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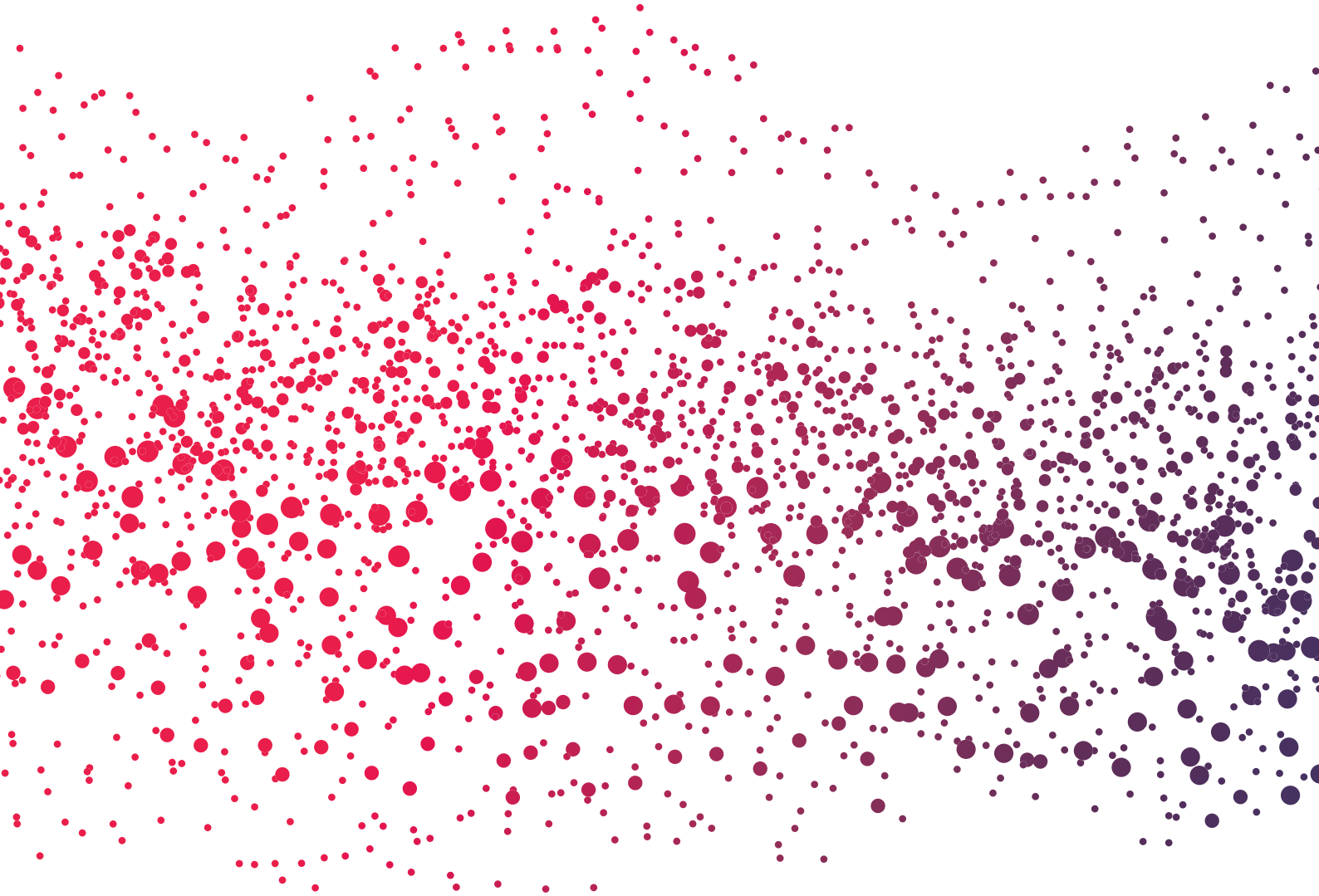

The transtympanic intermittent pressure therapy for Meniere's disease

Diabetes-induced auditory complications

COVID-19 and audio-vestibular symptoms

CONTENT

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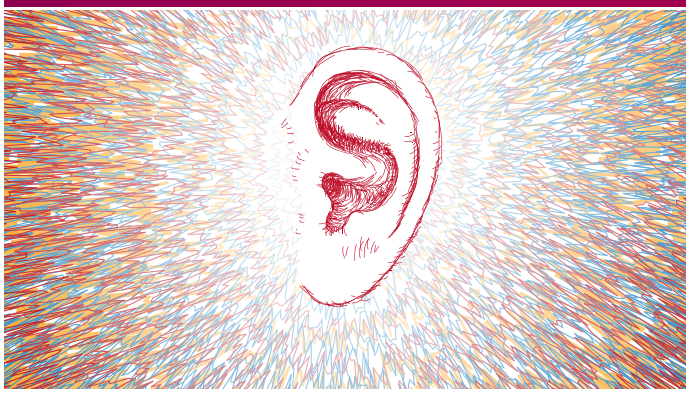
EDITORIAL



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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 happy to share these new reviews with you. For this issue, our team reviewed 12 interesting articles published in the fourth quarter of 2021.

Two reviews are related to a new transtympanic intermittent pressure therapy for Meniere's disease which presents the benefit of not requiring a tympanic ventilation tube while offering significant improvement of vertigo attacks.

It is a well-established fact that one of the side effects of Diabetes is hearing loss. Both the American Diabetes Association and the US Centres for Disease Control and Prevention recommend diabetes patients undergo regular hearing checks. This issue features a review of the interventions which could prevent Diabetes-induced auditory complications.

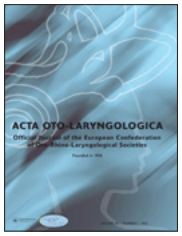
Another very relevant concern in these pandemic times is the potential relation between COVID-19 and audio-vestibular dysfunction. Our reviewer explores the conclusions we can draw from a systematic review covering one year of publications, as well as the underlying factors of such a relationship.

Our other reviews focus on key topics for our clinical practice, ranging from tinnitus prevalence and management to hearing aid uptake, selection and use.

We hope you enjoy this issue of
our *CRS Scientific Journal*

Mark Laureyns,
Global International CRS & Medical Scientific Research Manager

EFFECTS OF TRANSTYMPANIC INTERMITTENT PRESSURE THERAPY USING A NEW TYMPANIC MEMBRANE MASSAGE DEVICE FOR INTRACTABLE MENIERE'S DISEASE AND DELAYED ENDOLYMPHATIC HYDROPS: A PROSPECTIVE STUDY



Shojaku H., Aoki M., Takakura H., et al.

Acta Otolaryngol (2021): 141(10), 907–14

By Thomas Zacharia – Australia

The new transtympanic membrane massage (TMM) device (EFET) showed similar results as the Meniett device, but EFETis recommended to the benefit of not requiring a tympanic ventilation tube.

The Meniett device and transtympanic membrane massage device (TMM) are the two most effective treatment options for patients with intractable Meniere's disease (MD) and delayed endolymphatic hydrops (DEH) by providing intermittent positive pressure on the tympanic membrane.

The aim of the current study was twofold: firstly, to determine the effectiveness of the latest TMM device named EFET in treating intractable MD and DEH; and secondly to compare its outcomes with those offered by the Meniett device. For the purpose of this study, the authors defined intractable MD as patients presenting with at least two episodes of definite vertigo in the course of a month despite conservative treatment protocols such as oral diuretic and anti-vertigo drugs.

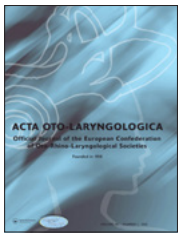
The EFET device produces intermittent pressure pulses between -7cm H2O to +12cm H2O with a frequency modulation of 7Hz. This is then applied to the ear canal using a polyethylene tube with a close-fitting cuff. The treatment protocol was defined as three-minute sequences, with two cycles a day for a total of 16 weeks. Alongside this, patients continued to take any pre-existing medications for intractable MD and DEH.

The findings showed a significant amelioration within days, with vertigo improving within 1-4 weeks of using the EFET; and the vertigo score improving from weeks 9-12. The number of sick days and activity score at weeks 13-16 were significantly lower than pre-treatment. In addition to measuring outcomes on activity score, the authors also studied the impact of EFET usage on hearing activity using Pure Tone Audiometry (PTA). No difference in hearing activity was found before and after treatment.

Both Meniett and EFET devices offered similar outcomes in reducing the severity of Intractable MD and DEH. However, the authors recommend the latter over the former because, unlike the Meniett, the EFET does not require a transtympanic ventilation tube, a procedure which can cause central perforation of the tympanic membrane. •

CRITICAL NOTE:
The EFET and Meniett devices are the two most effective treatment options for Intractable Meniere's disease and Delayed Endolymphatic Hydrops by providing intermittent positive pulses on the tympanic membrane without affecting hearing activity. The authors successfully demonstrate the benefits of the EFET device over the Meniett device, in particular considering the fact that the former does not require a tympanic ventilation tube.

LONG-TERM EFFECT OF TRANSTYMPANIC INTERMITTENT PRESSURE THERAPY USING A TYMPANIC MEMBRANE MASSAGE DEVICE FOR INTRACTABLE MENIERE'S DISEASE AND DELAYED ENDOLYMPHATIC HYDROPS



Shojaku H., Takakura H., Asai M., et al.

Acta Otolaryngol (2021): 141(11), 977–83

By Thomas Zacharia – Australia

Eight months of pressure treatment in patients with intractable Meniere's disease and delayed endolymphatic hydrops using transtympanic intermittent pressure therapy and Meniett device can have significant improvement in their vertigo attacks.

Meniere's disease (MD) is an inner ear disease characterised by recurrent vertigo, fluctuating hearing loss (HL), tinnitus and ear pressure. On average, in 30% of cases, patients do not respond to conservative treatments for vertigo attacks. In such cases, an alternative treatment option is pressure treatment, with the Meniett device or the transtympanic membrane massage (TMM) device. Both have shown positive effects in patients with intractable MD/Delayed endolymphatic hydrops (DEH). The aim of this study is twofold: to identify the long-term effect of treatment by TMM over Meniett's device in treating intractable MD and DEH; and to determine the appropriate duration of pressure treatment for achieving remission.

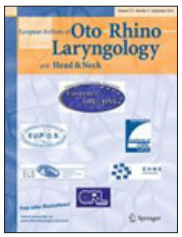
The study population included 41 subjects who were clinically diagnosed with Intractable MD and DEH and did not respond to conservative treatments. The subjects were divided into two groups: the TMM group; and the Meniett group. TMM treatment was performed for cycles of three minutes, twice a day for 1-30 months, with a follow-up for 24-42 months. Meniett treatment was performed for cycles of five minutes, three times a day for 1-36 months, with a follow-up for 24-45 months. Since most of the subjects achieved significant improvement in definite vertigo, the pressure treatment was terminated after four months.

CRITICAL NOTE:
More research is required, in multiple centres and on more subjects, before this treatment can be considered to be evidence based.

The authors found there was significant improvement in vertigo after both TMM and Meniett device treatment, be it in terms of Numerical Value (NV) and/or frequency of definite vertigo attacks per month.

The authors recommend the TMM device over the Meniett device due to the need for a transtympanic ventilation tube insertion for the latter, with the corresponding risk of permanent TM perforation, outer ear infection, etc. The changes in external ear pressure by the TMM device are transmitted to the inner ear via the ossicular chain and the middle ear cavity; the amplitude of pressure transfer through intact tympanic membrane to the inner ear via the middle ear cavity is much larger than via ossicular chain. Long-term studies have reported a complete control of vertigo after 24 months of treatment. In addition, there was improved PTA after use of the Meniett device in most patients, whereas hearing outcomes remained unimproved with the TMM device. •

DIABETES- INDUCED AUDITORY COMPLICATIONS: ARE THEY PREVENTABLE? A COMPREHENSIVE REVIEW OF INTERVENTIONS



Hajiabolhassan F. & Tavanai E.

European Archives of Oto-Rhino-Laryngology (2021): 278, 3653–65

By Thomas Zacharia – Australia

Diabetes patients can exhibit both cochlear and central auditory dysfunctions which can be identified using various auditory tests. Managing the disease itself and medical treatments specific to diabetes can reduce the severity of the auditory dysfunction caused by diabetes.

Diabetes is characterised by elevated levels of glucose in the blood and insufficient production or action of insulin produced by the pancreas. WHO estimates diabetes to be the most common endocrine disrupter in the world, resulting in 4 million deaths every year. There are three types of diabetes: Type 1, insulin dependent; Type 2, non-insulin dependent; and gestational diabetes. Long-term elevation of blood glucose level causes degenerative changes to various organs of the body which can be macrovascular (coronary artery disease, stroke and peripheral vascular disease) and microvascular (neuropathy, retinopathy and nephropathy).

Peripheral neuropathy is the most commonly reported complication associated with diabetes, affecting approximately 50% of patients. Various auditory studies have reported not only auditory neuropathy associated with diabetes, but also deterioration in the auditory pathway from the cochlea to the cortex over time.

Histopathological studies have demonstrated changes in the cochlea of diabetic patients, such as thickened vessel walls of the stria vascularis and basilar membrane, and the sclerosis of the internal auditory artery. Three possible mechanisms could explain the effect of diabetes on the auditory system: microangiopathy of the cochlea; auditory neuropathy and neurodegeneration of the central auditory system; and mitochondrial damage from cochlea to cortex. As for the peripheral auditory system, it has been reported that diabetes can cause degeneration in the spiral ganglion neurons and vestibulocochlear nerve – thereby narrowing the stria vascularis capillaries and basilar membrane vessels –, the sclerosis of the internal auditory artery and hair cell loss. These can, in turn, disturb the blood supply and nerves in the inner ear. There is well-documented evidence that patients with diabetes suffer predominantly from sensorineural hearing loss (SNHL) which is described as progressive, bilateral and as affecting primarily high frequencies. This seems to indicate that auditory dysfunction in diabetic patients is not related to diabetes-induced microangiopathy and neuropathy. This finding means cochlear dysfunction is independent of auditory neuropathy, which can be assessed using otoacoustic emissions (OAEs) which are absent or abnormal in diabetes patients. Diabetes is also reported to be a risk factor for sudden SNHL due to microvascular lesions, greater blood viscosity as well as embolic and thrombotic episodes. As well as SNHL, patients with diabetes exhibit vestibular dysfunction (dizziness, floating sensation, tinnitus, weakness and sweating).

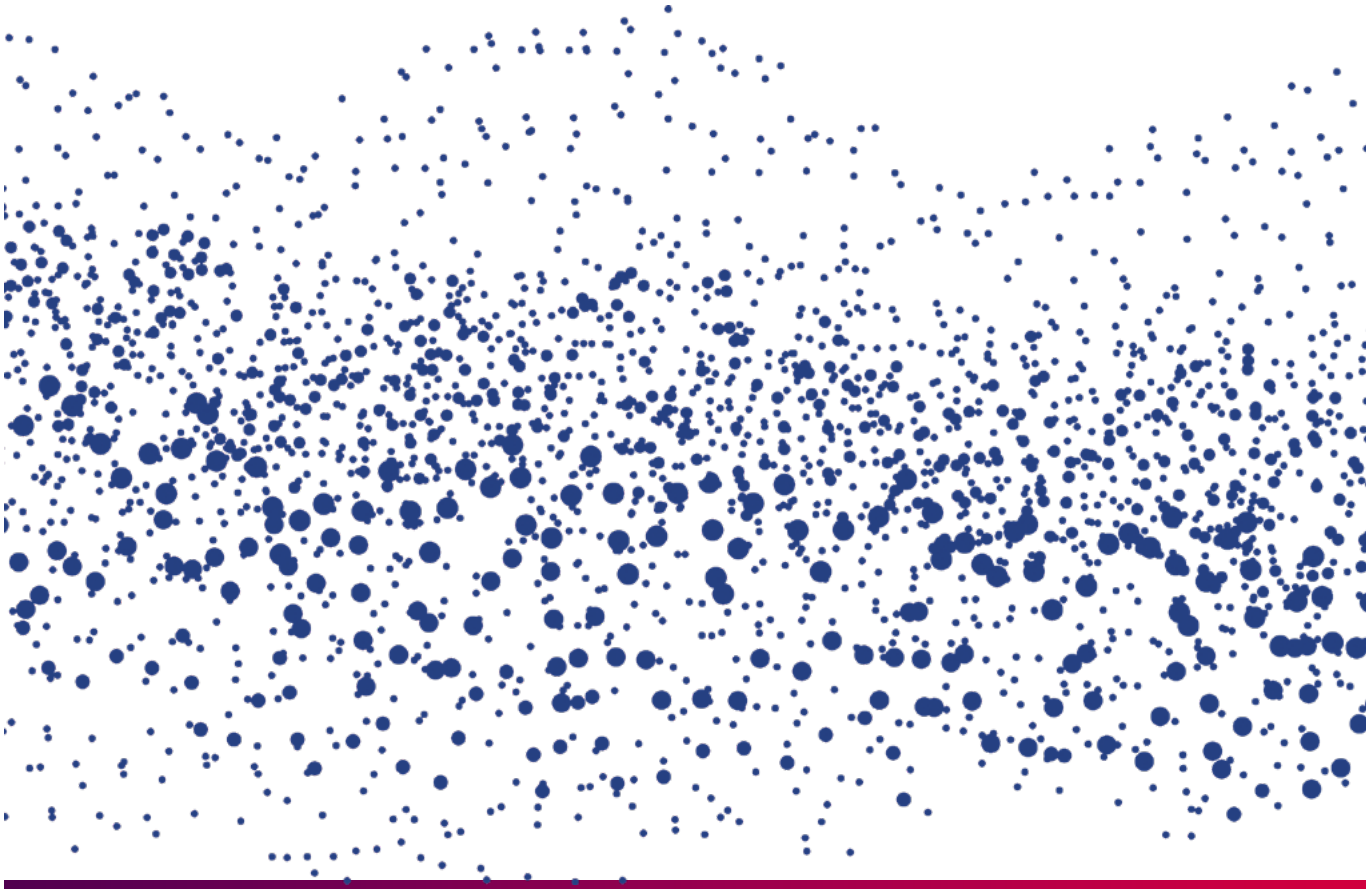
Regarding the effect of diabetes on the auditory nerve and central auditory system, the authors highlight that three mechanisms are involved in the neuropathic changes in diabetes patients: inflammation; oxidative stress; and mitochondrial dysfunction. Studies reported that in diabetic patients, the auditory brain stem responses (ABR) are affected before hearing thresholds are. ABR latencies are reported to be more prolonged in diabetic patients than in normal hearing subjects.

CRITICAL NOTE:

Diabetes patients can exhibit both cochlear and central auditory dysfunctions which can be identified using various auditory tests, such as PTA, ABR, OAE, CM, MLR, LLR, P300. Managing the disease itself and specific diabetes-related pharmacological treatment can significantly reduce the severity of the auditory dysfunction caused by diabetes.

There are also studies reporting differences in auditory dysfunction between Type 1 and Type 2 diabetes. Prolonged ABR latencies and cochlear dysfunctions are reported more in Type 1 diabetic patients as compared to Type 2. ABR with OAEs and Cochlear Microphonics (CM) are recommended in diabetic patients in order to rule out auditory neuropathy in which OAE and CM will be preserved with abnormal ABR latencies indicative of auditory neuropathy. Along with ABR, OAE and CM, more upper cortical evoked potential results also provided interesting insights for diabetes patients. Prolonged Pa latency in Middle Latency Response (MLR), N100, P200, N200, P300 latencies and reduced P300 amplitude were reported in diabetic patients. Event Related Potentials (ERPs) are a sensitive tool for identifying cognitive decline in diabetes patients.

Diabetes and diabetes-related complications such as auditory dysfunctions are susceptible to treatment, such as: disease-modifying treatments (reducing risk factors, glycemic control, targeting blood pressure and lipids); pharmacological treatments (medication to control diabetes or antioxidants, given that oxidative stress is one of the causes of auditory dysfunction). Many studies have reported significant improvement in ABR latencies following pharmacological treatment. •



A RETROSPECTIVE CROSS-SECTIONAL STUDY ON TINNITUS PREVALENCE AND DISEASE ASSOCIATIONS IN THE DUTCH POPULATION-BASED COHORT LIFELINES

Schubert NMA., Rosmalen JGM., van Dijk P., et al.

Hearing Research (2021): 411, 108355. Doi: 10.1016.

By Leen Vandenbossche – Belgium

In this retrospective study, the authors confirm already-known factors for tinnitus, but also identify new associations.

Despite the prevalence of tinnitus, existing research has suffered from a lack of consensus around this condition: variances in the criteria or the characterisation of tinnitus subtypes; sample bias because study populations only included patients with tinnitus bothersome enough to seek medical help; current treatments focus on management of the distress rather than alleviation of the pathophysiology; some studies focus on very specific factors, but are too small (<200 patients) to be clinically significant, which contrast with other larger studies which take a broad approach to the condition but lack detailed tinnitus phenotyping, etc.

For this retrospective study, the authors used Lifelines, a large-scale biobank of non-clinical participants who are followed in a unique three-generation design, developed specifically to improve the investigation and understanding of the genetic contribution of complex diseases. Lifelines includes over 167,000 participants from the northern Netherlands, which represents approximately 10% of the population.

The Lifelines cohort study assesses participants using five-year comprehensive visits, complemented by a questionnaire between visits. The data was collected between 2006 and 2014, with a follow-up questionnaire assessing tinnitus (2011–2015).

The large size and wide scope of parameters available for investigation in Lifelines make it a powerful tool for investigating tinnitus associations in a non-clinical population. The authors identified already-known factors, but more interestingly, they were able to identify new associations.

CRITICAL NOTE:

The Lifelines databank shows potential for future research, especially for identifying underlying physiological and genetic mechanisms contributing to tinnitus. It could help both professionals and patients in understanding the causes of tinnitus and maybe cause a shift in current treatments, which currently focus primarily on managing the distress caused by tinnitus.

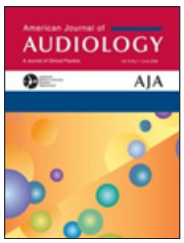
As can be expected, the largest positive association identified was hearing difficulties in day to day life. This was followed by: arrythmia; panic disorder without agoraphobia; male sex; transient ischemic attack and social phobia.

Other, lower scored, associations were found, including: major depressive disorder; general anxiety disorder; BMI (underweight and overweight); dysthymia; oedema; important lifestyle factors such as smoking, diabetes mellitus, self-reported hypertension and elevated systolic blood pressure.

Some of the newly-identified associations included rheumatoid arthritis, irritable bowel syndrome and chronic fatigue syndrome. In addition, a corelation was found with the thyroid and inflammatory disease groups as well as functional somatic.

Some drawbacks of this study are the limited phenotyping of tinnitus and hearing status, and the fact that the assessment of tinnitus perception was acquired later (with questionnaires) than the other measures used in the study. •

THE RELATIONSHIP BETWEEN TINNITUS PITCH, AUDIOGRAM EDGE FREQUENCY, AND AUDITORY STREAM SEGREGATION ABILITIES IN INDIVIDUALS WITH TINNITUS



Jain S., Cherian R., Nataraja NP., et al.

American Journal of Audiology (2021): 30(3), 524–34.

By Frederic Debruycker – Belgium

People with tinnitus face more difficulties in noise than people without tinnitus, and they can also demonstrate an exacerbated activity of the areas near the median frequency, which may explain the perception of tinnitus.

Based on the observation that the presence of tinnitus is very often associated with hearing loss (HL), this study set out to analyse the relationship between tinnitus and HL, and more specifically the median frequency. Secondly, this study sought to investigate the possible influence of the presence of tinnitus on intelligibility in noise.

This retrospective paper explores mechanisms that are reported to generate the perception of tinnitus, especially the brain plasticity leading to abnormal overactivity, due to sensory deprivation.

The aim of the analysis was to find out whether:
- the perception of tinnitus was related to the median frequency of the audiogram (the largest difference in threshold between normal and impaired areas).
- segregation abilities were altered due to the presence of the tinnitus.

The sample group was selected based on:
- the presence of tonal tinnitus,
- bilateral cochlear impairment,
- the possibility of matching the same audiogram (one participant with tinnitus and another one without tinnitus)

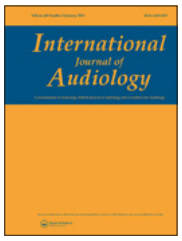
The tests performed for this study included:
- Pure tone audiometry at all frequencies (between 250 and 12500 Hz)
- Speech audiometry
- THI-inventory
- A segregation capacity test (between the frequency area of the tinnitus and one octave lower). This measure analyses the subject's ability to perceive two different signals or if the two signals are heard as only one. Same frequencies were used for non-tinnitus

CRITICAL NOTE:
- *This article provides additional evidence for tinnitus as abnormal cortical activity in the presence of cochlear hearing loss.*
- *All participants showed tinnitus in the 1500 Hz – 3000Hz area. The study did not include any subjects with high-frequency tinnitus.*
- *The findings are useful in counselling subjects with tinnitus associated with HL.*
- *There is no information on whether or not these subjects previously used hearing aids*

The results of this study show:
- A high correlation between the frequency of tinnitus perception and the median area of the audiometry.
- A poorer ability to segregate sounds for subjects with tinnitus compared to subjects without tinnitus (in the tinnitus area.)

The second result confirms observations that people with tinnitus face more difficulties in noise than people without tinnitus and can also indicate an exacerbated activity of the areas near the median frequency, which may explain the perception of tinnitus. •

HEARING AID ACQUISITION AND OWNERSHIP: WHAT CAN WE LEARN FROM ONLINE CONSUMER REVIEWS?



Bennett RJ., Swanepoel DW., Ratinaud P., et al.

International Journal of Audiology (2021): 60(11), 917–26.

By Tali Bar-Moshe – Israel

This study sheds light on public HA online reviews posted by their owners. It emphasises the centrality they attribute to the technology itself and described the barriers they experience that limit successful usage.

More and more, consumers rely on online searches for health services, and social networks have become a major source of information and reviews influencing decisions. The researchers used 1,378 hearing aid (HA) users' online reviews of their HA posted on the website HearingTracker.com between 2013-2019.The main purpose of this study was to explore the opinions HA owners published in online HA reviews, in order to identify the most key topics for HA ownership and use.The data included metadata (HA brand and technology level, unilateral/bilateral fitting, duration of use), a questionnaire with ten closed response items and open-text reviews.The data was analysed using IraMuTeQ (open-source automated text analysis software).

From these data, the researchers were able to extrapolate two main fields, each containing three response clusters

CRITICAL NOTE:
Our clients, as in other healthcare fields, look for and are exposed to online information. This information may be scientific knowledge published by professionals, or advertising and commercial information published by companies, or merely personal opinions and reviews published by laypeople. As healthcare providers we must be aware of the influence of online information on our clients, their expectations, perceptions and engagement in the hearing rehabilitation process. We have to find out the specific and individual challenges they have to deal with, identify the barriers they face and make sure to offer appropriate professional support, by providing the information and training they need.

DEVICE ACQUISITION:

- Finding the right provider, device and price-point: HA users emphasised the importance of finding the right and the most cost-effective clinic; HA; and services.
- Selecting a HA suited to the Hearing Loss type: this cluster had a greater number of statements by experienced HA owners and those who purchased lower-level devices. The statements related to "shopping around" in order to find the right HA, price and services.
- Attaining physical fit and device management skills: this cluster related to the physical and acoustical fitting process as well as the learning HA use and management skills

DEVICE USE

- Hearing in noise: the experience of HA users in noisy situations and the gaps between HA performance and expectations in those situations
- Smartphone streaming to HAs: positive and negative experiences with audio-streaming to HA via smartphones.
- HA adjustment using smartphone: using Apps to adjust acoustic parameters of HAs. This particular cluster garnered more responses from higher-level HA owners.

This study sheds light on public HA online reviews posted by their owners. It emphasises the centrality they attribute to the technology itself and described the barriers they experience that limit successful usage. The authors recommend audiologists use a patient-centred approach, and stress the importance of professionals being able to understand their clients' abilities, expectations and difficulties in order to address them and foster successful HA adoption. •

DIRECT SARS-COV-2 INFECTION OF THE HUMAN INNER EAR MAY UNDERLIE COVID-19-ASSOCIATED AUDIOVESTIBULAR DYSFUNCTION

Jeong M., Ocwieja KE., Han D., et al.

Communications Medicine (2021):1, 44. doi: 10.1038/s43856-021-00044-w.

By Sofie Peeters – Belgium

The findings of this article (and the fact that there still remain many unresolved questions on this topic) highlight the need to monitor hearing closely in children born during the COVID-19 pandemic and to monitor for signs and symptoms of audiovestibular impairment in patients infected with COVID-19.

A number of viruses are known to cause audiovestibular symptoms, such as Herpesviridae (CMV, HSV, VZV, EBV), Paramyxoviridae (Parainfluenza, mumps, measles), Polio virus, Hepatitis viruses, HIV, Rubella virus, Influenza viruses, etc. While coronaviruses are a common cause of middle ear infection, little research has been carried out on the role these viruses play in inner ear infection. This study assesses the effect of COVID-19 on the human inner ear, across ten adult COVID-19 patients (ages ranged from 22 to 72) with new-onset audiovestibular symptoms, developed within three weeks of contracting COVID-19 (diagnosed by PCR or serum antibody testing). Nine of the ten patients experienced common COVID 19-symptoms (fever, cough, dyspnea, and/or fatigue) between 21 days before and 14 days after the onset of the audiovestibular symptoms. In three patients, the audiovestibular symptoms were presenting symptoms of COVID-19.

Audiometric data and otoacoustic emission test results were collected. All patients experienced mild to profound SNHL (with eight experiencing severe to profound hearing loss, HL). Tinnitus was reported in nine out of ten patients. Six patients experienced rotational or linear vertigo that lasted several days. No participants suffered from chronic vestibular dysfunction after COVID-19 infection. Brain MRI during COVID-19 infection ruled out retrocochlear pathology. Only one MRI (a patient with SNHL and true rotational vertigo) showed diffuse enhancement of the vestibule, cochlear and vestibular nerves, geniculate ganglion and facial nerve ipsilateral to the ear with SNHL, consistent with viral-induced inflammation, suggesting a correlation between HL and COVID-19. The complete hearing recovery in two of the ten patients is consistent with the rate of spontaneous recovery in patients diagnosed before the COVID-19 pandemic with sudden idiopathic SNHL.

CRITICAL NOTE:
The findings of this article (and the fact that there still remain many unresolved questions on this topic) highlight the need to monitor hearing closely in children born during the COVID-19 pandemic and to monitor for signs and symptoms of audiovestibular impairment in patients infected with COVID-19.
Further research is necessary to collect more data in order to establish definitive correlations. However, the human cellular models (2D and 3D) for HL used in this study offer promising insight into the implications of viruses entering the inner ear and possible treatments.

The expression of SARS-CoV-2 cell entry-related genes and proteins in human and mouse inner ear tissue were examined so as to investigate whether HL, vestibular dysfunction and/or tinnitus might be due to direct infection of audiovestibular structures. Human vestibular tissue (fresh inner ear tissue was collected during surgical labyrinthectomies and translabyrinthine resections of vestibular schwannomas performed on patients who did not have SARS-CoV-2 infection, N=6) was infected in order to identify target cell types of SARS-CoV-2.

The results show that human adult inner-ear tissue co-expresses the angiotensin-converting enzyme 2 (ACE2,

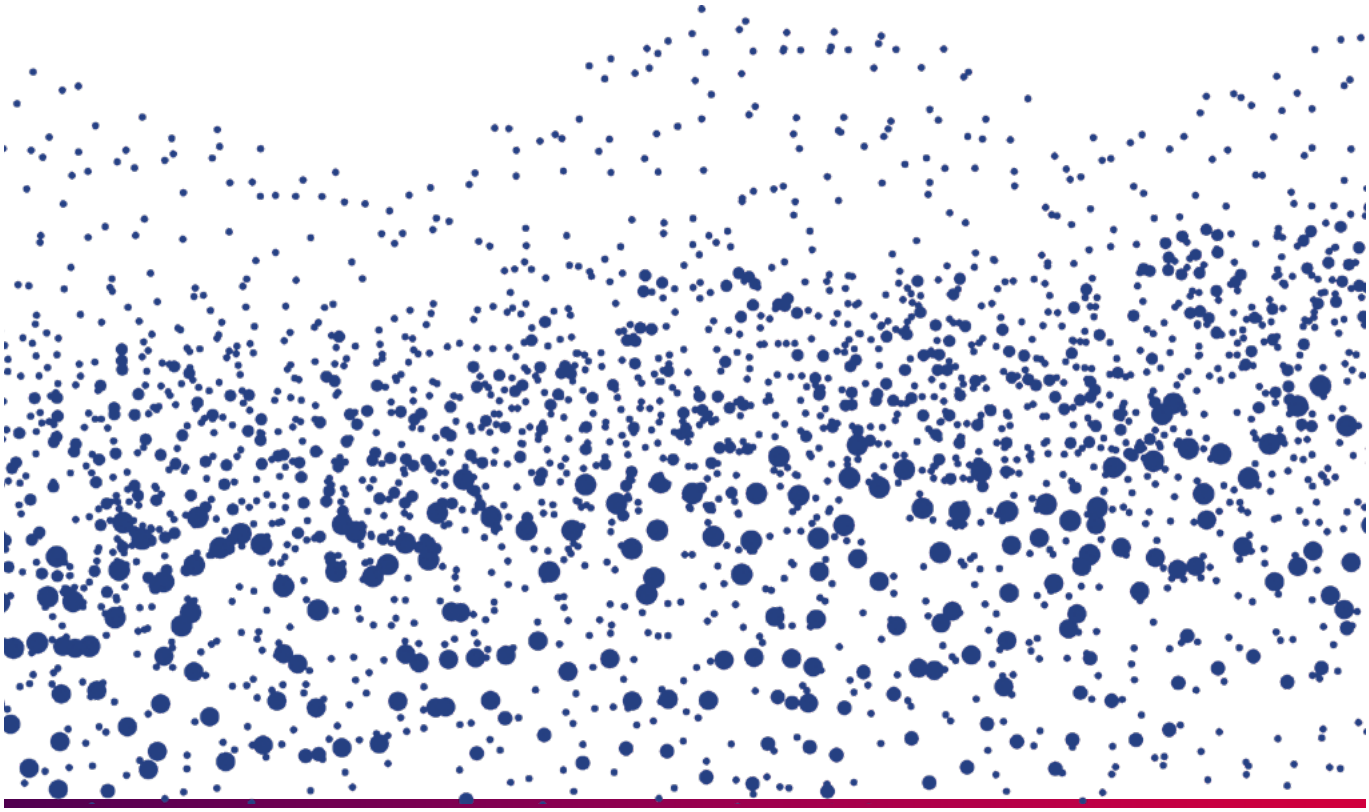
receptor for SARS-CoV-2), the transmembrane protease serine 2 (TMPRSS2) and FURIN cofactors required for virus entry. Confocal microscopy showed that hair cells and Schwann cells in explanted human vestibular tissue can be infected by SARS-CoV-2. Mouse inner ear cells also have the molecular machinery to allow SARS-CoV-2 entry.

Because researchers cannot access cells from a healthy, living human inner ear, three human induced pluripotent stem cells (hiPSCs)-in vitro models were established: two-dimensional otic prosensory cells (OPCs) (precursors of hair cells and their supporting cells); two-dimensional Schwann cell precursors (SCPs) and three-dimensional inner ear organoids (organised structures mimicking inner ear epithelium). The inner ear organoids show that hair cells express ACE2 and are targets for SARS-CoV-2, also OPCs and SCPs are permissive to SARS-CoV-2 infection with, however, lower infection rates in SCPs (lower ACE2 and FURIN expression in SCPs than in OCPs).

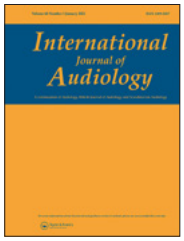
These findings suggest that hair cells may be particularly vulnerable to infection by SARS-CoV-2 in the human inner ear. The authors propose at least three possible mechanisms for the observed acute audiovestibular symptoms.

1. The absence of outer hair cell (OHC) function (as measured by otoacoustic emissions) and irreversible HL suggests that SARS-CoV-2 may directly infect and kill cochlear hair cells, vestibular hair cells and/or primary afferent auditory and/or vestibular nerve cells.
   Transient cell dysfunction due to COVID-19 rather than cell death is an alternative mechanism given the fact that there is low incidence of permanent audiovestibular dysfunction. For example, vestibular testing in a patient after recovery from COVID-19 was normal, suggesting that if vestibular hair cells were infected, they recovered, or alternatively that other mechanisms, such as endolympathic hydrops, could have caused the audiovestibular symptoms.
2. Direct viral infection of inner ear cells might trigger innate interferon-mediated responses. The resulting inflammatory response may damage inner ear cells, resulting in symptoms as hearing loss, tinnitus and vertigo.
3. Damage to the stria vascularis may disrupt the endocochlear potential and potassium homeostasis of the endolymph within the cochlear duct, leading to hearing loss.

This also poses the question of the path SARS-CoV-2 might take to access the inner ear. Potential paths are through the central nervous system via the olfactory groove, through the endolymphatic sac or through hematogenous spread through the stria vascularis. A fourth possible path could be through the round or oval window, because it has already been identified that the mucosa of the middle ear and mastoid are vulnerable to infection with SARS-CoV-2. •



ONE YEAR ON: AN UPDATED SYSTEMATIC REVIEW OF SARS-COV-2, COVID-19 AND AUDIO-VESTIBULAR SYMPTOMS



Almufarrij I. & Munro KJ.

International Journal of Audiology (2021): 60(12), 935–45. doi: 10.1080/14992027.2021.1896793

By Majda Basheikh – Canada

This paper offers a review of studies linking COVID-19 to hearing and balance-related symptoms and highlight the variability in audiovestibular symptoms among COVID-19 infections.

The world has endured the COVID-19 pandemic since 2019. This viral infection is defined primarily by the presentation of respiratory symptoms. However, there have also been reports of audiovestibular symptoms in some patients. This study reviews published literature reporting hearing loss (HL), tinnitus, and vestibular symptoms in cases of COVID-19.

A systematic review was conducted in compliance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The eligibility criteria included: subjects with medically confirmed (probable) and medically unconfirmed (suspected) audiovestibular symptoms. The main symptom of interest in this systematic review was a change in hearing acuity. Secondary symptoms of interest were tinnitus, vertigo, and hyperacusis. A total of 850 records were identified, which were further analysed to remove duplicates, remove studies with questionable/biased results or poor methodological quality and exclude studies that did not meet the eligibility criteria. This yielded a total of 56 studies, 28 of which were case/report series, and 28 cross-sectional studies.

HL was reported in 17 case reports and one case series. Nine reported sensorineural hearing loss (SNHL), and the remaining cases reported either conductive, mixed, or unknown HL. A total of 13 cross-sectional studies reported HL, but only three of them conducted audiological tests, from which only one found a significant audiometric difference between COVID-19 cases and controls. In this particular study, significant high-frequency HL was reported in addition to lower amplitudes for transient-evoked OAEs. The remaining cross-sectional studies used either a review of medical records or questionnaires to inquire about audio-vestibular symptoms. In total, 12 of these studies identified reduced hearing acuity as a symptom of COVID-19, whereas the remaining one study had four subjects self-report HL in response to an open-ended question. In summary, the estimated prevalence of HL in the reviewed COVID-19 subjects was 7.6%.

CRITICAL NOTE:
Numerous studies have emerged since the start of the COVID-19 pandemic reporting tinnitus, hearing loss, and vertigo following infection. However, the studies included in this review were limited to survey/questionnaire-based data and their study design lacked quality. The pandemic also directly resulted in changes to lifestyle which could potentially contribute to or exacerbate pre-existing audio-vestibular symptoms in and of themselves. Further research is needed to define the direct impact of this virus on the audio-vestibular system.

Tinnitus was reported in 11 cases, either as an aggravation of pre-existing tinnitus or an onset of tinnitus following COVID-19 infection. Tinnitus was also identified in 15 cross-sectional studies, with only three studies investigating the characteristics of the tinnitus via self-reports or questionnaires such as the Tinnitus Handicap Inventory (THI). Tinnitus was reported either as constant or intermittent, and pre-existing tinnitus was on average further aggravated due to the onset of COVID-19. The estimated prevalence of tinnitus in COVID-19 subjects was 14.8%.

Vertigo was mentioned in nine case reports and 11 cross-sectional studies. The latter identified vertigo via self-reported questionnaires. The estimated prevalence of vertigo in COVID-19 subjects was 7.2%. It should be

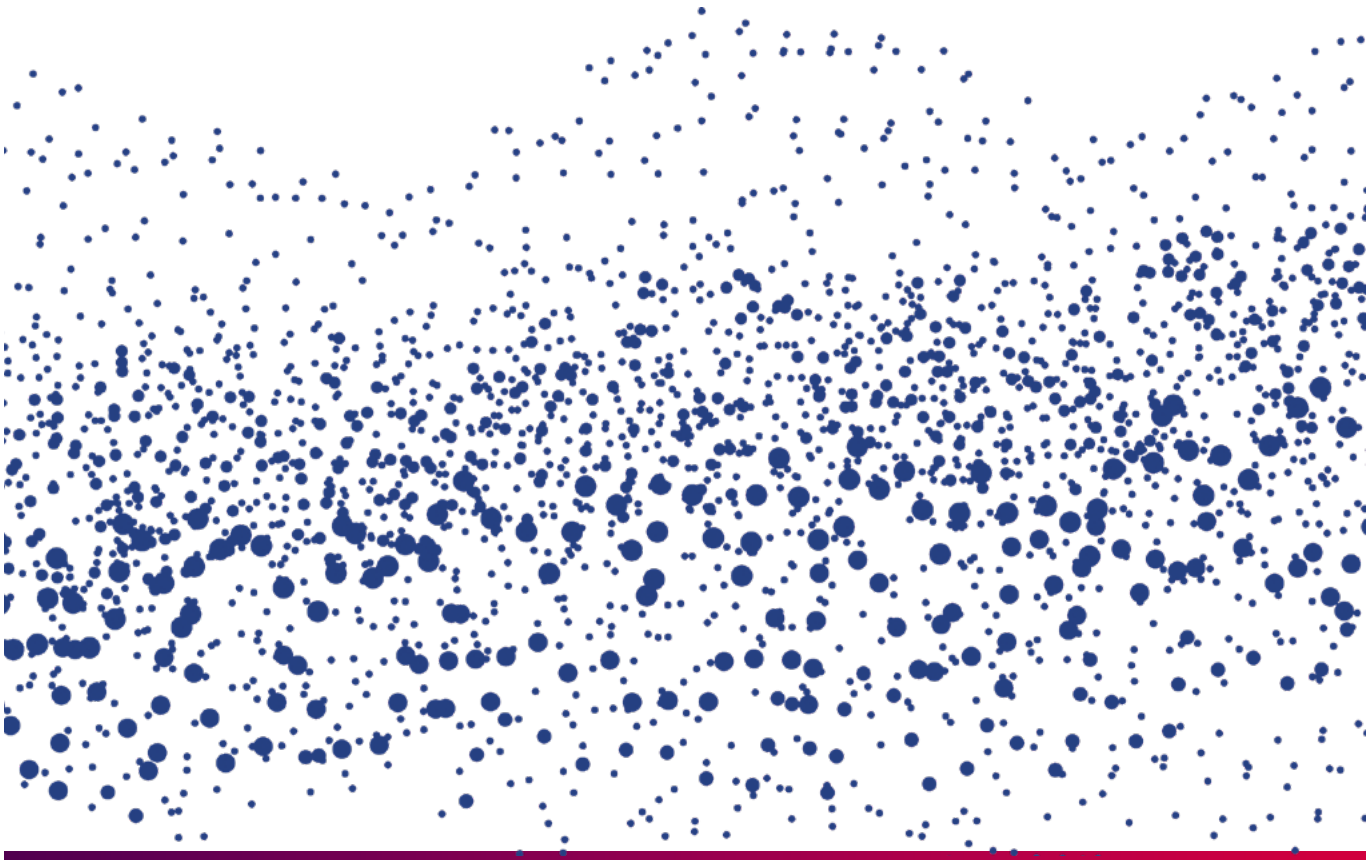
noted that dizziness may not necessarily be vestibular in origin, so this estimate is possibly over-exaggerated since some studies combined the prevalence of dizziness with vertigo, or even used the terms interchangeably. Furthermore, it was not clear in the reviewed studies whether the vertigo was a new or a pre-existing symptom.

In the case report studies examining HL, the SNHL cases fit the characteristics of sudden sensorineural hearing loss (SSNHL). It is possible that COVID-19 may cause SSNHL, but it is also true that most cases of SSNHL are idiopathic. The reviewed studies did suggest other potential causes such as ischemia, and immune-related issues. In order to determine possible associations of SSNHL with COVID-19 infection, some researchers tallied the cases of SSNHL before and during the pandemic. No clear consistent trend was found, so more research is needed to further examine whether such a relationship truly exists. Conductive and mixed HL cases were fewer in number and could possibly be related to other life factors such as acute otitis media. Therefore, it is impossible to definitively conclude that COVID-19 is attributed to conductive and mixed HL.

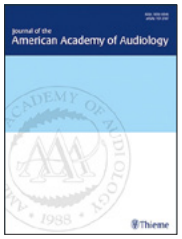
All pooled and estimated prevalences should be treated with caution, as they were mostly based on self-reported questionnaires or medical records that did not include thorough analyses of audiovestibular symptoms. There are other pandemic-related factors to consider in self-reported data. Environmental contributors that hinder communication (i.e., plexiglass shields, face shields, and face masks) could have potentially inflated self-reports of hearing challenges.

Across all studies, tinnitus was the most-frequently studied audiovestibular symptom. However, they offered no in-depth analysis of the characteristics of tinnitus presentation. Some studies reported variability in onset and presentation, but it was not discussed consistently throughout all included studies. Furthermore, tinnitus was defined by some subjects with pre-existing tinnitus as more bothersome but this could also be attributed to added stress resulting from pandemic-related- lifestyle disruptions.

The reviewed studies provide some measure of insight into the variability in audiovestibular symptoms among COVID-19 infections. However, the review focused exclusively on self-reported data and case studies. Further studies are needed in order to gain a better understanding of the impact of COVID-19 on hearing and balance systems. •



EFFECT OF HEARING AID TECHNOLOGY LEVEL ON NEW HEARING AID USERS



Hausladen J., Plyler PN., Clausen B., et al.

Journal of the American Academy of Audiology (2021): 32. doi: 10.1055/s-0041-1731592.

By Katrien Hoornaert – Belgium

The authors set out to identify the impact of the level of technology of hearing aids on the actual and perceived gain of users. Laboratory evaluations showed a significant positive effect of technology level for the Acceptable Noise Level. The field-trial evaluations showed significant impact on the satisfaction rating for speech in a large group.

A hearing aid (HA) with a higher technology level (and accordingly a higher price) does not necessarily result in increased benefit in everyday life for all users.

Existing literature has found that experienced HA users have similar outcomes across most measures (in both technology levels); only noise acceptance and satisfaction ratings for speech in a large group were significantly improved when using the premium technology.

In order to determine the effect of HA technology level for new HA users, non-experienced participants completed two, four-week trial periods with HAs programmed either with basic or premium technology. Participants were seen for three visits:

1) HA fitting
2) laboratory and field-trial evaluations and changing the technology level of the HAs
3) laboratory and field-trial evaluations.

Unitron Tempus Moxi Fit FLEX:TRIAL™ receiver-in-the-ear HAs were selected, which could be programmed as premium (Pro) or basic (600) technology levels.

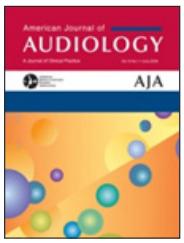
After each four-week trial, laboratory evaluation (speech perception using QuickSIN and HINT; and noise acceptance using ANL) and field-trial evaluations (SSQ-1 and satisfaction ratings & preference) were administered. A total of 24 participants completed both trial periods, but only 15 of them completed both laboratory evaluations (due to COVID-19).

The laboratory evaluations showed an impact of the technological level only on the Acceptable Noise levels (ANL) criterion (improved ANL with premium technology). The field-trial evaluations showed significant satisfaction with speech in a large group setting. The number of participants who preferred the premium technology was significantly higher. •

CRITICAL NOTE:

No improvement for speech perception performance was identified. The authors suggest that this is because even with a basic technology level, modern HAs are able to restore audibility for speech sufficiently in quiet and in noise.
The fact that noise acceptance improved only with 3 dB can probably be explained by the fact that ANL with basic technology was already very good. Further research with participants with a higher degree of HL would be interesting.
Of course, all findings are limited to the HAs used in this study.
Overall, measurement of speech in quiet (and even in noise) is not a helpful test for demonstrating the benefits of a higher technology level.

SELF-REPORTED REASONS FOR THE NON-USE OF HEARING AIDS AMONG HISPANIC ADULTS WITH HEARING LOSS



Desjardins JL. & Sotelo LR.

American Journal of Audiology (2021): 30(3), 709–16. doi: 10.1044/2021_AJA-21-00043.

By Angela Ryall – Canada

In this study, the authors explore self-reported reasons why Mexican-American Hispanic do not use hearing aids although hearing loss is present.

A number of studies have investigated factors associated with hearing aid (HA) adoption. However, these focus primarily on certain ethnicities and have so far failed to include Hispanic/Latinx populations. Furthermore, as the authors highlight in this paper, the self-reported reasons for the non-use of amplification among these ethnic populations has not been examined, especially among adults who have hearing loss (HL). In the study under review, the authors explored self-reported reasons why Mexican-American Hispanic do not use HAs although HL is present.

A total of 122 adults were recruited from community centres around El Paso, Texas. Participants were aged between 43 and 93 and 62% were female. In order to be included in the study participants had to meet the following criteria: identify as Hispanic; have no prior experience with amplification; and fail a hearing screening (tested at 1000, 2000, and 4000 Hz at 40 dB HL) bilaterally. Participants completed the Hearing Handicap Inventory Screening Version questionnaire (HHI-S), a hearing history questionnaire, and then had their hearing screened. The HHI-S explored participants' perceived hearing difficulties in different situations through ten questions; a higher score indicates greater self-perceived difficulty. The hearing history questionnaire was used to collect general demographic information (e.g., age, gender, employment status, and health insurance status) as well as self-reported HL, previous HA experience, willingness to use amplification, and reasons for the non-use of amplification. Possible reasons for the non-use of amplification were presented in a closed set of responses where participants were encouraged to check as many reasons as applicable and were also given extra space to write additional reasons. This questionnaire was translated into Spanish and then back-translated for accuracy with a team who were either bilingual

CRITICAL NOTE:

I was thrilled that the study focused on a population other than Caucasian, as many other ethnic/cultural groups are under-represented in studies throughout North America. To have all Hispanic participants who were easily recruited from Texas with similar backgrounds (first generation American-Hispanic) is an excellent tool for carrying information over to other patients who may be from similar backgrounds. Although the authors suggest not all the data can be translated to other populations such as citizens of another country, e.g., people residing in Mexico, the results provide insight into the challenges HA users hindering HA uptake.

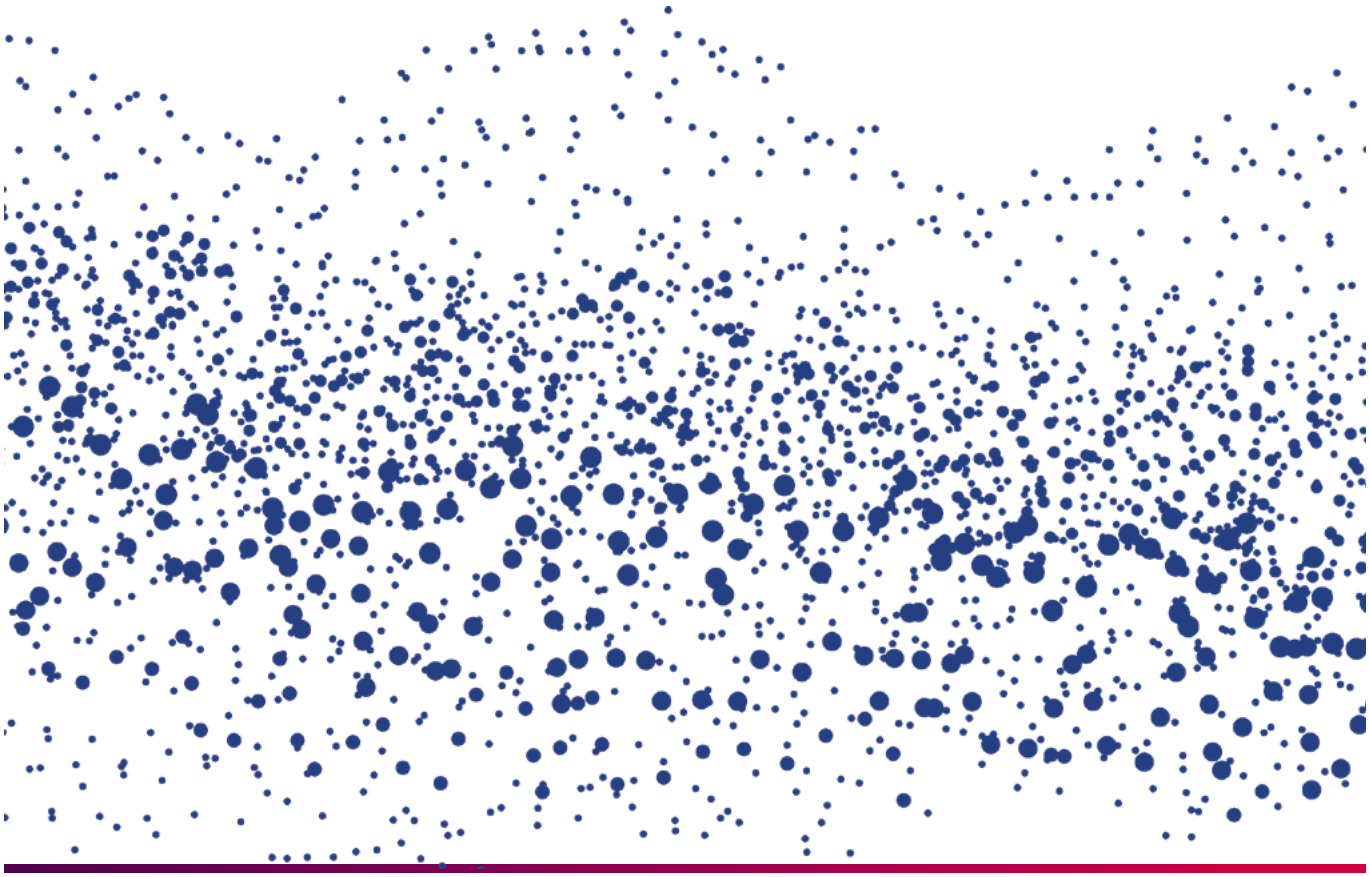
The authors used the HHI-S standardised questionnaire and a questionnaire specifically developed for this study, which was back translated for accuracy from English to Spanish. Although it is a screening, the questions target different situations and emotions/feelings (e.g., embarrassment, frustration, TV, and restaurant settings) designed to give clinicians more insight into patients/participants feelings.

Overall, the study provides conclusions which can inform clinicians daily practice when interacting with patients. There may be underlying reasons for patients' refusal to use HAs and may still not be motivated to try amplification. It is important we keep in mind that it is a big part of our job to educate our patients on their hearing healthcare and why it is important to treat HL.

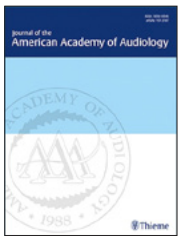
English-Spanish or native Spanish speakers.

A majority of participants reported an education level lower than high school; 54% were retired; and approximately 60% had health insurance. From the HHI-S, more than half of participants self-reported HL: approximately 36% reported mild to moderate difficulty; and 22% reported a severe hearing handicap. More than half of the participants, i.e., 54%, were willing to use amplification. There was a strong correlation between greater hearing difficulty and willingness to use amplification. A second factor is health insurance, with those benefiting from health coverage being more likely to use HAs to manage their HL. Common reasons listed by participants as to why they were not currently using HAs were: feeling that their hearing was not bad enough to use a hearing aid; cost of HAs, transportation issues to appointments; and hearing healthcare was a lower priority compared to other health issues. Out of participants who were willing to use amplification, 75% of them stated the cost of HAs was the reason for no uptake.

One way to reduce stigma around HAs and mitigate minimisation of HL, the authors highlight, would be to increase community/patient education about hearing healthcare. Educating aging populations about the effects of untreated HL may empower them to make more fully-informed decisions about their hearing health. •



THE EFFECT OF MUSIC GENRE AND MUSIC – PREFERENCE DIMENSION ON ACCEPTABLE NOISE LEVELS IN LISTENERS WITH NORMAL HEARING



Babajanian EE., Patel NS. & Gurgel RK. Seminars in Hearing (2021): 42(4), 342–351. doi: 10.1055/s-0041-1739367

By Evelyne Bekaert – Belgium

After analysing the effects of music genre on Acceptable Noise Levels (ANL), the authors found that rock or blues music as background noise is associated with a lower ANL score than classical, country and jazz music as well as twelve-talker babble. In addition, music preference did not impact ANL.

Does the Acceptable Noise Level (ANL) vary depending on the music genre or the listener's music preference?

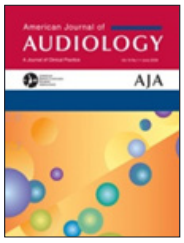
- Nabelek et al (1991): Successful hearing aid (HA) users accept more background noise (BN), i.e., they have a lower ANL. However, the type of BN can influence ANL: when the BN is easy-listening music, the ANL is significantly higher than other noises.
- Rentfrow and Gosling (2003) compared music and speech babble as a BN. When music was used, the ANL improved (i.e., was lower). The authors created the ShortTest of Music Preference (STOMP) questionnaire to evaluate how different music genres affect listener preferences, and identified the following dimensions: Reflexive and Complex; Intense and Rebellious; Upbeat and Conventional; Energetic and Rhythmic. Every dimension has its own association with self-view, cognitive abilities and personality.
- Gordon, Hickey and Moore (2007) reported a lower ANL when the BN was rock music.
- Ahn et al (2015) found tempo bears no influence on the ANL; however, music genre does result in different ANL scores.

Other studies found that when the music genre has a meaningful lyrical content, it is a stronger informational masker; and that music as BN affects our decisions.
The study population comprised 33 young normal hearing adults, mostly female (this begs the question: is music preference gender neutral?).

CRITICAL NOTE:
The findings, while interesting, do pose a number of questions, for example: whether comparable findings would be found with a male population, as opposed to 32 women as is the case here. Is music 'gender neutral'? Will similar results be found in other regions/states? (e.g., country music in Belgium?). Also, the study population was very young. Would the same results be found with older test subjects (e.g., mean age of 50?) This population might have more 'experience' with classical music. How would this impact the results?

Music sample selection was carried out in such a way as to ensure that every sample was correctly categorised in the correct music genre. Five different music genre samples were used: blues; country; classical; jazz; and rock.
Testing included: measuring Most Comfortable Level (MCL) and Background Noise Level (BNL) for every background stimulus in order to calculate the ANL; rating music genres in order; and completing the STOMP questionnaire.
The researchers found no significant difference for ANL depending on the subjects' order of music preference. Moreover, the ANL score was lower with rock or blues music than with classical, country, jazz and twelve-talker babble. The authors posit this could be due to young people's exposure to noisy settings and leisure activities, meaning they are more used to it, and it bothers them less (and so the ANL is lower). •

FREQUENCY-LOWERING PROCESSING TO IMPROVE SPEECH-IN-NOISE INTELLIGIBILITY IN PATIENTS WITH AGE-RELATED HEARING LOSS



Bruno R., Freni F., Portelli D., et al.

European Archives of Oto-Rhino-Laryngology (2021): 278(10), 3697–706.
doi: 10.1007/s00405-020-06431-8

By Yanic Windels – Belgium

The authors explore whether linear-frequency transposition (LFT) in hearing aids (HA) can improve speech intelligibility. They found no improvement of speech in noise intelligibility. However, they did identify a possible correlation between age and positive response to LFT.

In this study, the researchers set out to investigate whether the use of linear frequency transposition (LFT, a frequency lowering algorithm) in hearing aids (HAs) can improve speech intelligibility for patients with age-related HL.
Modern HAs use digital sound processors to obtain good amplification gain. There are several types of algorithms for processing sound for better speech intelligibility.
High frequencies hold a lot of information, particularly for differentiating consonants (up to 80%).
The best candidates for a study around frequency lowering would be people with (sub)normal hearing in the lower frequencies and a ski-slope starting from 1kHz where hearing would be possible only with amplification. The aim of the study was to test whether linear frequency transposition can help hearing.

CRITICAL NOTE:

The finding that frequency lowering has no negative impact on Quality of Voice is very positive. However, the impact of frequency lowering on speech understanding in noise has already been studied at length in multiple systematic reviews and was found to be very limited. Therefore, the main conclusion of the authors that frequency lowering is not useful for improving speech understanding in noise is not surprising. Therefore, it seems counter-intuitive that the authors recommend systematically trying three different types of frequency lowering settings.

PARTICIPANTS:

- 77 patients (37 male, 40 female)
- Age-related HL
- > 55 years (average 74,8)
- Symmetrical HL with an average Pure Tone Average (PTA) between 35 and 50 dB HL with a HL lower than 40 dB in lower frequencies under 1 kHz and above 70 dB HL in the higher frequencies.

EXCLUDED:

- Conductive HL
- Facial-skull malformations
- Previous ear operations
- Acute or chronic ear diseases

CONDITIONS:

- Patients were all fitted with the same type of HAs, the same receivers, with open or tulip domes
- They had a period of four weeks to adapt to the gain settings, verified with Real Ear Measurements (REM).
- The researchers used several tests: Word Recognition Score (WRS) in quiet and in noise; and the quality of voice score (QVS) evaluated with an 11-point visual analogue scale.

The Speech Audiometry in Quiet and in Noise (WRS) was performed in three settings.

1. in quiet, speech level 50 dBHL
2. in pink noise at 40 dBHL, speech level 50 dBHL, SNR+10dB
3. in babble noise at 40 dBHL, speech level 50 dBHL, SNR+10dB

Both WRS and QVS were performed for three types of amplification.

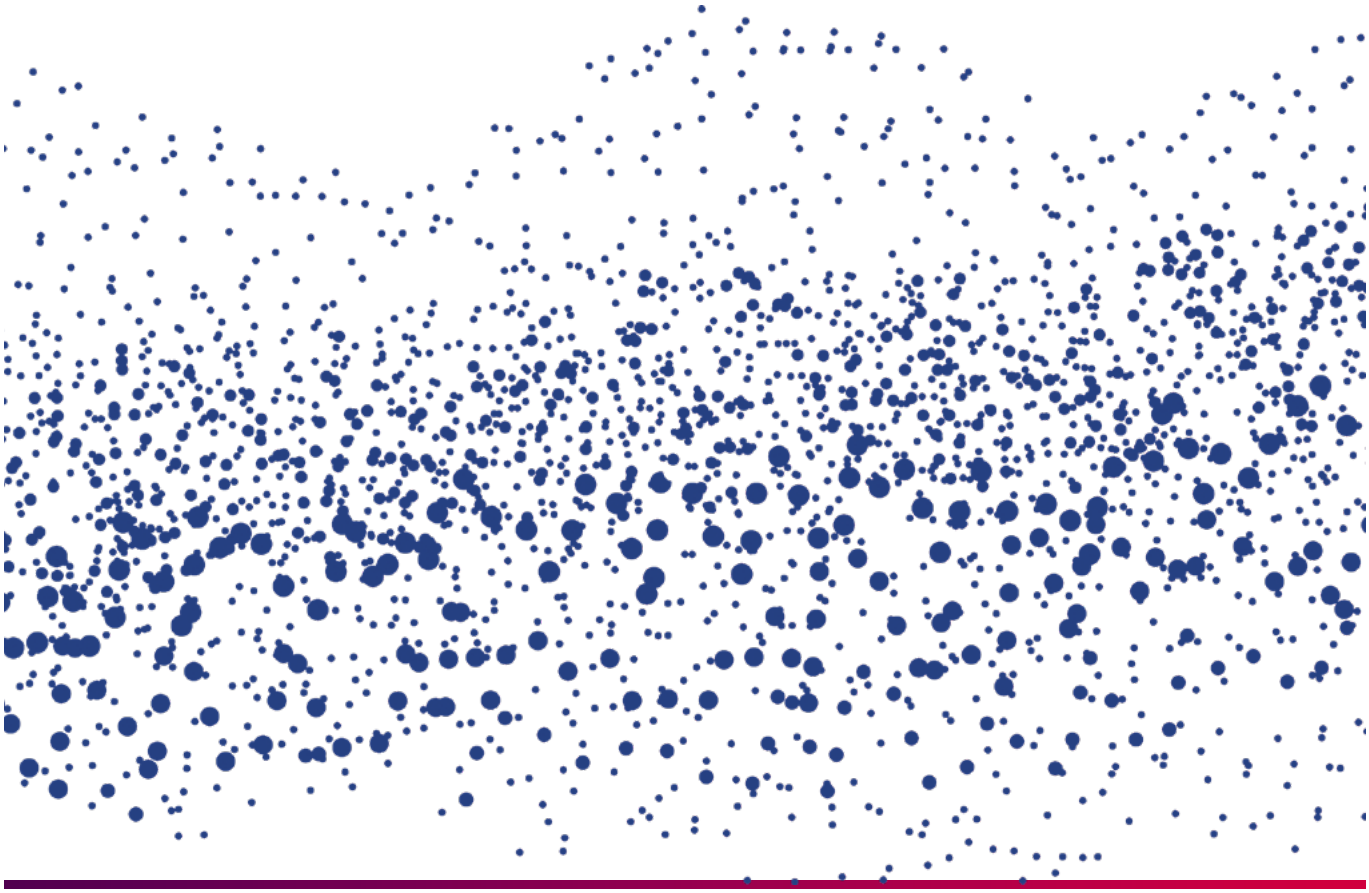
1. No frequency lowering
2. High Transposition (HT) – The default setting by the fitting software
3. Low Transposition (LT) – The start frequency at the lowest possible level

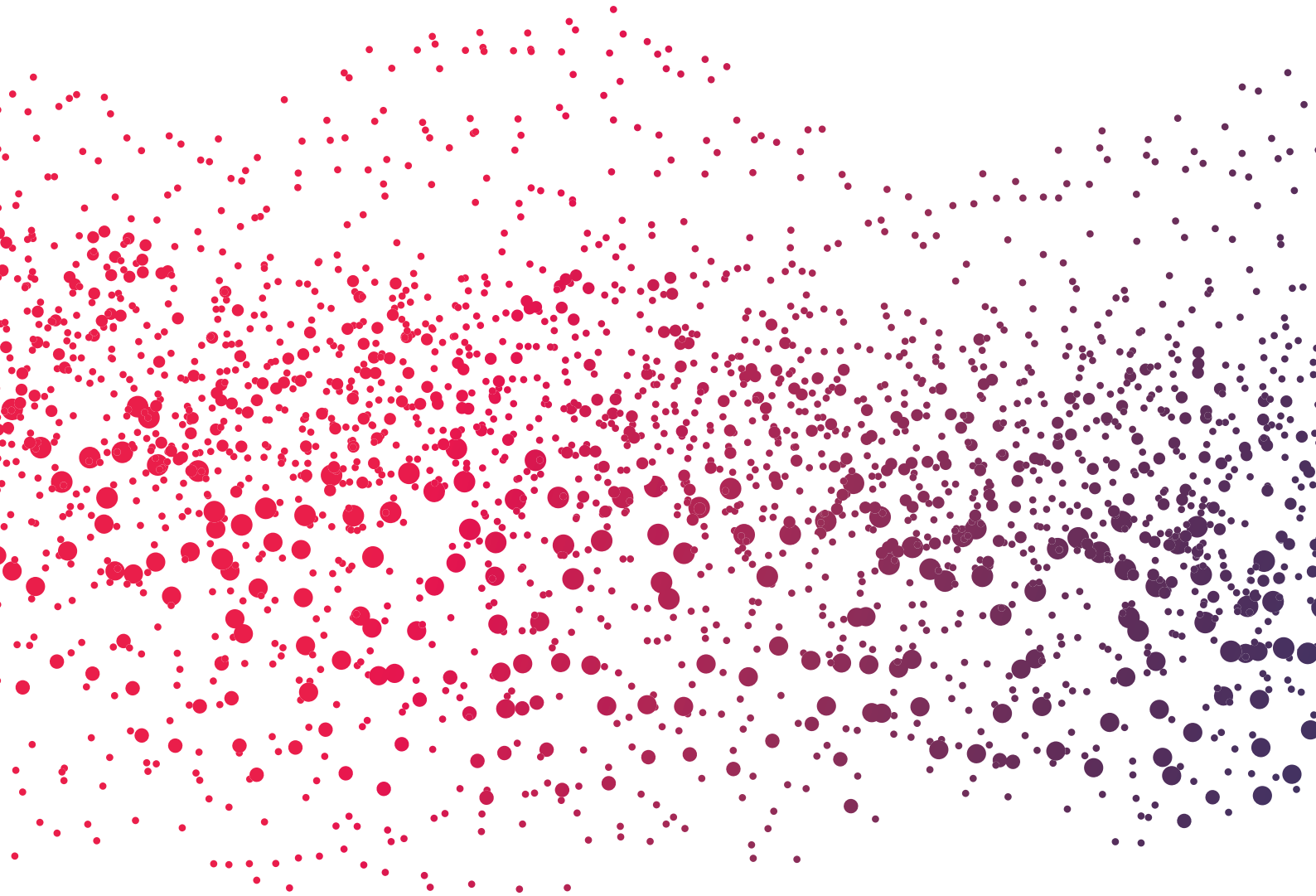
RESULTS:

The authors were not able to detect a statistically significant difference between the several positions in both tests (WRS & QVS) and concluded that in this study, frequency lowering is not useful for improving speech understanding in noise.

They did, however, find two groups who had significant differences in test results when babble noise was used. The 33 patients displaying the largest difference were set off against 44 patients who did not seem to experience any gain from the lower frequency transposition. The authors found an age-related difference between these groups, indicating that the younger the person, the better the chance of a positive reaction on the frequency-lowering algorithm.

The researchers recommend trying the three types of amplification in three different programmes so the users can decide for themselves in their natural listening environment. •





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