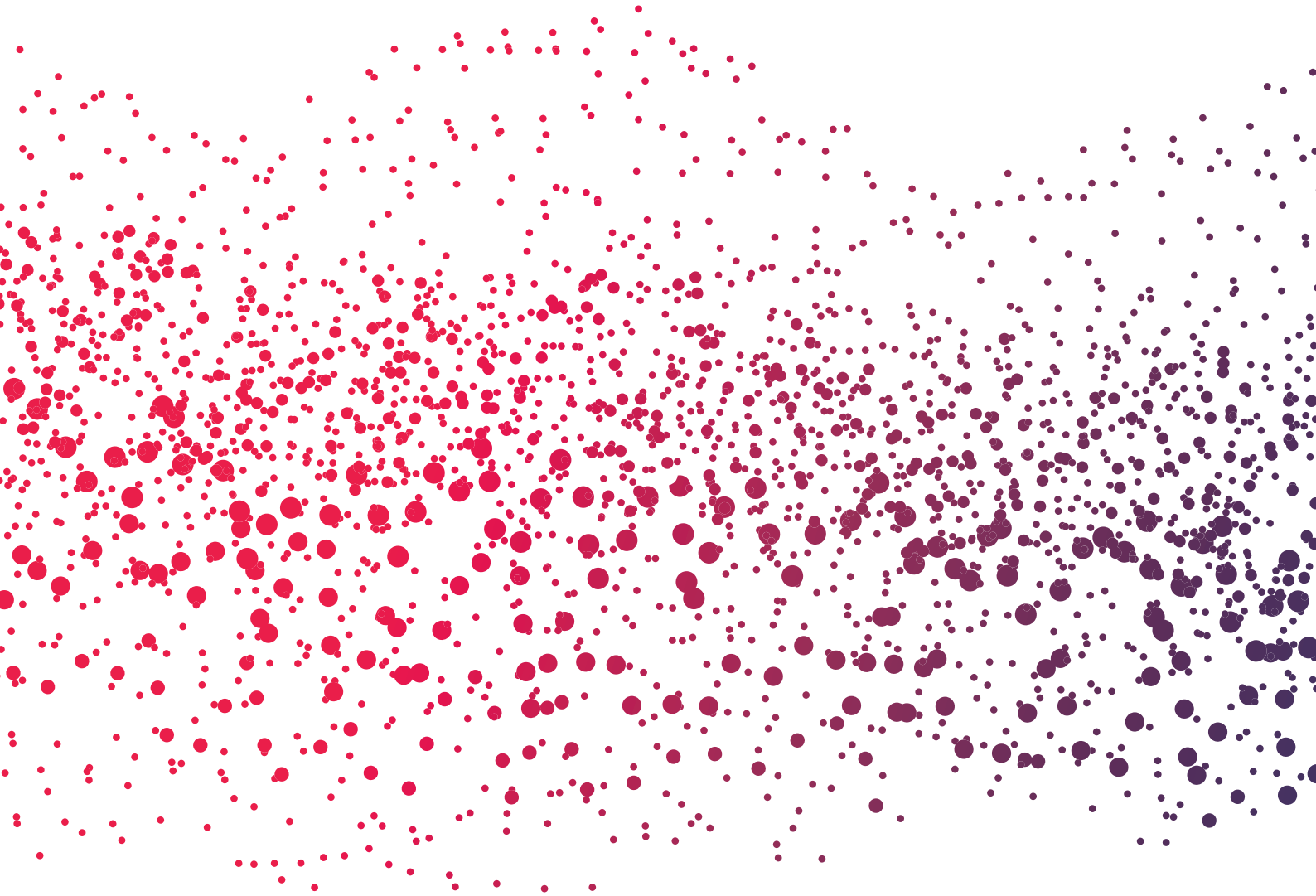

A Comparison of The Severity of Tinnitus in Patients with and without Hearing Loss

Unilateral Auditory Deprivation in Humans

Hearing And Exposure to Music in Adolescents

CONTENT

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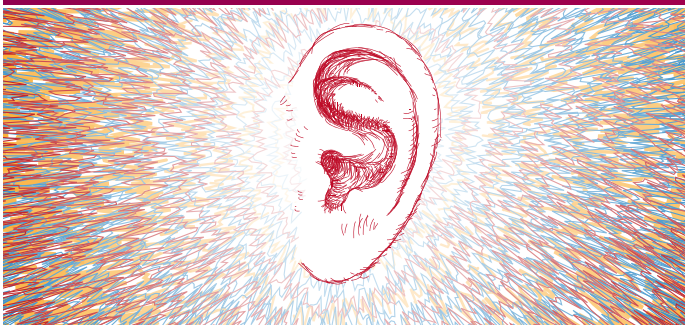
EDITORIAL



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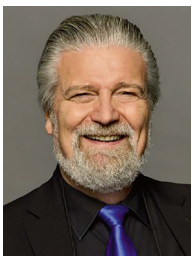
Dear Reader,
The Amplifon Centre for Research and Studies (CRS) houses one of the finest private libraries in the field of audiology and otorhinolaryngology, offering the sector's most important international journals. Every quarter, a team of Amplifon Audiologists from around the globe select the most relevant publications in the field of Otology and Audiology and make a comprehensive review. The Amplifon Centre for Research and Studies coordinates the development of this quarterly review. We are pleased to share this latest selection of reviews with you. For this issue, our team reviewed ten interesting articles published in the second quarter of 2021.

Two articles discuss tinnitus and tinnitus management. The first of these concludes that tinnitus patients with sensorineural hearing loss report more severe annoyance, higher subjective discomfort and that they experience more anxiety, depression and sleeping disorders. In the second article, 22 young researchers in the field of tinnitus cooperated to provide a highly relevant overview of the current state of knowledge on tinnitus and tinnitus management, and their view on future directions of research and treatment. They also strongly recommend setting up preventive school programs on safe listening, since noise exposure is the most important risk factor for tinnitus. This recommendation is fully in line with one of the actions of the Make Listening Safe workgroup from the World Health Organization, to promote "Safe Listening Content" in schoolbooks and the official school-curriculum.

We also offer three reviews focusing on unilateral or asymmetric hearing loss. The findings highlight that having normal hearing in one ear is no guarantee against having hearing health or psychological well-being issues. Moreover, these papers found that such types of hearing loss can not only result in significantly poorer understanding in noise but also poorer auditory working memory capacity.

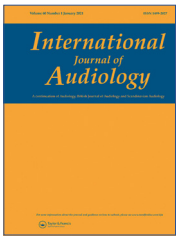
Also of particular interest, the last review in this journal discusses a study by a team from Argentina, who analysed the level of music exposure reported by adolescents in relation to audiometric results and OAE recordings. They conclude that non-occupational sound exposure can lead to noise induced hearing loss for adolescents, but that classic audiometry is not sensitive enough to detect this at an early stage. In their conclusion, they make very relevant recommendations for performing high-frequency audiometry and setting up prevention programmes make a lot of sense.



Mark Laureyns
Global International CRS
& Medical Scientific Research Manager

A COMPARISON OF THE SEVERITY OF TINNITUS IN PATIENTS

WITH AND WITHOUT HEARING LOSS USING THE TINNITUS FUNCTIONAL INDEX (TFI)



Mahafza N., Zhao F., El Refaie A., et al.

International Journal of Audiology (2021): 60(3), 220–26

By Tine De Boodt – Belgium

Tinnitus patients with sensorineural hearing loss report significantly worse tinnitus annoyance.

In this study, researchers set out to establish a possible relationship between individuals' hearing status and tinnitus severity. The study population included 73 patients with tinnitus, who were required to complete the Tinnitus Functional Index (TFI) questionnaire in addition to undergoing audiological examinations (including pure tone audiometry, PTA).

Tinnitus questionnaires are used to identify the impact of tinnitus on the everyday life of sufferers, and to measure tinnitus therapy outcomes. For this particular study, the Tinnitus Functional Index (TFI) was selected because of its reliable categorisation of tinnitus types and treatment related change.

The study found that a significant amount of tinnitus patients with sensorineural hearing loss (SNHL) reported more severe tinnitus annoyance. In addition, the researchers found that hearing loss (HL) increased subjective discomfort. As a result, these patients experience more anxiety, depression and sleeping disorders as a reaction to their tinnitus. Existing research had hitherto failed to support this finding due to a lack of a homogeneous study population, as well as a lack of sensitivity in the questionnaires.

One of the most important clinical implications of this paper's findings for our daily practice is that early amplification should be implemented for patients with tinnitus and mild to moderate SNHL, even if the patient's main complaint is not HL per se.

Moreover, the authors highlight the importance of early intervention and the need to provide clear and realistic information regarding patients' tinnitus to manage expectations, and to give them appropriate coping strategies to reduce general tinnitus distress. •

CRITICAL NOTE:

These findings open up new avenues for the management of such cases in our daily practice. Caution should be exercised, however, in generalising the idea of the homogeneous test group which was used in this research because of the great heterogeneity among tinnitus sufferers, which makes it difficult to compare cases.

HISTORY AND LINGERING IMPACT
OF THE ARBITRARY 25-DB CUTOFF FOR NORMAL HEARING

Gatlin A. & Dhar S.

American Journal of Audiology (2021): 30(1), 231–34.

By Majda Basheikh – Canada

A review of how the normal hearing cut-off in an audiogram was initially defined and the impact of its use.

The audiogram is one of the most important tools in the practice of hearing healthcare. It defines how we classify our patients (normal hearing or hearing-impaired) and the extent of services we provide (e.g. counselling, prescribing and dispensing hearing aids, etc.). It also impacts other areas of audiology including clinical research (e.g. which participants a study should include) and medicolegal (e.g. eligibility for worker's compensation). This paper explores the history of the audiogram, as well as the various limitations it presents.

Normal hearing was initially defined in the U.S. in 1935 after a large-scale survey evaluating health and chronic disease in the general population. The survey evaluated individuals aged from eight to ninety, with various levels of hearing difficulty. At the time, there was also a need for more research in audiology due to high cases of noise-induced hearing loss (HL) on the part of soldiers returning home from the war. Therefore, the American Standards Association (ASA) used the data from the survey to further define the normal hearing cut-off as 20 dB HL. This value was chosen by researchers as it accounted for possible variations in individuals with no clinical history of hearing difficulty, as well as variations between tests and possible discrepancies between testers, instrumentations, and environment. The data analysis by ASA also led to our current standards for audiometric calibration.

In the 1950s, researchers in Europe, via the International Organization for Standardization (ISO), also undertook a similar process of obtaining data from surveys in order to develop standards for audiometers. However, there were significant inconsistencies between the British and American standards, with ISO-calibrated audiometers generating thresholds as much as 15 dB worse than the ASA calibrated audiometers. Since the ISO developed their standards after the ASA, they offered the advantage of including more recent research and technologies in their studies, allowing for better testing conditions, better testing techniques, and more modern equipment. The ASA eventually changed their standards in 1969 to align with ISO. This did not sit well with American audiologists as it shifted calculations associated with percent impairment ratings, and thereby affecting one's eligibility for compensation. As a result, the normal hearing cut-off was shifted to 25 dB HL which avoided percent impairment ratings being affected by the updated ISO-aligned standard.

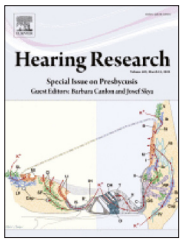
CRITICAL NOTE:
Despite years of research and implementation, our current audiograms do not fully define normal hearing, nor the impact of HL. This has numerous implications in clinical, medicolegal, and research fields. Advances in research, technologies, and clinical innovations are required to move beyond the limitations that current hearing cut-offs present.

The need to standardise the audiogram classification was highly encouraged by the medicolegal community, so that a consistent, objective classification system of HL could be used to determine legal decisions and/or financial compensation. However, the methods applied were not in line with the physiological and functional impact of HL. The American Medical Association (AMA) initially classified HL as a percentage using the Pure Tone Average (PTA) of frequencies 500, 1000, and 2000Hz. Based on the PTA, the percent impairment was derived by allotting 1.5% impairment for every decibel over the 25 dB HL cut-off. The 1.5% metric was determined by dividing 100% (full range of impairment) by the difference between the upper measurement limit of 90 dB HL and the 25 dB HL normal hearing cut-off. The authors of this review argued that this method was not scientifically sound or fully representative of the functional impact of HL. A subject's hearing ability can exceed 90 dB HL, and the PTA did not account for high frequency HL which is commonly seen in noise-induced cases. Therefore, in 1979

the PTA was altered again, so as to include 3000 Hz, and these four frequencies are still the standard used by AMA in today's impairment rating guide for HL.
High frequency HL is the most common type of hearing loss seen clinically. High frequencies play a critical role in speech understanding. These factors continue to call into question the validity of the four-frequency PTA model. In addition, this model fails to take into consideration the type of HL. This is all the more problematic given that sensorineural and conductive HL can have differing impacts on speech understanding.
In the field of hearing research, control groups typically consist of subjects with normal hearing levels using the 25 dB HL cut-off. However, current research suggests hearing difficulties can still exist in individuals with normal audiograms ("hidden hearing loss"). In cases of noise exposure, synaptic loss is possible whereby permanent damage occurs in the connection between cochlear hair cells and nerve fibres. Studies have indicated that this interruption can still be found in normal audiograms in cases of noise-induced HL, as hair cells remain intact but suprathreshold measures of cochlear responses are permanently reduced. Cochlear nerve degeneration and synaptopathy, which the audiogram does not measure, can also explain why some individuals with normal audiograms perceive significant speech understanding difficulties in noise. Furthermore, hearing research also indicated that pure tone thresholds in quiet are not affected by inner hair cell loss and cochlear nerve degeneration. Studies have also linked HL to dementia, with further research indicating that as hearing thresholds worsen, so do measures of cognition. This was found true even if the thresholds still fall within the 25 dB HL cut-off.
In summary, years of research and debate went into the development of the audiogram we still use today. However, it presents significant limitations in audiology practice, hearing research, and medicolegal applications: the current 25 dB HL cut-off fails to take into consideration a great many factors which can influence outcomes in all fields. Individuals with hearing thresholds within 25 dB HL can still experience speech understanding difficulties and exhibit indications of cochlear nerve degeneration. This suggests that professionals must look beyond the audiogram in their clinical/medicolegal/research judgments. •

UNILATERAL AUDITORY DEPRIVATION IN HUMANS:

EFFECTS ON FREQUENCY DISCRIMINATION AND AUDITORY MEMORY SPAN IN THE NORMAL EAR



Dey R. & Mishra S.

Hearing Research (2021): 405, 108245.

By Majda Basheikh – Canada

An analysis of the functional outcomes of auditory deprivation in the normal ear of individuals with unilateral hearing loss.

Unilateral hearing loss (UHL) can result in significant speech understanding difficulties, especially in noise, as well as spatial orientation difficulties. It is also associated with auditory deprivation, whereby the lack of auditory stimulation results in structural and functional alterations within the brain. Auditory deprivation greatly affects a person's ability to recognise and understand speech.

CRITICAL NOTE:
The normal hearing ear of individuals with UHL does not perform to the same ability as individuals with normal hearing bilaterally. Auditory deprivation has significant impacts in overall hearing ability and not just on the poorer ear.

Studies have shown that the normal hearing ear in individuals with UHL reacts more slowly in measures of speech-induced cortical responses compared to individuals with normal hearing bilaterally. This has sparked interest in investigating cortical alterations in the normal ear in individuals with UHL. This study specifically examines frequency discrimination and working auditory memory in the normal ear of individuals with UHL.

The study subjects were split into two groups: UHL and normal hearing (NH). The UHL group consisted of 17 unaided individuals with severe-to-profound sensorineural hearing loss (SNHL) in one ear and normal hearing in the other. The NH group consisted of 19 individuals with normal hearing in both ears. Cortical responses to auditory stimuli were measured by examining difference limens for frequency (DLF). At pure tone frequencies 250 and 4000 Hz, the minimum change discerned by the ear to the pitch of sound (i.e. the DLF) was measured for all subjects as a percentage of the target frequency. A digit span test was also conducted to assess working memory, whereby digits between zero and nine were randomly played and the subject was scored by the average number of correct recalls.

The results indicated that the DLF for the UHL group was larger than for the NH group, demonstrating an overall poorer performance in frequency discrimination. However, this difference between the two groups was only statistically significant at 250 Hz. The digit span scores were found to be significantly lower for the UHL group, indicating poorer working memory capacity. Furthermore, correlation analyses found no associations between DLFs and digit span scores for both groups. This suggests no significant association between working memory and frequency discrimination. No further correlations were found with the UHL group when compared to other factors such as severity of hearing loss, normal hearing thresholds, or duration of UHL.

The authors believe that the results are indicative of the neural reorganisation resulting from auditory deprivation. Reduced working memory in the UHL group reflects a loss of cognitive function, whereas larger DLFs reflect a loss of sensory function. Auditory deprivation itself is a form of sensory deprivation and has already been established to affect the cognitive system with links to dementia. Further research is needed to define the structural origins of larger DLFs in UHL, with the authors hypothesising that it reflects changes in the central auditory pathways resulting from acoustic trauma. Nonetheless, this study does confirm that hearing deficits are still present within the normal ear of individuals with UHL, providing further evidence of the notion of hidden hearing loss (HHL) in normal audiograms. •

MODELING HEARING LOSS PROGRESSION AND ASYMMETRY IN THE OLDER OLD: A NATIONAL POPULATION-BASED STUDY

Sharma RK., Lalwani AK. & Golub JS.

The Laryngoscope (2021): 131(4), 879–84.

By Katrien Hoornaert – Belgium

This research aims to characterise the progression, severity and asymmetry of hearing loss in the elderly (80 years and older).

This research aims to develop a formula for modelling the evolution of the level of hearing loss (HL) and difference or asymmetry between both ears in subjects of 80 years and older.

As life expectancy rises, so too does the number of people with HL and related co-morbidities. One of the challenges in assessing the progression of HL in later life is that population-based surveys, such as the NHANES

CRITICAL NOTE:
Being able to model HL progression is very interesting. Of course, as the authors themselves advise, this model should not be interpreted too strictly. However, it does provide a valuable tool for raising awareness and counselling, and it highlights the importance of monitoring hearing as age progresses in order to provide better support to individuals in their hearing healthcare journey and decisions.

study in the US, do not provide real-age information for the oldest subjects, in order to maintain patient confidentiality. For the purpose of this study, the authors managed to obtain this information by going through a very strict authorisation procedure.
The audiometric data from 5,465 subjects was available, 621 of whom were 80 or older. This includes both people who do and do not receive care for their HL. The average HL was 39 dBHL for the subjects in the target age group, with a gradual worsening of the HL for each frequency with age.
Based on their findings, the authors were able to create a formula that defines the average HL in relation to age:

PTA average in better ear = 0.0052 x age^2

This means that the average HL increased at a rate of 0.0052 dB per squared age. This predictor proved reliable: for all subjects, the accuracy for the predicted PTA fell within 5 dB, regardless of the subjects' age

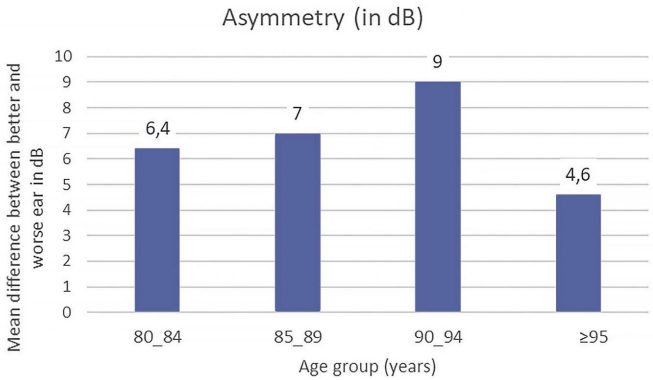
Overall, the progression of HL per year increases by a factor of five over the life course.

Age	20	21	40	41	80	81	100	101
PTA	2.08	2.29	8.32	8.74	33.28	34.12	52	53.05
Rate	0.21		0.42		0.84		1.05	

The authors further proposed that the formula to calculate the age at which a mean PTA is reached:

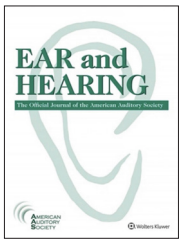
$$\text{Age} = \frac{\sqrt{\text{Pure tone average in better ear}}}{0{,}0052}$$

In terms of the asymmetry between both ears:



For participants aged 80 and older, the average asymmetry reached 6.7dB; for the entire group, starting from 20 years of age, the asymmetry increased by 0.06 dB per year. •

EFFECTS OF DIRECTIONALITY, COMPRESSION AND WORKING MEMORY ON SPEECH PERCEPTION



Rallapalli V., Ellis G. & Souza P.

Ear & Hearing (2021): 42(3), 492–505

By Thomas Zacharia – Australia

Working memory plays a key role in determining which hearing aid feature is selected for a particular individual.

The aim of this study was to understand the combined effect on the wearer's working memory and speech perception of the most common hearing aid features, such as directionality and compression.

Hearing aid features, such as directionality, noise reduction and compression manipulate the sounds captured by the hearing aid in order to improve intelligibility for the listener. Unfortunately, these features can also hinder speech perception by creating distortion of the speech cues by significantly altering the temporal envelope. In this study, the authors studied two hearing aid features in particular: wide dynamic range compression (WDRC) and directionality. WDRC is used to correct the dynamic range by increasing the level for soft sounds and preserving the sound level for loud sounds. However, since WDRC needs to constantly monitor and change the level of incoming signals, the attack and release time of this feature can introduce distortions of the signal, which, in turn, can lead to reduced intelligibility, particularly when the compression is syllabic or fast acting. Hearing aid directionality relies on two or more microphones, to allow higher gain for the wanted signal and to reduce the gain for unwanted signals when these are spatially separated. This type of processing improves the signal to noise ratio, and could reduce the negative effects of other features. Earlier studies demonstrated that subjects with poor working memory capacity have poorer results when fast acting compression is used.

The study under review was carried out on 23 hearing-impaired individuals, aged between 59 and 92 years old. A pair of premium hearing aids were used in this study, selected specifically because they offered features enabling the experimenter to control the WDRC speed (FAST and SLOW). Both OMNI and DIR (fixed directionality with a hypercardioid response) were used as the hearing aid directionality features. Working memory was measured using the reading span test (RST). Speech audiometry in quiet and in noise was performed with a fixed set-up, where speech was presented at a fixed level of 65dBA from 0° and babble-noise was presented at 55, 60 or 65 dBA from three directions (90°, 180° and 270°). Signal modification was analysed by a cepstral correlation measurement, which compared the signal envelope from the incoming signal with the outgoing signal after hearing-aid processing.

CRITICAL NOTE:

The group of subjects is fairly small, which makes it difficult to show clear effects on the impact of working memory capacity. The authors only compared omni-directional and fixed hypercardioid directionality, while most modern hearing aids use more aggressive adaptive directionality. The latter may also introduce distortions, which were not covered in this study. Pamela Souza, one of the authors of this study, concluded in her 2014 publication that "for fast-acting compression, the best performance was obtained by patients with high working memory". This makes it difficult to draw clear conclusions on how to implement these findings in clinical practice.

Ref: Souza P. & Sirow L. Relating working memory to compression parameters in clinically fit hearing AIDS. Am J Audiol (2014):23, 394–401

THE RESULTS:

Signal modification:

- At poorer SNR (0dBSNR), there was significantly more modification compared to a better SNR (+10dBSNR)
- At 0 dBSNR, DIR was significantly better than OMNI and SLOW was significantly better than FAST

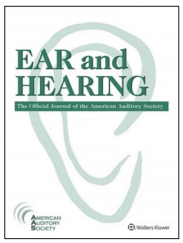
- At 10 dBSNR, SLOW was significantly better than FAST in the OMNI condition, but there was no significant difference between FAST and SLOW in the DIR condition.
- In Quiet, there were no significant differences in signal modification between the different conditions.

Speech audiometry in Quiet and in Noise:
- On the box & whiskers plots, there is very little or no difference between the results with FAST and SLOW compression, in de DIR condition, in quiet and in the +5 and +10 dBSNR condition.

For the interaction, SNR condition, signal modification, speech understanding in noise and working memory:
- When the signal modification is the lowest, there is a significant improvement of the results in understanding speech in noise with improving working memory capacity.

These findings support the conclusion that working memory is a critical aspect in determining which hearing aid feature is selected for a particular individual. At higher SNRs, FAST WDRC along with OMNI directionality will result in poorer speech recognition irrespective of the person's working memory abilities. At lower SNR, with SLOW WDRC and DIR feature, working memory plays a crucial role in improving the speech recognition. •

ASSOCIATIONS BETWEEN HEARING HEALTH AND WELL-BEING IN UNILATERAL HEARING IMPAIRMENT



Pierzycki RH., Edmondson-Jones M., Dawes P., et al.

Ear & Hearing (2021): Vol. 42(3), 520–30.

By Thomas Zacharia – Australia

The message from this study to every practicing audiologist is that having normal hearing in one ear does not guarantee an individual is not experiencing hearing health or well-being issues.

The aim of this study was to address the effect of unilateral hearing loss (UHL) on hearing health and well-being, across a population of 861 participants aged between 40 and 69 years old. The effects of bilateral hearing loss (BHL) on overall health and well-being have been studied extensively. However, there is a lack of research on the effect of UHL on the same domains. Existing studies reported issues hearing speech in noise in unilateral hearing-impaired individuals even with speech perception in the better ear being good. This could be due to the inability to localise and separate talkers of interest from background noise.

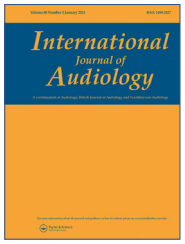
In this study, the authors report that, even though the adverse well-being outcomes are similar in both unilateral and bilateral symmetrical HL, the risks of self-reported loneliness and poor health were greater in the UHL group than with BHL group. This poor hearing health outcome in UHL could be explained by the loss of binaural hearing, which has been associated with increased hearing difficulties in noise, decreased selective attention and selective listening, as well as poor sound localisation (although, the authors note, some studies

CRITICAL NOTE:
Individuals with UHL report a higher rate of loneliness and depression when compared to individuals with BHL, depending on the aetiology, duration and symptoms of hearing impairment. It is important for clinicians to have a holistic management strategy to understand and manage both hearing and well-being aspects in unilateral hearing impairment.

have reported good monoaural localisation in unilateral hearing-impaired groups).
The increased adverse effects among the UHL group as compared to the BHL group could be linked to the severity of symptoms, etiology and duration of deafness. The authors note that the psychosocial consequences of congenital unilateral deafness being less severe might be explained by the fact that individuals get used to the condition over time. Most of the consequences reported in the current study included acute onset of unilateral HL due to sudden hearing loss or loss of hearing due to removal of a benign acoustic tumour.

The key takeaway from this study for clinical practice is that having normal hearing in one ear is not a reliable indicator of whether or not the person is experiencing any hearing health or well-being issues. The authors further emphasise the need for a holistic approach so as to address both hearing and well-being aspects in defining management strategies for individuals with UHL. This study also lists a number of hearing amplification systems used for individuals with such presentations, which include, and depending on the symptoms: contralateral routing of signals (CROS); bone anchored hearing aids (BAHA); hearing aids; cochlear implants. •

HEARING OUTCOME MEASURES FOR CONDUCTIVE AND MIXED HEARING LOSS TREATMENT IN ADULTS:
A SCOPING REVIEW



Hill-Feltham PR., Johansson ML., Hodgetts WE., et al.

International Journal of Audiology (2021): 60(4), 239–45.

By Melissa Babbage – New Zealand

The data indicate that surgery and hearing implants – the principal interventions for conductive/mixed hearing loss – often report different outcome measures. When patient-centred core outcomes sets (COS) measures are finalised, it will be necessary to evaluate whether different interventions require different or additional core outcome measures

A number of treatment options are now available for conductive or mixed hearing loss (HL), including middle ear surgery and hearing implants. Although many studies report hearing outcomes with these treatments, the potential benefits are increasingly being called into question by the hearing care community, based on the lack of quality of the evidence provided. For instance, one particular issue is that there is no agreed outcome measure and more than 200 measures have been reported in existing literature. The lack of standard outcome measures makes comparison across rehabilitation options difficult for clinicians and patients.

In this paper, the authors advocate the development of a patient-centred Core Outcomes Sets (COS) for mixed/conductive HL, and lay out the foundations for such an approach. COS can be defined as a set of standardised outcome measures to be used across trials and other interventions in order to ensure homogeneity across studies, and therefore increase the reliability and statistical relevance of findings while at the same time reducing the risk of bias.
In a previous article, the authors had already defined hearing, economic and psychosocial as the core areas of a future COS for rehabilitation outcomes for conductive and mixed HL. In this article, they present the results of a scoping review of existing literature in order to identify relevant outcome measures used across these core areas in existing literature, for adults with conductive and/or mixed HL following an intervention (middle ear surgery, bone-conduction hearing implants and middle ear implants).

METHOD

The review covered literature reporting hearing outcome measurements for the treatment of conductive and/or mixed HL (any cause) in adults, published between 2006 and 2016. All hearing/audiological outcome measures were identified and recorded in a database. Each of these was then assigned to one of nine "domains" identified by the researchers: hearing threshold; speech testing; questionnaires; immittance; binaural; electrophysiology; tinnitus; device output; and device performance.

RESULTS

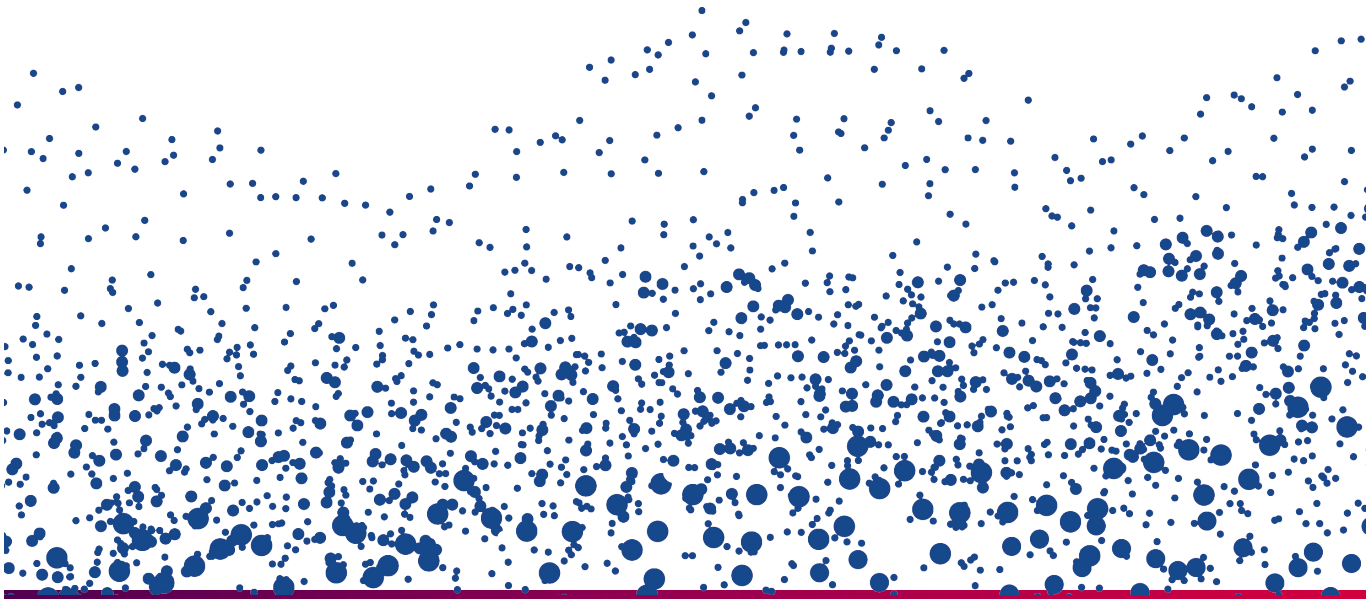
The literature search yielded a total of 1,434 studies, 278 of which met the criteria for inclusion in the review. After analysis, 837 hearing outcome measures were identified. The three main reported outcome measures were: pure-tone threshold measurements (65%), with eight tests covering 97% of all measurements (air-bone gap; pure tone average; bone conduction thresholds; air conduction thresholds; functional gain; soundfield thresholds; soundfield aided thresholds; and air conduction gain); speech testing measures (20%), covering a wide range of variables; and questionnaires (9%), mainly found in studies on hearing implants, with 14 standardised questionnaires against 18 non-standardised questionnaires.
Measures in the remaining domains represented 6% of all outcome measures identified by the authors.

DISCUSSION

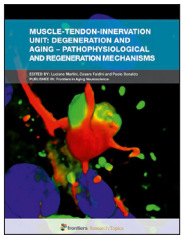
The authors stress that, although audiometry-based measurements, like speech testing, are most often performed in quiet, and therefore fail to offer insight into the overall impact of an individual's HL.The authors suggest that as a consequence of the overwhelming predominance of audiometry-based outcome measurements, there is a comparative lack of other outcome measures being used. The authors conclude that a COS with a greater range of outcome measurements, including patient centred measures, could offer greater insight into "real-life" hearing challenges met by patients, thereby enhancing the evidence base for treatments. They also highlight that a necessary step after defining COS measures is to assess whether different intervention types (e.g. surgery vs hearing implants for conductive/mixed HL) require different or additional core outcome measures.
The group's intended next step is to use these results as a basis for interviewing stakeholders, including patients, clinicians, scientists, and industry managers, to determine which of the domains and outcome measures in the hearing core area should be included in the COS. •

CRITICAL NOTE:

This article presents a review of outcome measures following treatment of conductive and/or mixed HL which highlights the significant variation in how outcomes are reported. It is also evident that outcome measures tend to be clinician-focused, concentrating primarily on hearing thresholds, rather than taking a patient-centred approach relating to real-world hearing outcomes. It is important for clinicians and researchers to be aware of the lack of standardisation when evaluating and comparing outcomes of treatments for HL. The long-term aims of this group of researchers – namely, to develop and disseminate patient-centred core outcome measures to be reported in all trials or interventions treating mixed or conductive HL – will be beneficial in improving the quality of research in this field as a whole.



MULTIDISCIPLINARY TINNITUS RESEARCH: CHALLENGES AND FUTURE DIRECTIONS FROM THE PERSPECTIVE OF EARLY STAGE RESEARCHERS



Simoes JP., Dapid E., Shabbir M., et al.

Frontiers in Aging Neuroscience (2021): 13, 179.

By Mark Laureyns – Italy & Belgium

This paper offers an overview of the current state of knowledge and evidence base on tinnitus, tinnitus-assessment, tinnitus-treatment and tinnitus-research, as well as recommendations for future directions by young researchers.

In this paper, 22 authors from a total of 28 European institutes – five in the UK, five in The Netherlands, four in Belgium, four in Denmark, three in Germany, three in Switzerland, and one in each of France, Italy, Spain and Sweden – collaborated on a literature review in order to provide an overview of the current evidence base on tinnitus research and tinnitus management.
They discuss the different International and mostly European Tinnitus Research Projects and Groups, such as: TRI; TINNET; ESIT; TIGER; TIN-ACT; and UNITI. However, the authors conclude that although these tinnitus projects and groups have been doing great work, the number of scientific publications on tinnitus has not increased at a rate similar to that of other research fields, such as depression, anxiety or hearing loss (HL).

The authors share some general facts on the characteristics of tinnitus:

- Hearing loss is found in 67.7% of tinnitus cases. This figure can vary depending on the definition of HL used.
- Hyperacusis is found in 40% of tinnitus cases, but 86% of hyperacusis cases report tinnitus. However, there is no standardised definition of hyperacusis, as a result it is challenging to establish comparisons across studies.
- Depression occurs in 14 to 80% of tinnitus cases.
- Anxiety occurs in 45% of tinnitus cases.

The prevalence of tinnitus depends on how tinnitus is defined, how long it lasts, its loudness, its annoyance and its clinical significance. In most publications, prevalence ranges from 10 to 15% of the adult population for the overall experience of tinnitus, and from 0.5 to 1% of in cases which require treatment (clinically significant). The authors highlight the relation between tinnitus and noise exposure, which they categorise as the most important risk factor, and so strongly advise starting school-based prevention programs on safe listening and noise protection. There is a general lack of consensus on the mechanisms that cause tinnitus. Some groups focus on the fact that deprivation from sound input can result in an increase of neural activity, which can explain tinnitus. Other groups focus on neuroimaging to find structures and functions which could explain tinnitus. Genetic research on tinnitus

CRITICAL NOTE:
The main strength of this article lies in the fact that so many authors – young researchers in the field of tinnitus –cooperated to create a very interesting overview of the current state of knowledge and evidence base on tinnitus, tinnitus- assessment, tinnitus-treatment and tinnitus-research. The fact that they strongly recommend developing preventive school programs on safe listening to limit noise exposure shows their interest goes beyond treatment to include prevention.
The weakness of this article lies in using a non-systematic review and failing to quantify the relative amount of research and publications in favour or not in favour of a certain treatment, assessment procedure or mechanism to explain tinnitus. They state that the increase of the number of studies on tinnitus is much slower than for other research topics such as depression, anxiety and hearing loss. However, they fail to provide numerical support for this, even though they do provide 342 references at the end of the article.

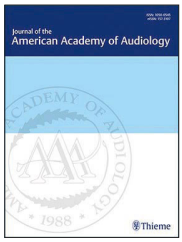
is also emerging, and one of the studies included in the authors' review states that 56% of bilateral tinnitus has a genetic cause, as opposed to 27% of unilateral tinnitus. Regarding tinnitus assessment, the authors highlight the lack of an overall accepted protocol for evaluating tinnitus. In their literature review, a number of tests are discussed – tinnitus anamnesis, questionnaires, audiometry, tinnitus loudness and pitch matching, tinnitus masking and or residual inhibition tests. However, no reliable objective measure has yet been identified.

Based on their review of existing literature, the authors were able to identify that Cognitive BehaviouralTherapy (CBT) provided very positive results in tinnitus management. An alternative internet-based version has been developed to offer this treatment to the greatest number. Sound-based interventions, such as Sound Generators, Hearing Aids and Cochlear Implants, are only discussed in terms of fitting and the kind of studies available on the topic, but the authors fail to address the importance of counselling. In their review, this falls under the combination intervention category, and gets very little attention. Drug-based interventions and their limitations, chief of which is the fact that they only show short-term positive effects on acute tinnitus. Lastly, other interventions, including transcranial magnetic stimulation, electric stimulation and neurofeedback approaches are explained, but so far, the authors state, there is a lack of conclusive quality studies to confirm the effectivity of these treatments.

The authors suggest that the creation and analysis of big data with quality tinnitus findings and outcomes, as has been done in recent tinnitus projects, namely projects funded by the European Union, could go a long way in building practice-based evidence on tinnitus and tinnitus management.

For future directions, systematic reviews, big data, agreed and consensus on definitions, research protocols and strong multi-disciplinary research and treatment are the main focus. •

PSYCHOSOCIAL WELL-BEING OF ADULTS WHO ARE DEAF OR HARD OF HEARING



Muñoz K., Baughman K., Meibos A., et al.

J Am Acad Audiol (2021): 32(2), 83–9.

By Angela Ryall – Canada

The authors recommend using the Acceptance and Action Questionnaire- Adult Hearing Loss (AAQ-AHL) as a screening tool in order to also assess psychosocial factors, for a more holistic approach in their clinical practice.

The authors investigated psychosocial factors (e.g., mental health and acceptance of hearing loss, HL) as possible treatment barriers for adults who are deaf or hard of hearing which could influence their functional impairment, mental health, and overall hearing aid usage. Participants (n= 269) completed various surveys about their demographic information, mental health, self-efficacy, work and social life, relationships, and acceptance of and action about their HL. Participants reported using spoken language as their primary mode of communication (97%) and had bilateral hearing loss (89%). Descriptive statistics were used to analyse the survey results.

The results indicate that participants have improved satisfaction and increased wellbeing from their hearing-health services. Most participants reported improvement from their treatment services for HL: approximately 32% reported it had "very much improved"; 35% "much improved"; 16% "minimally improved"; <1% "minimally worsened"; 3% "much worsened"; and <1% "very much worsened". There were a few areas for which participants required support, these are (from most to least significant): work/school; relationships/family; communication confidence; social support; financial; self-care; self-identity/stigma; intimate relationships;

and recreation. The surveys also revealed several participants were experiencing levels of depression, dissatisfaction with relationships, low self-efficacy, and functional impairment related to their HL. Several participants (27%) were 1-2 standard deviations below the mean for the quality-of-life survey. When assessing their own functional impairment, 19% rated themselves moderately-severe and 35% reported significant functional impact; those who were using bimodal amplification rated themselves less impaired than those who used no amplification. Finally, when rating their romantic relationships, 37% of participants reported dissatisfaction. By addressing patient's psychosocial wellbeing, we as professionals can provide our patients with more support services, including referrals for services outside our scope of practice. Clinicians can incorporate this into their practice through screening surveys. To that end, the authors recommend using the Acceptance and Action Questionnaire- Adult Hearing Loss (AAQ-AHL) as screening tool.

The researchers acknowledge the main limitations of their study. Firstly, the information regarding the degree of HL and hearing devices was self-reported. Secondly, the information regarding medical history provided by participants may not be accurate since it is self-reported. Thirdly, diversity among study participants was limited: there was no information on gender and most of the participants were Caucasian and had high levels of education (e.g., higher education). Finally, all participants had either severe or profound hearing loss. Thus, the findings may not generalise to other sample groups. •

CRITICAL NOTE:

When using a self-reporting survey as the only data collection method there is always uncertainty with patients' responses as they may not always be accurate, for example the severity of HL reported may not be accurate. The sample population included participants who used amplification and participants who did not. It would be interesting to analyse the well-being of adults after one or two years of aural rehabilitation treatment with and without amplification. Moreover, given that participants filled out several questionnaires, it is regrettable that the researchers failed to include sample questions from the various questionnaires. Therefore, we strongly recommend to also read the article on the "Acceptance and Action Questionnaire–Adult Hearing Loss (AAQ-AHL)": Clarissa W. Ong, John J. Whicker, Karen Muñoz & Michael P. Twohig (2019) Measuring psychological inflexibility in adult and child hearing loss, International Journal of Audiology, 58:10, 643-650, DOI: 10.1080/14992027.2019.1630759

HEARING AND EXPOSURE TO MUSIC IN ADOLESCENTS

FROM FOUR SCHOOLS OF CÓRDOBA, ARGENTINA

Gaetán S., Muratore J., Maggi AL., et al.

American Journal of Audiology (2021): 30, 281–94.

By Mark Laureyns – Italy & Belgium

In this article, the authors demonstrate the benefit of using high frequency audiometry in addition to traditional audiometry in order to identify early signs of cochlear damage as a result of non-occupational sound exposure.

In this study, the authors set out to determine the hearing status of a population of adolescents in relation to their exposure to recreational noise. In order to do so, they use both traditional and high-frequency audiological tests because, as they demonstrate, traditional audiometry is not sensitive enough to

capture the first signs or cochlear damage due to noise exposure. For this reason, the authors suggest using Oto Acoustic Emissions (OAEs), both Transient Evoked (TEOAEs) and Distortion Product (DPOAEs) OAEs, and high frequency audiometry, up to 16000 Hz, as being potentially more sensitive procedures.

The study included 255 subjects, aged 14 to 15 years, from public schools in Córdoba, Argentina. Participants filled out the Recreational Activities Questionnaire, in order to evaluate their music exposure (197 subjects). In addition, pure tone audiometry was conducted by means of headphones, from 250 to 16000 Hz and TEOAEs and DPOAEs (191 subjects) were recorded.

The population was divided in two groups based on audiometry: one group (G1) with all audiometric thresholds better or equal to 20 dBHL (250 to 16000 Hz); and the other group (G2) with at least one threshold higher than 20 dBHL. These were subsequently divided into three subgroups based on their music exposure: low; moderate; and high.

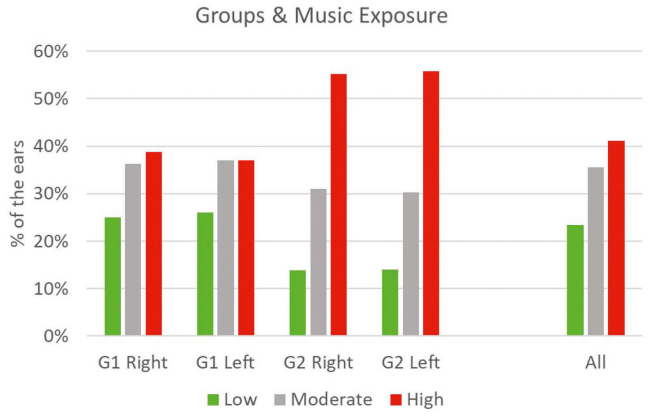
CRITICAL NOTE:

One of the main limitations of this articles is the lack of details on the questionnaire they used, and an explanation as to why the results were not included in the article. In addition, the authors fail to explain why a number of subjects did not fill out the questionnaire or did not undergo audiological testing. In the introduction, the authors cite WHO and the publications from Neitzel and Roberts. However, they do not refer to the WHO-ITU H.870 "Guidelines for safe listening devices/systems", where these finding are put into action.

This study offers objective evidence that non-occupational sound exposure can lead to noise induced HL in adolescents. However, traditional audiometry is not sensitive enough to detect such a deterioration at an early stage. The authors' recommendations to perform high-frequency audiometry and setting up prevention programs make a lot of sense.

RESULTS:

Below is a diagram summarising music exposure per ear across groups G1 and G2 and all exposure subgroups:



In G2 (the group with poorer audiometric thresholds), we see a higher percentage of subjects with high music exposure compared to G1. For the left ears, there was a significant correlation between the classification based on hearing loss in groups (G1 – G2) and High – Low music exposure. For the total group, more than 40% of the subjects reported high music exposure.

AUDIOMETRIC RESULTS:

- G1 - left ear: a significant difference was found between the subgroups with high and low music exposure for 6, 9, 10 and 12,5 kHz.
- G1 - right ear: there was a significant difference between the subgroups with high and low exposure for 1 kHz; and between the groups with low and moderate exposure for 1, 4, 8 and 11,2 kHz.
- G2 - left ear: there was a significant difference between the subgroups with low and high exposure at 1 kHz.
- G2 - right ear: there was a significant difference between the subgroups with low and high exposure at 1 and 8 kHz; and for the groups with low and moderate exposure at 1, 2, 8 and 9 kHz.

TEOAE:

No significant differences were found between the music exposure subgroups.

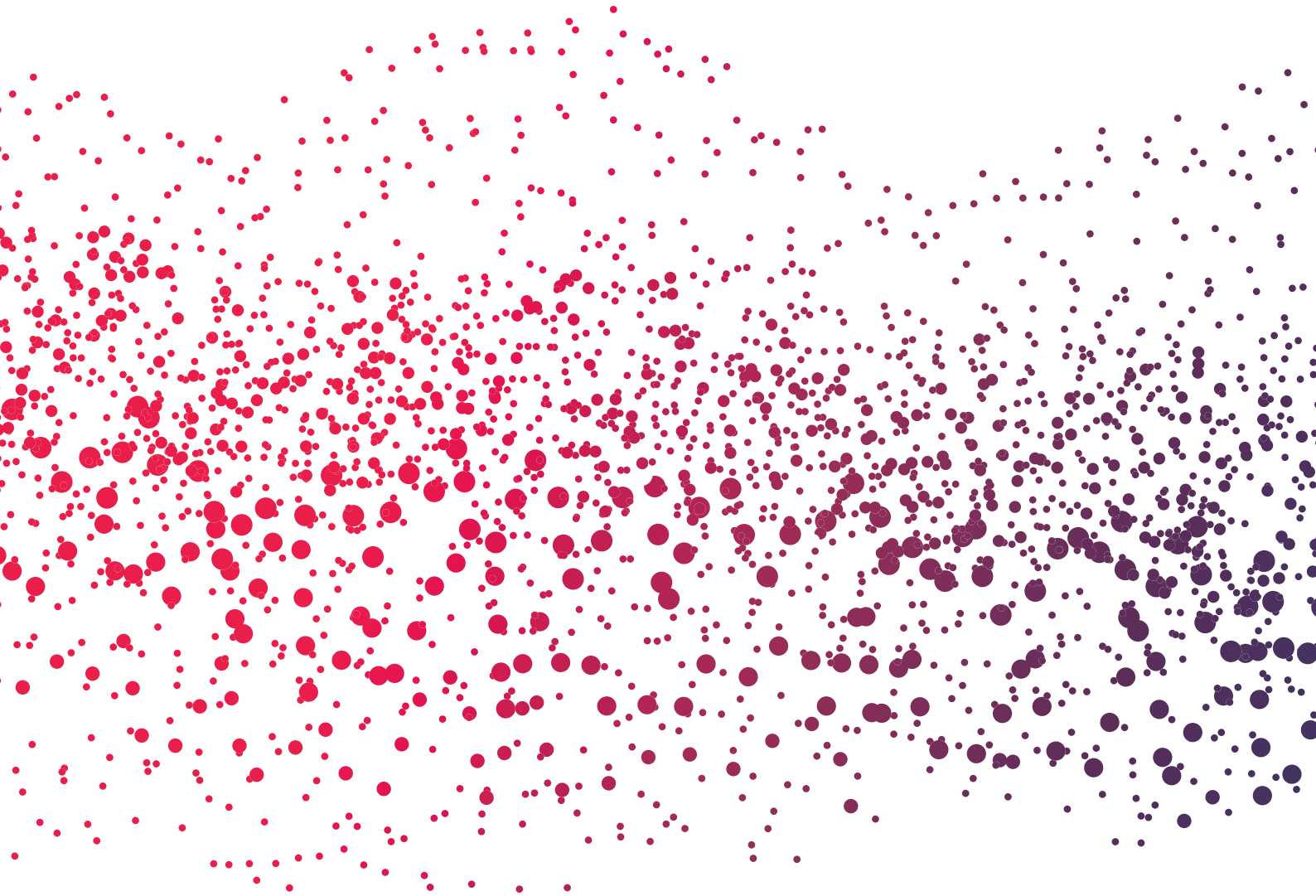
DPOAEs:

- For the left ear, there was a significant difference between the high, moderate and low music exposure subgroups at 1 kHz.
- For the right ear, there were no significant differences.

CONCLUSIONS:

The authors recommend the use of high frequency audiometry, in order to identify early signs of cochlear damage that could be related to non-occupational sound exposure. However, the authors stress the need for the definition of normative values for such evaluations in practice.

Since all subjects in this study report "fairly" high exposure to music, the authors conclude that setting up a prevention program in order to reduce the risk of noise induced HL, in line with the recommendations of the World Health Organisation, is strongly advised. •



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