14th Tinnitus Research Initiative Conference

JUNE 10 – 12, 2024

UBC ROBSON SQUARE

VANCOUVER, CANADA

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Dr Sylvie Hébert, University of Montreal

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Dr Victoria Duda, University of Montreal

Dr Philippe Fournier, University of Laval

Dr Arnaud Norena, Aux University France

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Ms Carol Lau

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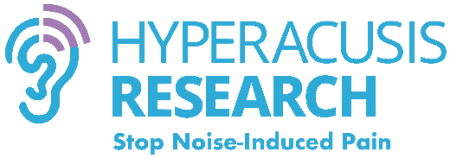


KEYNOTE SPEAKERS

Pawel J. Jastreboff, Ph.D., Sc.D., M.B.A., is currently Professor Emeritus at Department of Otolaryngology, Emory University School of Medicine, and Visiting Professor sine die at University College London, London, UK. He is Founder and CEO of Jastreboff Hearing Disorders Foundation, Inc., where he continues his research on tinnitus and decreased sound tolerance (DST) and provides clinical services to patients with a variety of hearing disorders. He continues to be involved in teaching professionals, including providing intensive courses on Management of Tinnitus and Decreased Sound Tolerance with Tinnitus Retraining Therapy (TRT) and has thus far offered more than 50 courses in the U.S.A. and over 90 internationally.

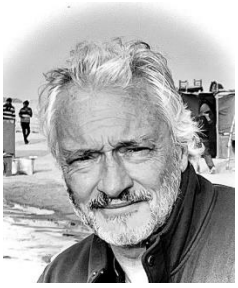
Dr. Jastreboff received a Ph.D. in Neurophysiology and Doctor of Sciences Degree (habilitation) in Neuroscience from the Polish Academy of Sciences. He did his Postdoctoral training at the University of Tokyo, Japan. He received an M.B.A. from Goizueta Business School at Emory University. He has been a Visiting Professor at University of Tokyo and at Yale University and Adjunct Professor at Salus University teaching tinnitus and hyperacusis class in the Au.D. program. He is a co-author of over 140 papers, 180 abstracts and three books. In 1993 he received the prestigious Robert W. Hocks award for his contribution to the field of tinnitus and in 2014, at 11th International Tinnitus Seminar the Award for Clinical Excellence, for 25 years work of TRT.

Dr. Jastreboff is recognized for his development of the first accepted animal model of tinnitus, the neurophysiological model of tinnitus and based on its clinical method of tinnitus and DST treatment, known as TRT. Furthermore, collaborating closely with his wife and colleague, Dr. Margaret M. Jastreboff, Ph.D., he proposed a concept, name, and treatment for specific a version of DST - misophonia - when patients exhibit negative reactions to specific for a given patient's patterns of sound.

Richard Tyler graduated as one of the first clinical audiologists in Canada at The University of Western Ontario. He completed a Ph.D. in Psychoacoustics at The University of Iowa and followed that with three years at the Medical Research Council in England. Dr. Tyler then returned to the University of Iowa as a faculty member in both the Department of Otolaryngology Head and Neck Surgery and in the Department of Communication Sciences and Disorders. His research contributions in audiology, cochlear implants, tinnitus, and hyperacusis are recognized the world-over.

His scientific work includes the quantification of tinnitus, necessary for its investigation, as well as the investigation of different treatments. Dr. Tyler sees tinnitus patients weekly and hosts an international conference on the management of tinnitus and hyperacusis patients to educate clinicians on cutting-edge evaluation and management strategies. He has edited The Tinnitus Handbook (2000), Tinnitus Treatments: Clinical Protocols Tyler, R.S. (Ed.). (2006), and The Consumer Handbook on Tinnitus (2008, 2016).

Sylvie Hébert is Professor and Program director of Audiology at Université de Montréal, where she teaches evidence-based practice in audiology and specialized courses on tinnitus and hyperacusis. She is a member of the BRAMS (International Laboratory for research on Brain, Music, and Sound) and of the Center of Research on Brain, Language, and Music (CRBLM). Her research expertise includes auditory and non-auditory factors involved in loudness perception, tinnitus and hyperacusis, and objective measures of tinnitus. *Dr Hébert who serves as Scientific Chair for the TRI-2024 Conference.*



Dirk De Ridder, MD, PhD, is professor of Neurosurgery at the Dunedin School of Medicine, University of Otago in New Zealand and co-runs a private neuromodulation clinic in Belgium. He is also associated with Manipal University in India, Trinity College in Dublin, and teaches at the University of Bonn in Germany.
His research is based on 2 pillars: 1. Network science, in which any symptom is the emergent property of a changed network, and 2. the Bayesian brain concept, i.e. considering the brain as a predictive machine that updates its predictions by active exploration of the environment through the senses, as a way to reduce the inherent uncertainty in a changing environment. Phantom percepts are seen as a maladaptive network phenomenon due to deficient updating resultant from sensory deafferentation.

His main research interest is the understanding and treatment of phantom perceptions (tinnitus, pain), especially by use of functional imaging navigated non-invasive (TMS, tDCS, tACS, tRNS, LORETA neurofeedback) and invasive (implants) neuromodulation techniques.

The approach to unravel phantom percepts is by developing an understanding of commonalities in different diseases such as in thalamocortical dysrhythmias (pain, tinnitus, Parkinson disease, depression, slow wave epilepsy) and reward deficiency syndromes (addiction, OCD, Personality disorders, ...)
He has developed “burst” and “noise” stimulation as novel stimulation designs for implants, and is currently working on multifocal or network stimulation, as well as reconditioning stimulation.

He has written more than 50 book chapters and more than 320 pubmed listed journal articles. This has resulted in a Google Scholar H-index of 80, with more than 26,000 citations and an i10 index of 288.

SYMPOSIA CHAIRS

Fatima T. Husain is an auditory cognitive neuroscientist by training and a Professor at the University of Illinois Urbana-Champaign, USA, where she is affiliated with the Department of Speech and Hearing Science, the Neuroscience Program, and the Beckman Institute for Advanced Science and Technology. She also presently serves as the Associate Dean for Diversity, Equity, and Inclusion in the College of Applied Health Sciences. Dr. Husain uses behavioral studies, advanced brain imaging, and computational modeling to better understand brain function as related to all aspects of hearing.

Emily E. McMahan is an audiologist and the owner of Alaska Hearing & Tinnitus Center in Anchorage. In addition to her physical practices in Alaska she serves high needs tinnitus patients via Telehealth and in-person field clinics across the United States. She holds multi-state licensure in order to help patients receive access to care closer to home. She is passionate about tinnitus patient care, audiology, and best practices. She dedicates a considerable amount of time to educating audiologists on evidence-based tinnitus care and how to establish a tinnitus clinic. Dr. McMahan earned her Doctorate in Audiology and graduated from Salus University.

Hazel Goedhart received her Bachelor's degree in Geology and Master's degree in Political Science, both from the Free University of Amsterdam. She started her career in the non-profit sector working on human rights and sustainability issues. In 2018, Hazel developed tinnitus, and struggled for months to find a way to cope with a condition that can be debilitating for some. She started volunteering for Tinnitus Hub, a non-profit patient organization that aims to improve the lives of people suffering from tinnitus. She currently manages Tinnitus Hub – in a volunteer capacity, next to her day job — together with Markku Vesala, the founder.

Her volunteer work for Tinnitus Hub has made Hazel passionate about representing the voice of the patient, empowering people with tinnitus through education, influencing the medical community to take tinnitus more seriously, and advocating for more cure focused tinnitus research. She strongly believes in the power of online communities to affect change.

Sarah Michiels is Assistant Professor in Musculoskeletal Rehabilitation at REVAL Rehabilitation Research Center of Hasselt University. After graduating as a Master in Physiotherapy in 2005 she obtained an additional Master in Manual Therapy at the Free University of Brussels. After working fulltime as a physiotherapist in her private practice for four years, Sarah started teaching physiotherapy students in 2009, at the University of Antwerp. After successfully completing her PhD, studying neck-related tinnitus complaints, in 2015, she continued studying somatic tinnitus, now focusing on temporomandibular-related tinnitus complaints. In 2020 she joined the Faculty of Rehabilitation Sciences and Physiotherapy of Hasselt University as Assistant Professor, teaching physiotherapy students and continuing her research on tinnitus complaints and other head and neck-related conditions.

In the meantime, she also continues her clinical work in the multidisciplinary tinnitus team of the Antwerp University Hospital, where she is responsible for diagnostic assessment and treatment of patients with somatic tinnitus and other neck or jaw-related ENT complaints.

ROUND TABLE FACILITATORS

Philippe Fournier, Assistant Professor, Faculty of Medicine, Department of Rehabilitation, Audiology / Laval University. Trained as an audiologist, his research focuses on various auditory pathologies, including tinnitus, hyperacusis, misophonia and acoustic shock syndrome. His research aims to better understand the pathophysiological mechanisms responsible for the onset of these different auditory pathologies, to develop new diagnostic measures and to improve the management of his patients through the implementation of innovative therapies.

Arnaud Norena, Professor, Professor in Aix-Marseille Université, France. I am working on both humans and animals. My work focuses on trying to understand the mechanisms of "normal" audiitory perception and the auditory perception disorders such as tinnitus, hyperacusis and misophonia.

MONDAY, JUNE 10th

8:00AM	**THEATRE FOYER**	**REGISTRATION OPENS**
8:30AM	**THEATRE**	**WELCOME + OPENING REMARKS** **Local Organizer:** Carol Lau **TRI Chair:** Berthold Langguth **Scientific Chair:** Sylvie Hébert
9:00AM	**THEATRE** **01**	**THE AAGE MøLLER DISTINGUISHED LECTURE ON TINNITUS** **WHERE ARE WE NOW? WHERE ARE WE GOING?** **Moderators:** Sven Vanneste, Carol Lau **Speaker:** Pawel Jastreboff, Professor Emeritus at Department of Otolaryngology, Emory University School of Medicine, and Visiting Professor *sine die* at University College London, London, UK.
10:00AM	**THEATRE FOYER**	**BREAK**
10:30AM	**THEATRE**	**SYMPOSIUM: SOUND TOLERANCE DISORDERS AND TINNITUS: INVESTIGATING HYPERACUSIS AND MISOPHONIA** **Chair:** Fatima Husain, University of Illinois Urbana-Champaign, United States **Speakers:** **02** • Julia Campbell, University of Texas at Austin, Texas, USA - T*he hyperacusis versus misophonia controversy* **03** • Fatima Husain, University of Illinois Urbana-Champaign, USA - *Electrophysiological measures of hyperacusis, misophonia and tinnitus* **04** • Arnaud Norena, Aix-Marseille University, France - *The putative neural mechanisms of noise-induced tinnitus and hyperacusis studied in guinea pigs* **05** • David Eddins, University of Central Florida, USA - *A transitional treatment for hyperacusis* **06** • Phillippe Fournier, *Hyperacusis and associated symptoms among conference interpreters*
10:30AM	**C400/420**	**ORAL PAPERS: ANIMAL RESEARCH** **Moderator:** Alex Galzyuk **07** Chun-Jen Hsiao, Alexander Galazyuk, *Depolarization shift in the resting membrane potential underlies hyperactivity of inferior colliculus neurons induced by an acoustic trauma.* **08** Jinsheng Zhang, Po Hung Chiang, Paul Morse, Tasnim Arroum, Maik Huttemann, *Near-Infrared (NIR) Light Treatment of Tinnitus*
12:00	**THEATRE FOYER**	**LUNCH**
1PM	**THEATRE**	**SYMPOSIUM: REAL WORLD EVIDENCE FOR MULTIMODAL TREATMENT APPROACHES FOR TINNITUS** **Chair:** Emily McMahan, Alaska Hearing and Tinnitus Center **Speakers:** **09** • Sven Vanneste, Trinity College Institute for Neuroscience, & School of Psychology, Trinity College Dublin, Ireland - *Exploring Transcutaneous Stimulation of Peripheral Nerves as a Source of Transcranial Electrical Stimulation Effects*

		10	• Emily McMahan, Founder of Alaska Hearing and Tinnitus Center - *A Hybrid Approach to Tinnitus Care: Utilizing Bimodal Neuromodulation*
		11	• Craig Kasper, Founder and Managing Director of New York Hearing Doctors – Institute for Hearing and Balance, New York, U.S.A and Brian Fligor – Co-Founder and Clinical Strategic Advisor at Lantos Technologies. President and Owner of Tobias and Battite Inc, Boston, Massachusetts, U.S.A. - *Bimodal Neuromodulation for the Treatment of Tinnitus: Real-World Clinical Outcomes & Outliers*
		12	• Stefan Schoisswohl, Universität der Bundeswehr München, Munich, Germany - *The Effects of Combining Transcranial Magnetic Stimulation with Auditory Stimulation on Tinnitus Symptoms*
		13	• Milena Engelke, Universitätsklinikum Regensburg, Germany - *Collecting real world evidence on tinnitus symptom dynamics through Ecological Momentary Assessment*
1:00PM	**C400/C420**		**WORKSHOP: REMOTE COUNSELLING AND TELECARE IN TINNITUS**
		14	**Presenter:** Dr Richard Tyler, Professor, Dept Otolaryngology and Head and Neck Surgery, and Communication Sciences and Disorders, The University of Iowa
1:30PM	**C400/C420**		**WORKSHOP: OVERCOMING ROADBLOCKS IN PRIVATE PRACTICE?**
		15	**Presenter:** Carol Lau, Private Practice Audiologist, Sound idEARS inc.
2:00PM	**C400/C420**		**SPONSOR SESSION: HYPERACUSIS RESEARCH, LIMITED**
		16	**Speaker:** Steven Barad, M.D., Director, Hyperacusis Research, Limited
3:00	**THEATRE FOYER**		**BREAK**
3:30PM	**THEATRE**		**ORAL PAPERS: SOUND THERAPY** **Chair:** Dr James Henry
		17	Min Young Kwak, Seung Yeon Jeo, Jung Ho Choi, Sun Seong Kang, Yong-Hwi An, Hyun Joon Shim, *Personalized Neuromodulation: A Novel Strategy for Improving Tinnitus Treatment*
		18	Anne W. Wendrich, Kelly K.S. Assouly, Jan A. A. van Heteren, Jeroen P. M. Peters, Wilko Grolman, Robert J. Stokroos, Huib Versnel, Diane L. Smit, *Effect of cochlear implant, bone conduction device and contralateral routing of sound hearing aid on tinnitus in SS*D
		19	Jose Lopez Santacruz, Emile de Kleine, Pim van Dijk, *Hearing aid amplification schemes adjusted to tinnitus pitch: an RCT*
		20	Nina Wunder, Winfried Schlee, *Sex effects in sound therapy for tinnitus*
		21	Dongmei Tang, Yunfeng Wang, Shan Sun, Huawei Li, *Effect of modified tinnitus relieving sound (MTRS) for tinnitus treatment - a multicenter randomized clinical trial*
3:30PM	**C440**	22	Jeon Mi Lee, Hyun Jin Lee, Gilmoon Lee and Jae-jin Song, *Auditory experience, for a certain duration, is a prerequisite for tinnitus*
		23	Ho Yun Lee, Seung-Ho Shin, *Exploring the Origins of Decreased Sound Tolerance in Tinnitus Patients*
		24	Sang Hoon Kim, *Association between tinnitus and inflammatory bowel disease: A national cohort study*
		25	Jiwon Kwak, Soo Jeong Choi, Jiwon Chang, Gi Jung Im, Euyhyun Park, *Is Zinc Deficiency a Risk Factor for Tinnitus? : An Analysis from Chronic Idiopathic Tinnitus Patients with Normal Hearing*
		26	Jae Sang Han, Minho Lee, Hyeon-Chun Park, So Young Park, Yeun-Jun Chung, Shi Nae Park, *Identification of SNPs Associated with Chronic Sensorineural Tinnitus in the Korean Population*

	27	Sneha Uttakalika[1], Manya Fangaria, Ashwini Tidole[2], Kamalakannan Karupaiah[3], Prashanth Prabhu, P*revalence of somatosensory tinnitus in individuals with tinnitus*
	28	Sneha Uttakalika, Diya ES Dinesh, Abhishek Jain, Kajal Bhatiwal, Suman Penwal, *Prevalence of hyperacusis and misophonia among individuals with tinnitus*
	29	June Choi, Hong Jin Kim, Ye Hwan Lee, Young Han Chung, Kang Hyeon Lim, Sang Yeop Kim, Yong Jun Jeong, *Analysis of auditory brain stem response and otoacoustic emission in unilateral tinnitus patients with normal hearing*
	30	Fournier, P., Valentin, O., Z., Walsh, Z., Zendel, B.R. & Lehmann, A., *Association between cannabis and tinnitus: could loud music listening under cannabis influence be the missing link?*
	31	Cosima F. Lukas, Paul Wilknitz, Prof. Dr. Orlando Guntinas-Lichius, Dr. Daniela Ivansic, Prof. Dr. Christian Dobel, Prof. Dr. Manuela Nowotny, *Occupational noise exposure: Early audiological and physiological signs of noise-induced hearing loss and mental health outcomes*.
	32	Kritika Nayyar, Sweety Chauhan, Neha Surkund, Swaham Mohanty, Kajal Bhatiwal, Suman Penwal, Kamalakannan Karupaiah, Prashanth Prabhu, *Prevalence of misokinesia and misophonia among adult population in India*
	33	Anusha Yasoda-Mohan, Katy Tobin, Iracema Leroi, Brian Lawlor & Sven Vanneste, *Investigating the longitudinal relationship between tinnitus and cognitive decline*.
6:00PM	**HYATT REGENCY HOTEL**	**TRI NETWORKING DINNER**

TUESDAY, JUNE 11th

8:00AM	**THEATRE** **34**	**OPENING SESSION: MEASURING TINNITUS IN THE CLINIC AND FOR RESEARCH** **Introduction:** Sylvie Hébert **Speaker:** Richard S. Tyler, Ph.D., Department of Otolaryngology-Head and Neck Surgery and Communication Sciences and Disorders, Iowa City, IA, The University of Iowa
9:00AM	**THEATRE** **35**	**ROUND TABLE: HYPERACUSIS AND OTHER SOUND TOLERANCE DISORDERS** **Moderator:** Philippe Fournier **Panel:** Myriam Westcott, Fatima Husain, Julia Campbell, David Eddins, Sylvie Hebert
9:00AM	**C400/C420** **36** **37** **38** **39**	**ORAL PAPERS: BIOMARKERS OF TINNITUS** **Moderator:** Anusha Yasoda-Mohan Bérangère Villatte, Alain Vinet, Sayeed Devraj-Kizuk, Sylvie Hébert, *A study on electrodermal activity under acute stress and noise exposure in tinnitus individuals* Kurt Steinmetzger, Benjamin Boecking, Petra Brueggemann, Laura Basso, Matthias Rose, Birgit Mazurek, Eva M. J. Peters, *Angiotensin II and -(1–7) concentrations in human hair samples reflect the degree of tinnitus-related distress* Licia Sayuri Tanaka, Luciana Lozza de Moraes Marchior, Daiane de Almeida Soares Ciquinato, Denilson deCastro Teixeira, Glória de Moraes Marchiori, Braulio Henrique Magnani Branco, Regina Célia Poli-Frederico, *Comparative study of Tumor Necrosis Factor Alfa (TNF-α) and impact of Tinnitus on the quality of life of older adults* Shagun Ajmera, Ivan Abraham, Fatima Husain, *Harmonizing resting state functional MRI data to find markers of tinnitus in brain connectivity using deep learning*
3:00	**THEATRE FOYER**	**BREAK**
10:30AM	**THEATRE** **40** **41** **42** **43** **44**	**SYMPOSIUM: HOW SHOULD WE MEASURE THE SUCCESS OF TINNITUS TRIALS AND INTERVENTIONS?** **Chair:** Hazel Goedhart, Tinnitus Hub, The Netherlands **Speakers:** • Hazel Goedhart, Tinnitus Hub, the Netherlands - *Outcome measures that tinnitus patients care about* • Inge Stegeman, University of Utrecht, The Netherlands - *Outcome measures in tinnitus research: the methodological perspective* • Diane Smit, University of Utrecht, The Netherlands - *Tinnitus outcome measure; what it brought us, where it leaves us in tinnitus care*. • Joel Berger, University of Iowa, USA - *The potential for objective testing of tinnitus in humans*. • Laura Basso, University Hospital Regensburg, Germany - *The 83 Symptoms of Tinnitus: Content Overlap of Commonly Used Scales for Tinnitus Distress*
10:30AM	**C440** **45**	**ORAL PAPERS: HETEROGENIETY OF TINNITUS** **Moderator:** Birgit Mazurek Mie Lærkegård Jørgensen,Torsten Dau, *Tinnitus subgroups based on supra-threshold hearing characteristics*

		46	Tanit Sanchez, *Long term total remission of tinnitus: fact or myth?*
		47	Gianfranco Velasco, Hyun Jae Cho, Young Jun Seo, Ji Hyung Lim, Jae Sang Han, Jae Hyun Seo, Shi Nae Park, *The Size Analysis of Stapedius and Tensor Tympani Muscles in CT scan in Patients with Middle Ear Myoclonic Tinnitus*
		48	Cosima F. Lukas, Daniela Ivansic, Gerlind Schneider, Orlando Guntinas-Lichius, Christian Dobel, *Short and sweet: Long-lasting therapy success after interdisciplinary tinnitus treatment - a 5-year follow-up study*
		49	Phil Gander, *What is the role of the hippocampus and parahippocampal gyrus in the persistence of tinnitus?*
10:30AM	**C400/C420**		**ORAL PAPERS: PULSATILE TINNITUS** **Moderator:** Jae-Jin Song
		50	Nicole M. Cancelliere, Gurnish Sidora, Zainab Hussain, David Steinman, Vitor Mendes Pereira, *Utilization of Transcanal Recordings for Objectification of Pulsatile Tinnitus*
		51	Gurnish Sidora, Nicole Cancelliere, Anna Haley, Vitor Mendes Pereira, David Steinman, *Understanding the Sound Production Mechanism of Pulsatile Tinnitus Using Computational Fluid Dynamics*
		52	Jae-Hyun Seo, Jae Sang Han, Shi Nae Park, *The Application of Distortion Product Otoacoustic Emission for the objective measurement of Vascular Pulsatile Tinnitus*
		53	Dave Korotkov*, Living with Pulsatile Tinnitus: A Self-Narrative Using McAdam's Levels of Personality Model*
		54	Yoonjai Lee, Won Jun Noh, Jae-Jin Song, *Forest for the Trees: Preliminary results of novel sigmoid sinus resurfacing in subjects with sigmoid sinus dehiscence and adjacent broad-based diverticulum*
12:00pm	**THEATRE FOYER**		**LUNCH**
1:00PM	**THEATRE**		**AFTERNOON SESSION: WAR ON TINNITUS** **Introduction:** Berthold Langguth
		55	**Speaker:** Dr Dirk de Ridder, Professor of Neurosurgery at the Dunedin School of Medicine, University of Otago in New Zealand and co-runs a private neuromodulation clinic in Belgium
2:00PM	**THEATRE**		**ORAL PAPERS: HYPERACUSIS** **Moderator:** Grant Searchfield
		56	Charlotte Bigras, Victoria Duda, Sylvie Hébert, *Exploring the Multidimensional Nature of Loudness Perception*
		57	Namitha Jain, Shagun Ajmera, Gibbeum Kim, Howard Berenbaum, Fatima T Husain, *Auditory Emotion Processing in Hyperacusis and Misophonia: A Comprehensive Behavioral and fMRI Study*
		58	Philippe Fournier, Pierre Bourez, Claudia Côté, Arnaud J. Noreña, L*oudness and affective responses to natural sounds in hyperacusis*
		59	Pierre Bourez, Guillaume T. Vallet, Nathalie Gosselin, François Bergeron, Philippe Fournier, *Experimentally measuring the functional impact of noisy environments on individuals with and without hyperacusis*
2:00PM	**C400/C420**		**WORKSHOP: CONTRIBUTION OF MIDDLE EAR AND MULTIMODAL PLASTICITY TO TINNITUS AND HYPERACUSIS.**
		60	**Speaker:** Dr Arnaud Norena, Aix-Marseille University, France; Ms Myrian Westcott, DWM Audiology
3:00PM	**THEATRE FOYER**		**BREAK**
3:30PM	**THEATRE**		**ORAL PAPERS: NEW IDEAS IN TINNITUS**

		Chair: Winfried Schlee
	61	Grant D Searchfield, *There is where I hear tinnitus.*
	62	Mehdi Abouzari, Hamid R. Djalilian, *Migraine Enhances Tinnitus Perception Leading to Loud Tinnitus*
	63	Jen-Tsung Lai, *Cochlear Migraine: A new concept to treat tinnitus*
	64	Wrzosek, M, Gil, M.,Klemens, W., Puzio, A., Józefowicz-Korczyńska, M., *Relation between dominant time perspectives and tinnitus annoyance*
	65	Inge Stegeman, *Prediction models in tinnitus research: how we do it, and what we need to create impact*
	66	Benjamin Boecking, Kurt Steinmetzger, Birgit Mazurek, *A schema mode-model approach for understanding chronic tinnitus-related distress*
3:30PM	**C440**	
	67	Ho Yun Lee, Seung-Ho Shin, Oak-Sung Choo, Jae Yong Byun, Jae Ho Chung, *Analysis of Loudness Discomfort Level Tests in Tinnitus Patients*
	68	Dave Korotkov, *Tinnitus Distress and the Steeling/Sensitization Hypotheses: A Secondary Data Analysis*
	69	Andréia Aparecida de Azevedo, Ricardo Rodrigues Figueiredo, Eliana Ferreira Vilela, Jeanne Oiticica, *Correlation between tinnitus severity and the big five personality traits*
	70	Sung Il Cho, Mohammad Mokhatrish, Wonyong Baek, Gi-Sung Nam, *Tinnitus characteristics in patients with idiopathic sudden sensorineural hearing loss and acute tinnitus*
	71	Min Young Kwak, Yong Tae Cho, Yong-Hwi An, Hyun Joon Shim, *Relation of Sound Level Tolerance to Tinnitus in Human: A Comparative Analysis of Unilateral, Bilateral, and Control Groups*
	72	Bourez, P.H. Vallet, Guillaume, T., Fournier, P., *Improving audiology student training by clinical simulation of tinnitus: a glimpse of tinnitus lived experience*
	73	Denise Fuchten, Kelly K.S. Assouly, Inge Stegeman, Diane L. Smit, *An ICF based content analysis of the overlap between tinnitus and depression questionnaires*
	74	Lieber Po-Hung Li, Cheng-Ta Li, Jen-Chuen Hsieh, *Steady-state auditory evoked fields reflect long-term effects of repetitive transcranial magnetic stimulation in tinnitus*
	75	Glória de Moraes Marchiori, Licia Sayuri Tanaka, Victor Augusto Santos Perli, Luciana Lozza de Moraes Marchiori, Braulio Henrique Magnani Branco, *Comparative study of olfactory and otoneurological symptoms among people post COVID-19*
	76	Luciana Lozza de Moraes Marchiori, Licia Sayuri Tanaka, Daiane de Almeida Soares Ciquinato, Glória de Moraes Marchiori, Braulio Henrique Magnani Branco, *Analysis between subjective sleep quality and level of intensity of the tinnitus in people post COVID-19*
	77	Shi Nae Park, Min Chae Jeon, Chan Mee Lee, Jae Sang Han, Jae Hyng Seo, *Clinical Management of Myoclonic Tinnitus for A Cure: From Botox Injection to Surgery*
	78	Kyu-Yup Lee, Da-Jung Jung,Sang-Heun Lee, *Study on protective effect of novel chemical compound against acquired hearing loss*
	79	Khodayar Goshtasbi, Mehdi Abouzari, Pooya Khosravi, Adwight Risbud, Elaine C. Martin, Hamid R. Djalilian, *Smartphone-Based Cognitive Behavioral Therapy and Customized Sound Therapy for Tinnitus: A Randomized Controlled Trial*
5:30PM	**HSBC HALL**	**MEET-THE-EXPERTS MIXER** **Organizer: Anusha Mohan, TRI Academy**

WEDNESDAY, JUNE 12th

8:00AM	**THEATRE** **80**	**OPENING SESSION: TINNITUS AND THE STRESS FACTOR** **Introduction:** Victoria Duda **Speaker:** Sylvie Hébert, Professor and Program Director of Audiology, Université de Montréal
9:00AM	**C400/C420** **81** **82**	**ORAL PAPERS: ELECTROPHYSIOLOGY** **Chair:** Victoria Duda Victoria Duda, Brandon Paul, Boutheina Jemel, Sylvie Hébert, *Cortical Responses to Tinnitus-Like Stimuli: Electrophysiological Insights* Emilie Cardon, Fien Aben, Laure Jacquemin, Vincent Van Rompaey, Marc J.W. Lammers, Olivier M.Vanderveken, Annick Gilles, *P300 latency correlates with subjective tinnitus severity on a between-subject and within-subject basis*
9:30AM	**C400/C420** **83** **84**	**ORAL PAPERS: EPIDEMIOLOGY** **Chair:** Victoria Duda Hobeika, L, M.Roy, M. Fillingim, A.Londero, E.Vachon-Presseau, S.Samson, *Socio-demographic, psychological, and health factors in tinnitus: predictors of awareness and distress across nine years* Denise Fuchten, Inge Stegeman, Yinan Mao, Robert H. Eikelboom, Diane L. Smit, *Risk factors for the development of tinnitus and change of impact – Results from the Busselton Healthy Ageing Study*
9:00AM	**C400/C420** **85**	**WORKSHOP: MISOPHONIA AND TINNITUS** **Speaker:** Margaret Jastreboff, Jastreboff Hearing Disorders Foundation
9:30AM	**C400/C420** **86**	**SPONSOR: NEOSENSORY – RESEARCH AND CLINICAL PROTOCOLS** **Speaker:** Allison Treseder (Aud), Head of Partnerships, Neosensory inc.
10:00	**THEATRE FOYER**	**BREAK**
10:30AM	**THEATRE** **87** **88** **89** **90** **91**	**SYMPOSIUM: TINNITUS AND PHYSICAL LINKS** **Chair:** Sarah Michiels, Hasselt University, Belgium **Speakers:** • Robin Guillard, University of Grenoble Alpes, France - *Tinnitus, dreams and awakening: new insights and theoretical implications* • Antonios Chalimourdas, Hasselt University, Belgium - *Can Physical Activity Decrease the Tinnitus Severity? -A Longitudinal Observational Study* • Sara Demoen, Hasselt University, Belgium - *Health-related Quality of life in patients with somatic tinnitus: A cross sectional study* • Annemarie van der Wal, ACTA Academic Center for Dentistry, Amsterdam, The Netherlands - *The effect of orofacial treatment on tinnitus complaints in patients with somatosensory tinnitus* • Tanit Ganz Sanchez, University of Sao Paulo, ENT Department, School of Medicine, Brazil - *Somatosensory tinnitus: who gets total remission?*
10:30AM	**C400/C420** **92**	**SPONSOR SESSION: NAVIGATING OTICON'S TINNITUS SOUND SUPPORT IN GENIE 2.0 – A STEP-BY-STEP GUIDE WITH A REVIEW OF CLINICIAN AND PATIENT RESOURCES, INCLUDING THE NEW OTICON COMPANION APP.**

		Speaker: Lia Best Au.D., R.AUD, R.HIP. Aud(C), Audiology Field Trainer Oticon Canada
11:00AM	**C400/C420** **93**	**SPONSOR SESSION: LENIRE TINNITUS TREATMENT REAL WORLD SUCCESS** **Speaker:** Tish Ramirez, Au.D., Global CommercializatIon Officer, Neuromod USA
11:30AM	**C400/C420** **94**	**SPONSOR SESSION: SCIENTIFIC AND CLINICAL IMPACT OF THE AMERICAN TINNITUS ASSOCIATION'S MISSION TO TRANSFORM TINNITUS PATIENT OUTCOMES** **Speaker:** Jinsheng Zhang and Patrick Lynch, ATA
12:00PM	**THEATRE FOYER**	**LUNCH**
1:00	**THEATRE**	**TRI ASSEMBLY** **Chair:** Berthold Langguth and TRI Board
2:00PM	**THEATRE** **95** **96** **97**	**ORAL PAPERS: CLINICAL APPLICATIONS** **Chair:** Grace Shyng (Aud) Pete Vernezze, *The effectiveness of a 6-week live, online mindfulness-based intervention for tinnitus distress* Diane L Smit, *Comparison of clinical practice guidelines regarding treatment recommendations for chronic tinnitus in adults* Gianfranco C. Velasco, MD; Jaclyn Leigh E. Vidal, MD; Min Chae Jun, MD; Chan Mee Lee, MD; Jae Sang Han, MD, PhD; Jae Hyun Seo, MD, PhD; Shi Nae Park, MD, *Clinical Characteristics of Cured Sensorineural Tinnitus Patients After Tinnitus Retraining Therapy - A Large Case Series*
2:00PM	**C400/C420** **98** **99** **100**	**ORAL PAPERS: REMOTE CARE** **Chair:** Sandra Baker (Aud) Grace Conchas, Yezihalem Mesfin, Abigail Heiller, Yuan He, Ali Stockness, Hubert H.Lim, Meredith E. Adams, Peggy Nelson, *Pilot Tinnitus Study Investigating Bimodal Neuromodulation with Virtual Sessions and Additional User-Controlled Settings* Ann Perreau, Richard Tyler - *Acceptability and Effectiveness of Remote Counseling for Tinnitus* Jason Zhang, Pranavi Sammidi, Brandon Nie, Bryan Nie, Kaibao Nie, *Development and Testing of Online Sound Therapy Platform*
3:00PM	**THEATRE FOYER**	**BREAK**
3:30PM	**THEATRE** **101**	**ROUND TABLE: HETEROGENIETY OF TINNITUS** **Facilitator:** Arnaud Norena **Panel Members:** Berthold Langguth, Pawel Jastreboff, Richard Tyler, Sylvie Hébert, Tanit Sanchez
3:30PM	**THEATRE** **102** **103** **104** **105**	**ORAL PAPERS: TINNITUS AND COGNITION** **Chair:** Emilie Cardon Max Scheepers, Elke Devocht, Erwin George, *Assessing Listening Effort in disRuptive Tinnitus (the ALERT study)* Sarah Van Genuchten, Annick Gilles, Griet Mertens, Ellen Andries, Emilie Cardon, Vincent VanRompaey, Marc J.W. Lammers, Olivier M. Vanderveken, Laure Jacquemin, *Tinnitus suppression by means of cochlear implantation: does it affect cognition?* Patrick Neff, Nick Sommerhalder, Zbynek Bureš, Oliver Profant, Tobias Kleinjung, Martin Meyer, *Speech Comprehension and Executive Dysfunction in Tinnitus* Lise Hobeika, Anna Skrzatek, Sophie Dupont, Alain Londero, Séverine Samson, *A comprehensive evaluation of attentional and executive functions deficits linked to tinnitus*

4:30PM	**THEATRE**	**AWARD PRESENTATION** **Presenter:** Sylvie Hébert **CLOSING + THANKS** **Scientific Chair:** Sylvie Hébert **TRI Board:** Berthold Langguth **Local Organizer:** Carol Lau
6:30PM	**THEATRE**	**TRI-2024 CONFERENCE ROUND-UP COMMUNITY EVENT** **Chair:** Carol Lau **Speakers:** Berthold Langguth; Sylvie Hebert, Patrick Lynch, Anusha Mohan, Gerald Blackwell

ABSTRACTS

01

THE AAGE MøLLER DISTINGUISHED LECTURE ON TINNITUS
WHERE ARE WE NOW? WHERE ARE WE GOING?

Pawel Jastreboff
Professor Emeritus at Department of Otolaryngology, Emory University School of Medicine, and Visiting Professor *sine die* at University College London, London, UK.

Abstract: During the past 40 years, tinnitus research and clinical intervention have improved greatly, but still there is no generally agreed-upon standard for evaluation and management methods available in tinnitus clinical practice. There is are significant increased numbers of publications, both per year and cumulatively (12-fold increase), and more stringent criteria are used in publications. Notably, organizations devoted to promoting tinnitus and offering support of research and clinical innovations have been created. Even though there is a proliferation of various treatment approaches, the number of clinical trials of tinnitus is well behind that of other chronic conditions, causing, if you will, that tinnitus is still a significant problem negatively interfering with the daily lives of a significant proportion of the general population. There are, still, a number of issues worth consideration to facilitate further progress of research and clinical approaches.

Even with the consensus of tinnitus as a phantom auditory perception, there are considerable differences in opinion regarding its definition. There is no agreement about how neuronal activity perceived as tinnitus looks like, and how to unequivocally determine tinnitus severity. While frequently coexisting with tinnitus, other auditory problems (hyperacusis, misophonia, hearing loss, tensor tympani syndrome) are fully recognized; there is a lack of agreement on how to eliminate impact of these problems in studies on the mechanisms of tinnitus and in the clinic for evaluation of tinnitus and treatment outcomes. In clinical studies there is a lack of agreement regarding the inclusion / exclusion criteria of subjects. In basic rese00000000000000000000000000arch, there are animal models allowing evaluation of tinnitus perception but not assessing tinnitus severity.

Artificial Intelligence (AI) has just started to be utilized in the tinnitus field, but its potential is not fully explored. The Portland database was the first stating point and now TRI has created a platform for the international collaboration of and the basis for vigorous use of AI to investigate various topics in the tinnitus field.
All these issues have a significant impact on tinnitus research and on clinical approaches to treat tinnitus and they will be briefly addressed in this presentation.

02

THE HYPERACUSIS VERSUS MISOPHONIA CONTROVERSY

Julia Campbell[1], *Lauren Ralston*[1]
[1] Central Sensory Processes Laboratory, Department of Speech, Language, and Hearing Sciences, University of Texas at Austin

Background and Aim: Hyperacusis and misophonia are both classified as sound tolerance disorders and share similar definitions (Campbell et al., 2023). Because of similarities between these two pathologies, disagreement has arisen in the literature as to whether misophonia is a stand-alone disorder or a subtype of hyperacusis. Clarification of this point is important for clinical diagnosis and appropriate, targeted intervention.
Methods: This presentation will review the characteristics of hyperacusis and misophonia as defined in the literature, including the recent Consensus Definition of Misophonia (Swedo et al., 2022). Current clinical diagnostic approaches will also be discussed.
Results: Given the current state of knowledge on hyperacusis and misophonia, it appears that misophonia should be classified as a subtype of hyperacusis only if diagnostic criteria for hyperacusis is also met. Otherwise, misophonia should be considered a separate disorder.
Conclusion: In the evaluation of misophonia, assessments for hyperacusis should also be performed in order to determine the appropriate diagnosis. This may inform the best intervention or management strategy for the patient, such as various types of behavioral therapies and tinnitus retraining therapy (TRT), as well as future research directions.

03

ELECTROPHYSIOLOGICAL MEASURES OF HYPERACUSIS, MISOPHONIA, AND TINNITUS

Fatima T. Husain[1,2], *Gibbeum Kim*[1,2], *Namitha Jain*[1,2], *Howard Berenbaum*[3]
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[2] Beckman Institute for Advanced Science and Technology, University of Illinois Urbana-Champaign
[3] Department of Psychology, University of Illinois Urbana-Champaign

Sound sensitivity disorders such as hyperacusis, and the more recently defined misophonia, often co-occur with tinnitus. Auditory brainstem responses (ABRs) of hyperacusis and misophonia provide us with objective electrophysiological measures of these conditions and allow us to differentiate them from each other and any comorbid tinnitus or hearing loss. In this talk, I review extant literature on the use of ABRs in the conditions of hyperacusis and tinnitus and what this literature tells us about neural correlates of tinnitus. Work from our lab and others is extending the use of ABRs to the study of misophonia and eventually distinguishing it from the correlates of hyperacusis and

tinnitus. The long-term goal of such studies is to use ABRs to better understand the pathophysiology of these conditions and to test therapies that provide relief to the patients.

04

THE PUTATIVE NEURAL MECHANISMS OF NOISE-INDUCED TINNITUS AND HYPERACUSIS STUDIED IN GUINEA PIGS

Arnaud Norena
Aix-Marseille Université, France

We will present recent findings obtained in guinea pigs on the neural changes before and after noise trauma in the inferior colliculus and auditory cortex. In brief, the neural activity is globally enhanced after noise trauma in both structures. In the auditory cortex, neural activity was assessed over the entire cortical depth using linear electrode array. Interestingly, cortical propagation of spontaneous activity was increased after noise trauma. Our results suggest that cortical inputs coming from adjacent frequency regions and superficial cortical layers were increased. Finally, we will present results suggesting that the KCC2 co-transporters may be involved in these neural changes after noise trauma.

05

A TRANSITIONAL TREATMENT FOR HYPERACUSIS

David A. Eddins[1], Craig Formby[2]
[1] University of Central Florida

Background and Aim: The complex symptoms associated with hyperacusis can include an abnormal sensitivity to the loudness of ordinary everyday sounds. The effects of this abnormal sensitivity can be profound and life-altering, often leading to sound avoidance behaviors, such as limiting daily activities to avoid specific acoustic environments, and overuse of earplugs or earmuffs to limit offending sound exposures. Such sound avoidance is known to exacerbate the hyperacusis condition.
Prevailing theories of hyperacusis implicate a chronic imbalance of inhibition and excitation that leads to abnormal neural gain within the central auditory system, which leads to increased perception of loudness. Successful treatment of hyperacusis often involves a combination of condition-specific counseling and sound therapy via extended exposure to low-level seashell-like noise. The goal of sound therapy is to induce counteractive neural plasticity that gradually re-regulates central gain. Access to such a treatment approach, however, is limited by difficulty transitioning a patient out of earplugs or earmuffs, or both, and into sound therapy via ear-worn device. The aim of the current study is to evaluate a novel method of treatment that seeks to overcome this barrier to access and restore more normal loudness perception.
Methods: Twelve participants with moderate to severe hyperacusis (based on loudness discomfort levels and the Hyperacusis Questionnaire) completed the 6-month protocol. The treatment protocol included structured counseling and use of a behind-the-ear sound therapy device with multiple features custom fit to the patient. Devices were coupled to an earpiece designed to function as a custom earplug with maximum attenuation. Amplification was adjusted to provide unity gain within the passband of the device while output limiting was used to limit exposure to high-level, offending sound levels. A sound generator provided low-level therapeutic sound. To maximize exposure to therapeutic sound, the custom occluded earpiece could be exchanged with an unoccluding vented earpiece for use in environments with low risk for offending sound levels. The transitional treatment allowed for progressive greater exposure to high sound levels in direct proportion to the treatment effect of the sound therapy.
Results: The primary outcome measure was the sound level (dB SPL) at which subjects rated running speech to be “loud, but ok.” Over the six-month treatment period, the level at which running speech was judged to be “loud but ok” increased an average of 34 dB, or 5.6 dB per month, and there was no evidence of a plateau in the treatment effect. Subjective indices of hyperacusis changed accordingly, with significant improvements on the Hyperacusis Questionnaire, the Tampa Scale of Hyperacusis, the Noise Avoidance Questionnaire, and Questionnaire on Hypersensitivity to Sound.
Conclusion: The novel treatment protocol effectively transitioned patients from stereotypical, life-altering, sound avoidance behaviors to a return to many normal daily activities posttreatment with high satisfaction for the intervention. [Work Supported by NIDCD R21 DC015054].

06

HYPERACUSIS AND ASSOCIATED SYMPTOMS AMONG CONFERENCE INTERPRETERS

1,2,3 Fournier, P., 4 Lessard-Dostie, H., 4 Bigras, J., 5 McDonald, T., 6 Noreña, A.J. & 4 Lagacé, J.
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5 Centre National de la Recherche Scientifique, Aix-Marseille University, Marseille, France

Background and Aim: Recent concerns have arisen about the hearing health of conference interpreters worldwide. For example, a report by the International Association of Conference Interpreters (2020) underscored a notable prevalence of acoustic incidents—brief, loud, and unexpected sounds—among interpreters, ranging from 47% to 67%. Consequently, interpreters who encountered these incidents were more likely to experience symptoms of differing severity and frequency, notably tinnitus and hyperacusis, compared to those who did not encounter such incidents. This study aims to compare the hearing status, symptoms, and work habits of interpreters with and without

hyperacusis. The data presented were collected as part of the ongoing Canadian Study on the Effects of Headphone Listening among Conference Interpreters.
Methods: A total of seventy-one adults (mean age = 43 years old, male/female = 11/60), employed as conference interpreters, were recruited. Participants were divided into two groups based on results from a psychoacoustic hyperacusis test using natural sounds. All participants underwent laboratory measurements, including conventional audiological assessments (standard and high-frequency audiometry, tympanometry, middle ear muscle reflexes, distortion product otoacoustic emissions or DPOAE, speech in noise). Additionally, each participant completed an online questionnaire on sociodemographic characteristics, symptom experiences, and work habits. Symptoms frequencies and intensity were evaluated using Likert scales and visual analog scales, respectively.
Results: The data obtained from the group of participants presenting hyperacusis symptoms (HS: n=35, mean age = 42, male/female = 3/32) and the group of participants without hyperacusis symptoms (WHS: n=32, mean age = 43, male/female = 8/24) were compared. A higher proportion of interpreters had been exposed to one acoustic incident or more in the HS group (49% vs. 30%, p = .015). The two groups exhibited similar auditory function across most measures, including hearing thresholds, DPOAE (1680-9512 Hz), speech in noise (triplet digit test), and tympanometry, with all p-values > 0.1. However, a notable distinction emerged: the HS group displayed a significantly lower middle ear muscle (MEM) reflex threshold in the ipsilateral condition bilaterally, particularly with white noise stimulation (79 vs. 87 dB HL, p = .003). A greater percentage of interpreters with hyperacusis reported fluctuating hearing loss (75% vs. 28%, p = .08), ear pain (60% vs. 34%, p = .05), burning sensation in/around the ear (40% vs. 19%, p = .07), and ear pressure/tension (54% vs. 28%, p = .04) in the last year. Furthermore, the intensity of fluctuating hearing loss (28 vs. 15), ear fullness (31 vs. 19), jaw pain (23 vs. 13), neck tension (33 vs. 19), and jaw tension (35 vs. 22) was significantly higher in the HS group, all with p-values < .05. No difference was found for tinnitus across measures.
Conclusion: The HS group reported encountering more acoustic incidents and coincidently, experiencing more frequent and intense otological symptoms over the last year than the WHS group. These results suggest a plausible association between these incidents, hyperacusis and other symptoms. The MEM may play a role in the manifestation of these symptoms. Further analyses need to be conducted to understand these trends, and data collection will continue until March 2024.

07

DEPOLARIZATION SHIFT IN THE RESTING MEMBRANE POTENTIAL UNDERLIES HYPERACTIVITY OF INFERIOR COLLICULUS NEURONS INDUCED BY AN ACOUSTIC TRAUMA.

Chun-Jen Hsiao, Alexander Galazyuk
Northeast Ohio Medical University (NEOMED)

Background: Neuronal hyperactivity has been associated with many brain diseases. In the auditory system, hyperactivity has been linked to hyperacusis and tinnitus. Previous research demonstrated the development of hyperactivity in inferior colliculus (IC) neurons after sound overexposure, but the underlying mechanism of this hyperactivity remains unclear. The main goal of this study was to determine the mechanism of this hyperactivity.
Methods: A total of 26 CBA/CaJ mice were used in this study. All animals were between 5-12 months old. The sound exposure was performed in adult animals (at least 2 months old). One octave narrowband noise centered at 12.5 kHz (8–17 kHz) was presented at the level of 116 dB SPL unilaterally for 1 h under ketamine/xylazine anesthesia. Intracellular recordings were conducted with quartz micropipettes filled with 1 M potassium acetate having impedance around 250 MΩ in unanesthetized animals. Electrodes were inserted into the IC via a small opening (≈100 μm) in the skull. Spontaneous and sound evoked activity to pure tones 100 ms duration presented at different sound frequencies at the level of 55 dB SPL were recorded and analyzed. We examined and compared spontaneous firing rates, resting membrane potentials, and half width of action potentials in IC neurons before and after exposure.
Results: We found that after sound exposure spontaneous firing rates were increased and resting membrane potentials were depolarized in the IC neurons with best frequencies at/above center frequency of sound exposure. The half width of action potentials in these neurons was also significantly decreased after exposure. All these intrinsic properties changes were evident on both contralateral and ipsilateral sides of IC but the effect on the ipsilateral IC was more robust. Surprisingly, we also found a resting membrane potential gradient in which neurons have more hyperpolarized resting membrane potentials with increasing depth in the IC. This gradient was altered in the sound exposed animals.
Conclusions: Our research suggests that depolarization resting membrane potentials of IC neurons, at least partially, explains why they become hyperactive following sound exposure.
Supported by NIH R01 DC016918 from the National Institute on Deafness and Other Communication Disorders of the U.S. Public Health Service.

08

NEAR-INFRARED (NIR) LIGHT TREATMENT OF TINNITUS

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2Department of Otolaryngology, School of Medicine, Wayne State University
3Center for Molecular Medicine & Genetics, School of Medicine, Wayne State University,

Background: Accumulative evidence demonstrates that tinnitus may be due to noise trauma-induced oxidative stress and inflammation in the cochlea. The auditory peripheral deafferentation leads to maladaptive neuroplasticity in the forms of hyperactivity, hypersynchrony, balance loss of inhibitory and excitatory processes, resulting in tinnitus percept. Hence, one would expect that reducing oxidative stress and inflammation to mitigate acoustic trauma induced auditory peripheral deafferentation reduces the maladaptive neuroplasticity and

relieves tinnitus. Our group has demonstrated that near-infrared light (NIR) light serves as a cytochromec oxidase inhibitor so “inhibit” mitochondrial respiration to down-regulate production of damaging reactive oxygen species, thus reducing oxidative stress and inflammation. In this paper, we report that NIR light administration has therapeutic effects on noise-induced hearing loss and tinnitus.
Methods: Thirty-two adult SD rats were used, among which, 14 were used to study the effect on hearing loss. Four rats were used for a MitoSOX superoxide test, and 6 for aCOXactivity test. Eight rats were used to study the effects on tinnitus using our optimized conditioned licking suppression behavioral paradigm (CLS, Pace and Zhang,2016), which allows behavioral evaluation of onset and long-lasting tinnitus at individual levels. To induce hearing loss and tinnitus, rats were exposed with a loud noise (8–16kHz, 105-116 dB SPL, 1.5-2 hours). For treating hearing loss, rats received 4 hours NIRlight treatment on day 0 after noise exposure and1 hour for additional 6 consecutive days. For treating tinnitus, NIR was administered 6 times over 2 weeks.
Results: Our data showed that ABR thresholds were significantly lowered in the ear that received laser treatment compared to the ear without treatment (4 kHz, p = 0.02; 12 kHz, p = 0.004; 16 kHz, p = 0.003; 20 kHz, p = 0.02; 28 kHz, p = 0.04; click, p = 0.002). DPOAE results showed that the ear with laser treatment exhibited significant recovery at the 20 kHz region compared to the ear without treatment (p = 0.006, n=6). The ear with laser treatment had a significant lower hair cell loss rate than the ear without treatment (apical, p = 0.02; middle, p = 0.01; basal, p = 0.04, n = 4). NIR light treatment also significantly reduced Mitosox (+) hair cells compared to non-treated group (apical, p = 0.0013; middle, p = 0.0004; basal, p = 0.019). The noise trauma induced 52% increase in cytochrome c oxidase (COX), which was reduced to 22% following laser treatment. Results of CLS behavioral assays showed that NIR light treatment significantly reduced the number of licks during silence trials in noise-exposed rats, compared to rats without laser treatment, indicating suppression of behavioral evidence of tinnitus.
Conclusion: The study demonstrated that NIR light administration has significant therapeutic effects on noise-induced hearing loss and tinnitus by inhibiting cytochrome c oxidase to reduce oxidative stress and inflammation.

09

EXPLORING TRANSCUTANEOUS STIMULATION OF PERIPHERAL NERVES AS A SOURCE OF TRANSCRANIAL ELECTRICAL STIMULATION EFFECTS

Sven Vanneste[1]
[1]Trinity College Institute For Neuroscience, Trinity College Dublin, Dublin, Ireland.

Background and Aim: Transcranial electrical stimulation (tES) stands as a promising noninvasive method for neuromodulation, exhibiting notable potential in the modulation of various cognitive faculties including hearing, motor skills, and memory. However, the underlying mechanisms of its efficacy remain contentious, with studies proposing that the cortical neural activity might not be adequately entrained due to the current strength reaching the cortex. In response to this controversy, I posit a novel hypothesis: the effects of tES might stem from transcutaneous stimulation of peripheral nerves in the skin rather than direct cortical neuron stimulation. This hypothesis posits that the subsequent activity from peripheral nerves could potentially induce entrainment in cortical neurons.
Methods and Results: This proposal juxtaposes tES against bimodal stimulation methodologies, incorporating vagus nerve stimulation, tongue stimulation coupled with tone therapy, and auditory-somatosensory stimulation. The culmination of research exploring the pairing of vagus nerve stimulation with sound, auditory-somatosensory stimulation, and tongue stimulation combined with tone therapy has unveiled promising advancements in modulating the brain's plasticity related to tinnitus. This emerging treatment avenue, recognized as bimodal stimulation, integrating sound stimulation with electrical nerve stimulation, presents an intriguing prospect in tinnitus management.
Conclusion: The discourse presented herein delves into the combined preclinical and clinical evidence supporting the efficacy of bimodal stimulation in treating tinnitus, drawing comparisons with outcomes from tES studies. Furthermore, this presentation delves into potential mechanisms of action and conducts an evaluation of the respective strengths and limitations of these distinct approaches, culminating in the identification of potential future research directions

10

A HYBRID APPROACH TO TINNITUS CARE: UTILIZING BIMODAL NEUROMODULATION

Emily McMahan[1]
[1] Alaska Hearing and Tinnitus Center, Alaska, United States.

Background and Aim: Remote health services have been proven to be a viable treatment delivery method to improve patients’ access to high-quality and cost-effective care. Telehealth encompasses different modalities and is used for diverse health conditions and patient populations. Tinnitus management had conventionally involved in-person care, however with stay-at-home orders and lockdowns during the COVID-19 pandemic, telehealth has become instrumental for routine follow-ups and consultations.
Methods: In this session, Real-World Evidence (RWE) from a hybrid approach to tinnitus management utilizing bimodal sound therapy and tongue stimulation as a treatment together with telehealth will be presented. In the Alaska Hearing and Tinnitus Center, in-person services were used for initial audiological and tinnitus assessments as well as fitting of the bimodal sound therapy and tongue stimulation device. Virtual video calls via CounselEAR’s telehealth portal were used for follow-up assessments, additional consultations, counselling, and education.
Results: Overall, the patients’ experience with this hybrid standard of care procedure for bimodal sound therapy and tongue stimulation treatment was positive. The majority of patients reported that the treatment was beneficial in their tinnitus care journey. The adherence to virtual follow-up assessments was exceptionally high with a large percentage of patients completing the full standard of care procedure. Improvements in tinnitus severity, measured using mean changes and percent responders to treatment on the Tinnitus Handicap Inventory (THI) at the first and second follow-up assessments were consistent with published clinical trial results evaluating the bimodal sound

therapy and tongue stimulation device. Over 200 patients have been treated at this clinic since it began offering bimodal sound therapy and tongue stimulation treatment. Patients have experienced a strong response to the hybrid care approach using bimodal stimulation with the vast majority responding to treatment at the first and second follow-up assessment.

Conclusion:

Bothersome tinnitus is a debilitating condition with a growing number of patients seeking treatment solutions. The use of virtual care will play a quickly growing component in the future landscape of tinnitus care. RWE from this clinic strongly supports the efficacy and feasibility of bimodal sound therapy and tongue stimulation together with a telehealth hybrid approach.

11

BIMODAL NEUROMODULATION FOR THE TREATMENT OF TINNITUS: REAL-WORLD CLINICAL OUTCOMES & OUTLIERS

Craig Kasper[1], *Brian Fligor*[2]

[1] Institute for Hearing and Balance, NY, United States.

[2] Tobias & Battite Hearing Wellness, Boston, MA, United States.

Background and Aim: An evolving direction for tinnitus treatment involves bimodal stimulation that combines sound stimulation with electrical stimulation of other non-auditory nerves such as vagus nerve, trigeminal nerve, and somatosensory nerves. In March 2023 a non-invasive bimodal stimulation device that combines sound therapy and somatosensory stimulation via the tongue, Lenire (Neuromod Devices, Ireland), was granted approval for the treatment of tinnitus by the Food and Drug Administration (FDA). This novel device is the only bimodal stimulation device approved by the FDA for the treatment of tinnitus. The therapeutic benefit and safety of the bimodal device has been established in three large-scale clinical trials. These large-scale clinical trials are considered higher in the evidence hierarchy when compared to real-world evidence (RWE). Yet, the eligibility criteria in clinical trials create a more homogenous population. In this session we present RWE for the effectiveness and safety of the bimodal device to bridge the gap between the controlled environment of clinical trials and the realities when utilized in the real world.

Methods: At NYHD | Institute for Hearing and Balance (New York, NY) and the Tobias & Battite Hearing Wellness (Boston, MA), patients were fitted with the Lenire bimodal stimulation device after completing an initial audiological and tinnitus assessment. Patients were asked to return for follow-up assessments and were also provided with additional consultations via telehealth appointments or phone calls between assessments if there were any issues or concerns.

Results: During the first follow-up assessment (approximately 6 weeks post device fitting), the majority of patients responded to treatment when measured on the Tinnitus Handicap Inventory (THI). There were further improvements in responder rates and THI scores at the second follow-up (approximately 12 weeks post device fitting). Data captured via the Tinnitus Functional Index (TFI) further elucidated areas of improvement in tinnitus reaction. Consistent with clinical trial
results, those with more bothersome tinnitus had a higher response rate and further improved with additional treatment. Importantly, in the real world, the bimodal device was safe and easy to use, with no reportable events.

RWE can greatly expand on improving the generalizability of trial results. Included in this session will be a discussion of data from a large cohort of bimodal device users including users who may not have met all criteria required for inclusion in the clinical trials, and how these data can deepen our understanding of this treatment approach in a clinical setting.

Conclusion: Tinnitus is a known heterogenous condition. Bias in treatment outcomes may arise from cohort selection in clinical trials. RWE results from these two clinics support the therapeutic benefits of using the bimodal device and showcase the generalizability of treatment effects

12

THE EFFECTS OF COMBINING TRANSCRANIAL MAGNETIC STIMULATION WITH AUDITORY STIMULATION ON TINNITUS SYMPTOMS

Stefan Schoisswohl 1,2, Berthold Langguth 1, Franziska C. Weber 1, Mohamed A. Abdelnaim 1, Tobias Hebel 1 & Martin Schecklmann 1

1Department of Psychiatry and Psychotherapy, University of Regensburg, Regensburg, Germany

2 Department of Psychology, Universitaet der Bundeswehr Muenchen

Background and Aim: Repetitive transcranial magnetic stimulation (rTMS) was introduced as a treatment option for tinnitus to counteract tinnitus-associated neural pathologies. By virtue of heterogeneity in tinnitus manifestations as well as inter-individual variability in treatment responses, the therapeutic effects of rTMS are still not obvious. RTMS effects in general are assumed to be dependent on the brain state immediate prior stimulation. For example, it was shown that auditory stimulation before rTMS is capable to shift the intended effects.

Methods and Results: During short-term tinnitus suppression induced via auditory stimulation it is assumed that a transient inversion of tinnitus-associated pathological brain activity takes place. Hence, an auditory stimulation before rTMS could theoretically shift the neural activity of tinnitus patients back to a “normal” state and could facilitate the therapeutic consequences of rTMS for tinnitus. With the present study we attempted to investigate this concept of combining auditory stimulation and rTMS as a treatment approach in a small sample of tinnitus patients.

Conclusion: Understanding how alternative multimodal treatment approaches act on therapeutic outcomes has the potential to further develop novel and research-focused treatments pathways for tinnitus.

13

COLLECTING REAL WORLD EVIDENCE ON TINNITUS SYMPTOM DYNAMICS THROUGH ECOLOGICAL MOMENTARY ASSESSMENT

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Background and Aim: Validation of single- and multimodal treatments in tinnitus is predominantly reliant on retrospective questionnaires, which are susceptible to recall bias such as personal heuristics and recency effects. Ecological Momentary Assessment (EMA), a real-time data collection method, has emerged as a promising alternative to enhance reliability and validity of symptom assessment. However, there is limited knowledge regarding its applicability in measuring treatment-induced changes.
Methods ad Results: This presentation delves into the concept of EMA from various perspectives and compares it with the current gold standard. The application of EMA is reviewed both within and outside the tinnitus literature. Further, empirical data from the UNITI study, which compares the effect of single and multimodal treatments, is utilized to evaluate the predictive accuracy of EMA data for clinical change. To do so, we employed a multidisciplinary data driven approach that involves extracting meaningful features or characteristics from timeseries data. The obtained results are compared with the predictive accuracy of retrospective questionnaires.
Conclusion: By addressing these questions, we aim to shed light on the clinical utility of EMA data and its potential to enhance our ability to predict and understand the improvement of tinnitus symptoms over time. Understanding the clinical implications of EMA data is crucial for its integration into routine clinical research and practice. Finally, the presentation aims to highlight the advantages of EMA for multimodal treatment approaches.

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WORKSHOP: REMOTE COUNSELLING AND TELECARE IN TINNITUS

Richard Tyler
Department Otolaryngology and Head and Neck Surgery, and Communication Sciences and Disorders, The University of Iowa

Summary: As in the clinic, it is important initially to connect with the patients and let them explain where they are at. Images can be used to help with the counseling, but the interaction is most important,

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WORKSHOP: OVERCOMING ROADBLOCKS IN PRIVATE PRACTICE TINNITUS CARE

Carol Lau
Sound idEARS Hearing & Listening Clinic, Vancouver Tinnitus & Hyperacusis Clinic

Summary: This presentation, based on over 20 years experience, provides some personal observations and insights into running a private practice tinnitus clinic in Canada (BC), and the differences when compared to a traditional audiology and hearing aid dispensing clinic.

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SPONSOR SESSION: Hyperacusis Research, Limited

Steven Barad M.D.
Director, Hyperacusis Research, Limited.

Summary: Hyperacusis Research, Limited, inc. is a non-profit charity dedicated to the development of effective treatments for hyperacusis and to funding research which will eliminate the underlying mechanisms that cause hyperacusis. Our foundation is dedicated to improving the quality of life for patients who suffer from hyperacusis and hyperacusis related disorders. Central to the mission of our organization is facilitating and supporting biomedical research which will lead to novel and effective therapies for Hyperacusis. We also provide information to those individuals with Hyperacusis that may help with their understanding of this disorder through various websites and organizations affiliated with our cause. Throughout our existence we have partnered with the Hearing Health Foundation. Money raised by our organization has helped fund several scientific research projects which might one day lead us to an effective therapy. The purpose of my presentation at TRI 2024 is to familiarize the audience with our cause.

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PERSONALIZED NEUROMODULATION: A NOVEL STRATEGY FOR IMPROVING TINNITUS TREATMENT

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Background and Aim: There have been studies focused on finding personalized, repetitive transcranial magnetic stimulation (rTMS) or transcranial direct-current stimulation (tDCS) protocols for tinnitus treatment, but no research has pursued the determination of the most suitable neuromodulation modality—either rTMS or tDCS—for individual tinnitus patients. This study aimed to evaluate the efficacy of personalized neuromodulation, where treatment modalities are chosen based on the patient's responses in a pilot trial.
Methods: A total of 71 patients with tinnitus were divided into two groups: a personalized group and a randomized neuromodulation group. In the personalized group (n = 35), rTMS and tDCS were assessed in a pilot trial, and responsive modalities were administered to 16 patients, while the non-responders (n = 19) were randomly assigned to rTMS, tDCS, or combined modalities. Patients in the randomized group (n = 36) were randomly allocated to rTMS, tDCS, or combined modalities. Each neuromodulation was applied for the following 10 sessions over a 2-week period. For all patients in both groups, tinnitus intensity, distress, and awareness questionnaires, as well as the Tinnitus Handicap Inventory (THI), were completed before and after the 10th session. Treatment success was defined as a reduction of

more than 1 point on the 10-point scales for tinnitus intensity or distress, a decrease of more than 10% points in the awareness score, or a reduction of more than 10% in the THI score.
Results: The THI score improvement after treatment was significantly greater in the personalized group than in the randomized group (p = 0.043), with no significant differences in tinnitus loudness, distress, or awareness. The personalized group was further divided into responders and non-responders to the pilot test, and the changes in the four questionnaire scores were compared among the responder subgroup, the non-responder subgroup, and the randomized group. The improvement in the THI score was greatest in the responder subgroup, with a significant difference compared with the randomized group (p = 0.007), and greater improvements in tinnitus loudness were also observed in the responder subgroup compared with the non-responder subgroup (p_{Bonf} = 0.012). The treatment success rate was highest in the personalized responder subgroup (92.3%), and significantly greater than that in the non-responder subgroup (53.0%; p = 0.042) and the randomized group (56.7%; p = 0.033).
Conclusion: The findings suggest that personalized neuromodulation, where treatment modalities are chosen based on individual responses in a pilot trial, is an advantageous strategy for treating tinnitus.

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EFFECT OF COCHLEAR IMPLANT, BONE CONDUCTION DEVICE AND CONTRALATERAL ROUTING OF SOUND HEARING AID ON TINNITUS IN SSD

Anne W. Wendrich 1,2, Kelly K.S. Assouly 1,2,3, Jan A. A. van Heteren 1,2, Jeroen P. M. Peters 1,2, Wilko Grolman 4, Robert J. Stokroos 1,2, Huib Versnel 1,2, Diane L. Smit 1,2
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Background and Aim: Patients with single-sided deafness (SSD) often experience tinnitus, which can result in a decreased quality of life and psychological distress. Currently, there is a lack of high-level evidence studies comparing the effect of different treatment options for SSD patients on tinnitus. In this randomized controlled trial, we aimed to evaluate the effect of a cochlear implant (CI), bone conduction device (BCD), contralateral routing of sound hearing aid (CROS) and no treatment on tinnitus outcomes in SSD patients, up to 24 months of follow-up.
Methods: 120 eligible patients were randomized to 3 groups: cochlear implantation, to a trial period with first a BCD on a headband, then a CROS, or to a trial period with first a CROS, then a BCD on a headband. After the trial periods, participants opted for a surgically implanted BCD, a CROS, or no treatment. At the start of the follow-up, 28 participants were implanted with a CI, 25 with a BCD, 34 had a CROS, and 26 chose no treatment. The Tinnitus Handicap Inventory (THI), Tinnitus Questionnaire (TQ), Visual Analogue Scale (VAS) tinnitus burden and the Hospital Anxiety and Depression Scale (HADS) were completed at baseline, and at 3, 6, 12, and 24 months of follow-up. Generalized estimating equations was used to compare outcome values within each group over time and between groups.
Results: All treatment groups (CI, BCD, CROS) showed statistically significant decreased tinnitus impact scores at 24 months of follow-up compared to baseline. The CI group showed the largest significant decrease over time: the median THI score decreased with 23 points, the TQ score decreased with 17 points and the VAS score with 60 points at 24 months of follow-up compared to baseline. Tinnitus was not induced due to cochlear implantation. In the BCD group, the median THI score decreased with 11 points, the TQ score decreased with 9 points and the VAS decreased with 25 points at 24 months of follow-up compared to baseline. In the CROS group, only the TQ scores decreased significantly with 7 points at 24 months of follow-up compared to baseline. The HADS anxiety subscale showed no indication for anxiety at baseline for all groups, the depression subscale showed possible depression for all groups at baseline and was only significantly decreased in the CI group at 24 months of follow-up.
Conclusion:
In this RCT, SSD patients treated with a CI, BCD or CROS showed overall decrease on tinnitus impact scores up to 24 months of follow-up compared to baseline. The CI-group reported a stable and the largest reduction up to 24 months of follow-up. Cochlear implants appear to be superior to BCD, CROS and no treatment in achieving partial or complete resolution of tinnitus in patients with SSD.

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HEARING AID AMPLIFICATION SCHEMES ADJUSTED TO TINNITUS PITCH: AN RCT

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Background and Aim: Hearing aids can be used as a treatment for tinnitus. There are indications that this treatment is most effective when the hearing loss -and the tinnitus pitch- fall in the range of amplification of the hearing aid. Other models suggest that a gap in the amplification around the tinnitus pitch would enhance the lateral inhibition and thereby reduce the tinnitus.
Methods: We conducted a randomized controlled trial, designed as a Latin square balanced crossover study. Eighteen tinnitus patients with moderate hearing loss were included, all had been using hearing aids for at least 6 months. Patients were fitted with hearing aids using 3 different amplification schemes: (1) standard amplification according to the NAL-NL2 prescription procedure, (2) boosted amplification at the tinnitus frequency, and (3) notch filtered amplification at the tinnitus frequency. Amplification of the three settings was evaluated with real ear measurements. After two weeks of initial adaptation (during which the NAL-NL2 was used), the hearing aids were used for a period of twelve weeks, testing each setting for four weeks.
Results: There was a small reduction of the TFI score after the adaptation process, possibly due to a placebo effect. The TFI score did not differ significantly from the standard setting after using the notched or the boosted settings. However, notched amplification was

significantly better than boosted amplification. Regardless of the TFI outcomes, most participants had an individual preference for a particular setting.
Conclusion: Notch-filtered and boosted amplification did not provide better tinnitus suppression than standard amplification, although notched amplification performed better than boosted amplification. The individual preferences highlighted the importance of tailor-made approaches to hearing aid amplification in clinical practice. Further studies should explore the differences among patient's tinnitus and their preference for a hearing aid setting.

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SEX EFFECTS IN SOUND THERAPY FOR TINNITUS

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Background and Aim: Heterogeneity of tinnitus disorder leads researchers to focus on tailoring individual treatment strategies based on patient characteristics. However, which patient subtypes should be considered for recommending specific treatments? Previous reports suggest that sex plays a role in predicting treatment success, e.g. with sound therapy.
Methods: Within the European-wide study UNITI, different established treatments for tinnitus and its combinations were compared regarding therapeutic success. The present study examines data from the 12-week app-based intervention for sound therapy, exploring potential sex differences in both long-term (intervention effects as measured with THI) and short-term effects of acoustic stimulation (i. e., acute tinnitus suppression through lateral or residual inhibition). 52 participants (23 females) were assigned to this treatment arm and used the app autonomously throughout the intervention period.
Results: Using regression analysis, sex was identified as an important predictor for therapeutic effects. Data reveals that indeed the effectiveness of sound stimulation differed between men and women with a higher tinnitus loudness reduction in women (short-term effect). Further analyses focus on the potential role of app usage patterns and sound characteristics in explaining these sex effects.

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EFFECT OF MODIFIED TINNITUS RELIEVING SOUND (MTRS) FOR TINNITUS TREATMENT - A MULTICENTER RANDOMIZED CLINICAL TRIAL

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Objective: To study the safety and clinical effects of different acoustic stimulation strategies in tinnitus treatment, and to explore and determine the optimal tinnitus treatment plan.
Design and setting:
This double-blind randomized, multicenter clinical trial was sponsored by the Eye & ENT Hospital of Fudan University, and conducted at 3 university teaching hospitals in China. A total 400 patients aged 18 to 80 years with chronic tinnitus were recruited from May 17, 2021 to 1 March 1, 2022. Outcome data were collected in these 4-group acoustic therapy trial for tinnitus patients at 7 assessment points, including baseline, 1 month, 2 months, 3 months, 6months, 9 months, and 1 year.
Method: These subjects enrolled completed a baseline assessment that included the pure tone threshold, the history of tinnitus, and 4 questionnaires (tinnitus handicap inventory (THI), Hospital Anxiety and Depression Scale (HADS), Athens Insomnia Scale (AIS), and Visual Analog Scale (VAS)). They were then assigned randomly to four different groups of sound therapy and asked to apply the sound therapy for over 2 hours per day, followed by assessment data collection and telephone interviews since the intervention began at 6 assessment points (1 month, 2 months, 3 months, 6 months, 9 months, and 1 year). The four interventions were unmodified music (UM), combination of UM and narrowband noise centered at tinnitus pitch (UM + NBN), high frequency- enhanced music (HFEM), and modified tinnitus relieving sound (MTRS), respectively.
Results: Among 400 individuals from three hospitals in China, the median age was 44 years old (IQR [34, 55]), 51.2% (205 of 400) were male, and the average course of tinnitus was 12 [6, 36] months. Of these, 101 were randomized to receive unmodified music (UM, Group1), 100 were randomized to receive the combination of UM and narrowband noise centered at tinnitus pitch (UM + NBN, Group2), 98 were randomized to receive high frequency- enhanced music (HFEM, Group3), and 101 were randomized to receive the modified tinnitus relieving sound (MTRS, Group4). Results of the primary outcome measured by THI showed that the overall group× time interaction (4×7) was significant [$F = 29.54$, $P < .001$], and the MTRS group had the best treatment effect. Treatment effects were maintained at the 12-month follow-up (MTRS THI Cohen d = 0.98 [95% CI, 0.66-1.30]. The mixed-effect model indicated that the difference of research centers would not affect the tinnitus treatment effect, while different treatment strategies significantly affect the effect of acoustic therapy. Specifically, the treatment effect of Group 3 (HFEM) was worse than that of Group 1 (UM), while the treatment effect of Group 4 (MTRS) was better than that of Group 1 (UM), and the difference was more significant. All secondary outcomes including HADS-A, HADS-D, AIS, and VAS, also showed significant overall group × time interactions, favoring the MTRS group.
Conclusion: We demonstrated the efficacy of acoustic therapy for tinnitus and found that MTRS was the most effective treatment strategy for tinnitus compared to the unmodified music, high frequency- enhanced music, and the combination of unmodified music and narrowband noise centered at tinnitus pitch.
Trial registration:

chictr.org.cn Identifier: ChiCTR2000039007

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AUDITORY EXPERIENCE, FOR A CERTAIN DURATION, IS A PREREQUISITE FOR TINNITUS

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Background and Aim: Tinnitus has traditionally been considered an otologic disorder; however, recent advances in auditory neuroscience have shifted investigations toward the brain. The Bayesian brain model explains tinnitus as an auditory phantom percept. According to the model, the brain works to reduce environmental uncertainty, and thus the absence of auditory information due to hearing loss may cause auditory phantom percepts, i.e., tinnitus. As in animal studies, our recent human observational study revealed the absence of ipsilesional tinnitus in subjects with congenital single-sided deafness, suggesting that auditory experience is a prerequisite for the generation of tinnitus. Prompted by anecdotal cases, we hypothesized that subjects with acquired hearing loss would not develop tinnitus if their duration of auditory experience was not sufficiently long.
Methods: We retrospectively enrolled 22 subjects with acquired asymmetric hearing loss and unilateral tinnitus in better ear (TBE). Twenty-two hearing threshold-matched controls with tinnitus in worse ear (TWE) were selected from our database of tinnitus patients.
Results: All 22 TBE subjects reported that their acquired hearing loss developed before the age of 20, while all 22 TWE subjects reported the average age of 58 ($p<0.01$). The reported duration of auditory deprivation in the ear without tinnitus in the TBE group was significantly longer than that of the TWE group. (47.1±14.8 vs. 7.7±4.7, $p < 0.01$) In other words, the TBE group with limited auditory experience in the worse ear did not develop tinnitus in the worse ear while subjects with enough auditory experiences in the worse ear developed ipsilesional tinnitus in the TWE group.
Conclusion: These preliminary results support our hypothesis that both auditory experience itself, and an individually variable critical duration of auditory deprivation, are prerequisites for the generation of tinnitus.

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EXPLORING THE ORIGINS OF DECREASED SOUND TOLERANCE IN TINNITUS PATIENTS

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Background and Aim: This study aimed to confirm the characteristics of auditory function alterations in tinnitus patients with concomitant decreased sound tolerance (ST) and provide insights for developing tailored therapeutic approaches.
Methods: A retrospective analysis was conducted on patient records from a tertiary university hospital's tinnitus clinic between March 2020 and June 2023. Demographic attributes and audiological profiles were reviewed. Patients were categorized into Group 1 if loudness discomfort level test outcomes were 77 dB or below, measured using an average of frequencies from 250 Hz to 8 kHz. The remaining patients were allocated to Group 2.
Results: Among the 434 tinnitus patients, 115 (26.5%) demonstrated decreased ST and were classified as Group 1. This group exhibited higher DPOAE amplitudes ($p < 0.001$), shortened latency, and decreased threshold of ABR wave V bilaterally ($p < 0.05$). No significant disparities were observed in gender, age, tinnitus handicap inventory, visual analog scale, and pure-tone audiometry results except subjective hyperacusis. Binary logistic regression analysis utilizing the forward conditional method revealed that the difference between groups was independently linked to DPOAE response at 7277 Hz on the left side ($B = 0.093$, $p < 0.001$, $EXP(B) = 1.07$, 95% CI = 1.044–1.153).
Conclusion: Increased DPOAE amplitude and shorter and decreased ABR wave V in tinnitus patients with decreased ST might suggest a possible association with lesions in or around the superior olivary complex or higher central auditory pathway, potentially linked to the inhibition of medial olivocochlear efferents.

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ASSOCIATION BETWEEN TINNITUS AND INFLAMMATORY BOWEL DISEASE: A NATIONAL COHORT STUDY

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Background and Aim: Recent studies have shown that role of inflammation, especially inflammatory mediators TNF-α and IL-1β are increased in tinnitus. Otherwise, the etiology of IBD remains elusive, but IBD appears to be sustained in impaired immune response against intestinal microrganisms. Increasing evidence suggests that tinnitus is associated with inflammation. As of current scientific research, a direct cause-and-effect relationship between the two conditions has not been confirmed. The purpose of this study was to investigate the correlation of IBD patients and Tinnitus patients in national wide data.
Methods: Using data from the Korean National Health Insurance Service, the research has been conducted from 2008 to 2021, we estimated the risk of developing inflammatory bowel disease (IBD) in patients with tinnitus, comparing them to a control group. Additionally, we assessed the risk of developing tinnitus in patients with IBD compared to the control group. Disease occurrence was defined as patients who were hospitalized at least once or utilized outpatient services at least once, based on the diagnostic codes. Sub-analyses were conducted based on age groups, gender, and included results applying health screening variables.

Results: The final study population used for analysis, consisted of 580,531 individuals with Tinnitus, 712,014 in the control group, 46,227 with IBD, and 54,563 in the control group. After adjusting for gender, age, disability status, medical aid status, and medical history of hypertension, diabetes, dyslipidemia, cardiovascular disease (CVD), and stroke, the hazard ratio (HR) for the occurrence of IBD in tinnitus patients compared to controls was 1.164(1.099-1.232; p<0.001). In the 1:1 PSM scenario, the HR was 1.169 (1.098-1.244; p<0.001).The hazard ratio (HR) for the occurrence of tinnitus in IBD patients compared to controls was 1.228 (1.164-1.296; p<0.001). In the 1:1 PSM scenario, the HR was 1.26 (1.186-1.338; p<0.001).
Conclusion: The occurrence of tinnitus in IBD patients compared to controls was higher and the occurrence of IBD in tinnitus patients compared to controls was higher vice versa. This study suggests Tinnitus and IBD are thought to have a high correlation with each other's incidence

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IS ZINC DEFICIENCY A RISK FACTOR FOR TINNITUS? AN ANALYSIS FROM CHRONIC IDIOPATHIC TINNITUS PATIENTS WITH NORMAL HEARING

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Background and Aim: This study aimed to analyze chronic idiopathic tinnitus patients with normal hearing to determine whether zinc deficiency is a risk factor for tinnitus.
Methods: From January 2021 to December 2023, a total of 409 patients visited tinnitus clinic of our hospital. All patients underwent otolaryngologic physical examination, full audiological assessment, blood tests and tinnitus questionnaire. Of these, 107 patients (26.2%) had chronic idiopathic tinnitus with normal hearing, and they were divided into zinc deficiency and zinc normal groups according to serum zinc levels. Serum zinc levels between 66 and 110 μg/dl were considered normal in this study. The demographic data, hearing thresholds, and tinnitus severity and loudness of the two groups were compared.
Results: According to serum zinc levels, 22 patients were in the zinc deficiency group and 85 were in the zinc normal group. There was no difference in age, tinnitus duration, and mean hearing threshold between the two groups. The zinc deficiency group's score on the Tinnitus Handicap Inventory (THI) was 48.09 ± 25.95, which was significantly higher than the zinc normal group's score of 36.28 ± 21.91, and among the subscale of THI, the functional subscale was significantly higher (19.09 ± 11.87 vs 13.13 ±9.68). There was no difference in the emotional and catastrophic subscale. In the tinnitus loudness matching test, the zinc deficiency group had a higher sensation level than the normal group, but there was no statistically significant difference.
Conclusion: The results of this study, which included only chronic idiopathic tinnitus patients with normal hearing, it was speculated that zinc deficiency could be considered a risk factor for functional worsening of tinnitus.

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IDENTIFICATION OF SNPS ASSOCIATED WITH CHRONIC SENSORINEURAL TINNITUS IN THE KOREAN POPULATION

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Background and Aim: Tinnitus is the perception of a sound without an external sound source, and affects 10 - 15% of the population. Despite its high prevalence, the genetic background of tinnitus is still largely uncharacterized. This study was performed to identify genetic variants associated with chronic sensorineural tinnitus using a genome-wide association study (GWAS).
Methods: Patients diagnosed with chronic sensorineural tinnitus with serviceable hearing were enrolled. Patients with an acute tinnitus duration of less than 3 months, severe-to-profound hearing loss, past history of mental illness, age under 18 years or over 70 years, and pregnant or breastfeeding status were excluded. A total of 275 tinnitus blood samples were genotyped with KoreanChip and compared with the results of 72,298 normal Korean subjects.
Results: We identified 13 novel loci (P < 5 × 10-8) associated with chronic sensorineural tinnitus. The most significant SNP (P = 1.75 × 10-29) was located in an intronic region of DLGAP2. In gene-based GWAS analysis, ERICH1, a gene adjacent to DLGAP2, was found to be significantly associated with tinnitus. In functional enrichment analyses, the most significantly associated gene ontology was 'sensory perception'. eQTL analysis identified FAM20C as a functionally associated gene; this gene was previously reported as a marker for cisplatin-induced tinnitus.
Conclusion: Our findings suggest that tinnitus is influenced by genetic variants; further exploration of these genetic variants will enhance our understanding of the pathophysiology of chronic sensorineural tinnitus and aid in the development of personalized treatments for tinnitus in the future.

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PREVALENCE OF SOMATOSENSORY TINNITUS IN INDIVIDUALS WITH TINNITUS

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Background And Aim: Tinnitus can be influenced by changes in somatosensory afference from the cervical spine or temporomandibular area, and this condition is referred to as somatosensory or somatic tinnitus (ST) (Michiels et al., 2022). It is demonstrated that afferent fibers, the cell bodies found in the dorsal root ganglia or the trigeminal ganglion, transmit somatosensory information from the cervical and temporomandibular regions to the brain. Additionally, these fibers also project to the central auditory system. This makes it possible for the somatosensory system to affect the auditory system by changing the synchronization or spontaneous firing rates of neurons in the auditory cortex, inferior colliculus, or cochlear nucleus. The prevalence of somatosensory tinnitus has been observed to vary significantly, with reported rates ranging from 39.40% to 80% (Marco et al., 2023; Pinchoff et al., 1998; Ralli et al., 2017; Vielsmeier, 2012; Theodoroff et al., 2022). The variation in reported prevalence underscores the need for standardized criteria when studying somatosensory tinnitus prevalence. However, there is a paucity of research evidence to understand the prevalence of somatosensory tinnitus in India. Comprehensive prevalence studies not only aid in measuring the disease burden but also provide insight into the healthcare demands for effective assessment and management. Hence, the present study aims to estimate the prevalence of somatosensory tinnitus in individuals with tinnitus.
Methods: A total of 132 participants in the age range of 18 – 65 years with tinnitus and hearing status varying from normal to severe hearing loss and from no handicap, to catastrophically handicapped on the tinnitus handicap inventory (THI) (Newman et al., 1996) were included in the study. All participants underwent phone screening using a Rapid screening tool for somatosensory tinnitus containing four criteria: 'Tinnitus and neck/jaw pain increase/decrease simultaneously,' 'Tension in suboccipital muscles,' 'Somatic modulation,' and 'Bruxism.' (Michiels et al., 2022).
Results: The study's results showed that the prevalence of somatosensory tinnitus was 23.25 %. The findings align with previous studies that reported a higher prevalence of somatosensory tinnitus using temporomandibular and cervical spine maneuvers (Ralli et al., 2017; Theodoroff et al., 2022). In addition, one noteworthy aspect that the study aimed to explore was the potential influence of gender on the prevalence of somatosensory tinnitus. The results indicate that a higher proportion of females were affected by somatosensory tinnitus than males. The gender ratio of males and females is 3:7. While this gender difference is intriguing, it is essential to interpret these findings cautiously and within the broader context of somatosensory tinnitus research.
Conclusion: The results of this study underscore the need for further research on somatosensory tinnitus. The relatively high prevalence rate and gender differences observed in this study highlight the importance of addressing somatosensory tinnitus as a significant health concern. Future studies should aim to investigate the underlying causes of somatosensory tinnitus and develop effective interventions to mitigate its impact on the lives of affected individuals.

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PREVALENCE OF HYPERACUSIS AND MISOPHONIA AMONG INDIVIDUALS WITH TINNITUS

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Background and Aim: Tinnitus often accompanies other auditory conditions like hyperacusis, marked by heightened sound sensitivity, and misophonia, which elicits strong emotional or physiological responses to specific sounds. The coexistence of tinnitus and hyperacusis is documented in a few studies in the scientific literature. Andersson et al. (2002) found that approximately 40% of the tinnitus participants also reported hyperacusis symptoms. Some individuals with tinnitus also experience misophonia, as discussed by Jastreboff et al. (2014); while not specifically focused on prevalence, this study suggested overlapping mechanisms between the two conditions. However, there's a lack of prevalence studies, especially in India, regarding hyperacusis and misophonia in individuals reporting tinnitus symptoms. Thus, this study aims to estimate the prevalence of hyperacusis and/or misophonia in individuals with tinnitus along with the difference in prevalence between genders.
Methods: The study involved 150 participants with tinnitus for six months in the age range of 18 to 50 years, including both males (80) and females (70). The Tinnitus Handicap Inventory was employed to assess the severity of tinnitus experienced by each individual. Furthermore, the Khalfa Hyperacusis Questionnaire was administered to detect the presence of Hyperacusis. In contrast, the Amsterdam Misophonia Scale (A-MISO-S) was administered to the patients to identify the presence of misophonia.
Results: The results revealed that 21.27% of the individuals with tinnitus had hyperacusis, and 2.12% had misophonia coexisting with tinnitus. It was found that 8.51% of individuals with tinnitus had complaints of both hyperacusis and misophonia. This data correlates with the previous study conducted by Baguley et al. (2013) where out of a large cohort of tinnitus patients, approximately 40% exhibited symptoms consistent with hyperacusis alone.
The gender ratio was analyzed, revealing that males constituted the majority, by a slight factor, affected by comorbidities of tinnitus, comprising 32.65% of the cohort. It was found that 4.08% of males had misophonia with tinnitus, while no females reported misophonia. 22.22% of females reported hyperacusis, while 20.4% of males reported hyperacusis with tinnitus. 8.88% of females and 8.16% of males reported the presence of both hyperacusis and misophonia, and tinnitus. This finding is consistent with previous research indicating a higher prevalence of tinnitus among males (McCormack et al., 2016). Interestingly, the prevalence of misophonia coexisting with tinnitus was notably low among males, with only 4.08% of males reporting this combination of symptoms. This gender discrepancy in the prevalence of misophonia may reflect differences in the recognition and reporting of sensory aversion symptoms between males and females, as well as potential sociocultural influences shaping symptom expression and perception.

Conclusion: The findings from these studies underscore the importance of detailed assessments for patients presenting with tinnitus symptoms, suggesting that evaluations should extend to screening for accompanying conditions such as hyperacusis and misophonia. This comprehensive approach enables audiologists and healthcare professionals to tailor treatment plans effectively. Expanded inquiry into the overlap between these auditory conditions holds promise for refining diagnostic protocols and enhancing treatment efficacy with better rehabilitative strategies for individuals with tinnitus alongside hyperacusis and/or misophonia.

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ANALYSIS OF AUDITORY BRAIN STEM RESPONSE AND OTOACOUSTIC EMISSION IN UNILATERAL TINNITUS PATIENTS WITH NORMAL HEARING

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Background and Aim: In patients with unilateral tinnitus with normal hearing, several studies have compared the ipsilateral and contralateral ears; however, few studies have investigated its relationship with the duration of tinnitus. We compared the auditory brainstem response and otoacoustic emission parameters between ipsilateral and contralateral ears in adults with unilateral tinnitus and normal hearing.
Methods: This retrospective review included 84 patients with unilateral tinnitus and normal hearing who underwent auditory brainstem response and otoacoustic emission; they were categorized according to the duration of tinnitus. The latencies and amplitudes of waves I, III, and V, and V/I ratio of both ears in auditory brainstem response, and the results of distortion-product otoacoustic emission and transient evoked otoacoustic emission were examined. The auditory brainstem response parameters, distortion-product otoacoustic emission parameters, and transient evoked otoacoustic emission parameters between the ipsilateral and contralateral ears along the duration of tinnitus were analyzed. Moreover, the failure rates of both distortion-product otoacoustic emission and transient evoked otoacoustic emission between the ears along with the duration and the effects of the variables on the amplitude and latency of each wave were examined.
Results: In this study, laterality seemed to have an effect on wave I latency in the multiple linear regression analysis. The distortion-product otoacoustic emission failure rate of the ipsilateral ear was higher than that of the contralateral ear in all patients. However, there was no remarkable difference between the ears in the distortion-product otoacoustic emission and transient evoked otoacoustic emission parameters throughout the duration.
Conclusion: We found that outer hair cells and the distal portion of the cochlear nerve are possible pathologic lesions in tinnitus with normal hearing and cochlear synaptopathy could be suspected. Further studies, including those on inner hair cells and higher central cortex, are needed. This study has been published in Auris Nasus Larynx.

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ASSOCIATION BETWEEN CANNABIS AND TINNITUS: COULD LOUD MUSIC LISTENING UNDER CANNABIS INFLUENCE BE THE MISSING LINK?

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Background and Aim: Given the recent legalization of cannabis in various countries, there has been a growing interest in researching the benefits and consequences of cannabis use. These potential benefits include its therapeutic applications for a wide range of chronic conditions such as depression, anxiety, and pain. Consequently, therapeutic cannabis use for auditory chronic conditions like tinnitus has been proposed. Tinnitus, characterized by the perception of sound in the absence of an external source, is believed to stem from abnormal neuronal activity within the auditory system. Animal studies have identified potential cannabinoid receptors within the auditory central system that could modulate neuronal responses and potentially alleviate tinnitus. However, the mechanisms by which these receptors may impact tinnitus remain unclear. Furthermore, recent epidemiological studies have established a significant association between cannabis use and tinnitus. However, they have not found correlations between the severity or frequency of tinnitus and the quantity or frequency of cannabis use. The objective of the present study is to compare two groups of cannabis users, one with and one without tinnitus, regarding multiple facets of cannabis use (frequency, quantity, etc.), current therapeutic use and music perception both with and without the influence of cannabis.
Methods: A total of 107 cannabis users (Tinnitus=64, Controls=43) completed an online questionnaire designed to gather sociodemographic characteristics (age, household income, marital status, gender, employment status, etc.), and collect information about cannabis use, self-perceived auditory acuity, noise sensitivity, and the interactions between music perception and cannabis use.
Results: The two groups were comparable on all sociodemographic characteristics except for age and depressive symptoms: the tinnitus group was composed of younger participants (aged 18-34, $p<.001$) and scored significantly higher on the BDI depression questionnaire (19

vs 12, p=.004). Permanent and occasional tinnitus was reported by thirteen and fifty-one respondents, respectively. An increase in tinnitus was reported by 14% (n=9), whereas a decrease was reported by 19% (n=12), no effect by 25% (n=16) and 42% (n=27) were unsure about its effect. The tinnitus group significantly self-reported poorer hearing (p=.007) and greater sensitivity to noise (p=.02). The average number of years of cannabis use was significantly lower for the tinnitus group (7.9 vs. 12.6 years, p=.011), and all other aspects of cannabis use were similar between the two groups. The use of cannabis to treat health conditions was also comparable and no respondents reported using cannabis to treat tinnitus. Musicianship and frequency of music listening were similar between the two groups. However, a significantly higher proportion of tinnitus respondents reported listening to music at a louder level while under the influence of cannabis (p<.001). Furthermore, a significantly higher proportion of tinnitus respondents reported experiencing muffled hearing (p=.029) and sound distortion (p=.004) only after listening to music under the influence of cannabis.
Conclusion: The current findings don't support previous views that cannabis use causes increased tinnitus or that tinnitus causes increased cannabis use. Data from the current study suggest that the association between cannabis use and tinnitus may be explained by exposure to loud music while under the influence of cannabis.

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OCCUPATIONAL NOISE EXPOSURE: EARLY AUDIOLOGICAL AND PHYSIOLOGICAL SIGNS OF NOISE-INDUCED HEARING LOSS AND MENTAL HEALTH OUTCOMES

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Background and Aim: Hearing loss is one of the most frequent risk factors for chronic tinnitus. This observational study aimed to monitor early audiological and physiological signs of noise-induced hearing loss as well as mental health-related outcomes of occupational noise exposure.
Methods: Twenty-eight hospital employees working in the cafeterias and the central kitchen of the Jena University Hospital (JUH) have been examined using noise dosimeters to monitor individual noise exposure during their work shifts. We conducted pure tone audiometry, the Oldenburger Sentence Test (OLSA) for speech discrimination, and brainstem-evoked response audiometry (BERA) to capture physiological data related to changes in the inner ear. As part of the psychological measurements, depression, anxiety, psychosocial stress levels, somatic symptoms, and noise annoyance were assessed.
Results: Results showed an average noise exposure of 76 dB SPL(A) and short-term maximum levels of 136 dB SPL(CP) at the workplace. We also found an above-average hearing loss in the frequency range of around 6 kHz, which could be associated with increased noise exposure. The OLSA indicated normative speech discrimination abilities in background noise among participants. High noise exposure was associated with lower amplitudes in the first wave of the BERA response, independently of participants' age ($p = .02$). Adverse effects of increased noise exposure on mental health were mediated by subjectively perceived noise annoyance ($p < .05$) and noise sensitivity ($p < .01$). Noise annoyance was strongly correlated with anxiety ($r = .57$, $p < .01$), psychosocial stress ($r = .52$, $p < .01$), and depression ($r = .50$, $p < .01$). The participants reported experiencing noticeable somatic symptoms, predominantly including back and joint pain.
Conclusion: As noise annoyance and sensitivity are significant factors in determining the impact of noise exposure on individuals, this study emphasizes the relevance of assessing subjective perception and cognitive evaluation of the noise environment to create a healthy workplace. We aim to use these findings to develop preventive measures in our upcoming project phases.
Acknowledgment: Research was supported by the BGN and the German Research Council (DFG)

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PREVALENCE OF MISOKINESIA AND MISOPHONIA AMONG ADULT POPULATION IN INDIA

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Background and Aim: Misophonia and misokinesia represent two distinct but closely related sensory processing disorders characterized by aversive reactions to specific stimuli. Misophonia involves intense emotional and physiological responses to certain sounds, while misokinesia encompasses similar reactions triggered by repetitive movements (Schröder et al., 2013). Despite their conceptual overlap, research exploring the coexistence and interaction between the two remains limited it represents a significant concern due to its impact on daily functioning and mental health. Studies investigating the prevalence of misophonia and misokinesia individually have reported prevalence rates ranging from 6% to 20% for misophonia (Edelstein et al., 2013) and 20% to 80% for misokinesia (Rouw & Erfanian, 2018). However, few studies have specifically addressed the co-occurrence of these conditions.
Methods: The study considered 450 adults (240 females and 210 males) with normal hearing and no otological complaints for the study. The participants of the study were in the age range of 18-50 years across the country. All the participants provided their informed consent to participate in the study. Demographic details and presence or absence of misophonia and misokinesia was determined for all the participants. Those who reported symptoms of misophonia and/or misokinesia, the Misphonia Assessment Questionnaire (MAQ) and

Misokinesia Assessment Questionnaire (MkAQ) was administered respectively. The severeity of misophonia was determined using the scores of the questionnaire. The prevalence of misophonia and misokinesia and its co-occurrence was determined.
Results: The results of the study showed that the prevalence of misophonia was 16.89% and the prevalence of misokinesia was 5.34%. It was also found that the prevalence of co-occurrence of misophonia and misokineisa was 8.89%. The study found that the prevalence was more in females compared to males for misophonia, misokinesia and co-occurrence. The spearman correlation coefficient showed that there was a moderate negative correlation between scores of MAQ and MkAQ and age of the participants. This showed that younger adults had higher severity compared to the older adults.
Conclusion: In conclusion, this study provides evidence of the prevalence and co-occurrence of misophonia and misokinesia, highlighting gender differences and age-related patterns in sensory aversion experiences. The findings underscore the importance of recognizing and addressing sensory processing disorders within clinical practice and research. Future efforts should focus on refining diagnostic criteria, developing targeted interventions, and promoting interdisciplinary collaboration to improve outcomes for individuals affected by misophonia, misokinesia, and their co-occurrence.

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INVESTIGATING THE LONGITUDINAL RELATIONSHIP BETWEEN TINNITUS AND COGNITIVE DECLINE

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Tinnitus is not simply an auditory disorder but a biopsychosocial condition that affects sensory, cognitive, emotional and behavioural domains. Hearing loss, stress, anxiety and depression are significant risk factors for both tinnitus and dementia. Taken together with other population studies, it may be possible that tinnitus may be a risk factor for cognitive decline. However, there are other studies that suggest that tinnitus may be a protector for cognitive performance. In the current poster, we use The Longitudinal Study of Ageing (TILDA) in Republic of Ireland to disentangle the relationship between tinnitus s and cognitive decline. The TILDA dataset is organised into Waves and each wave consists of 2 years. Here, we examine the relationship between tinnitus (on a subjective scale from 1-5) and cognitive function (Montreal Cognitive Assessment and Mini-Mental State Examination scores) a□er controlling for age, hearing loss (assessed using a subjective self-report score), depression and anxiety using Waves 4 and 5 of the TILDA data set. We also present the odds of developing cognitive impairment in the presence of tinnitus after controlling for confounding factors.

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KEYNOTE: MEASURING TINNITUS IN THE CLINIC AND FOR RESEARCH

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In the Clinic, measuring tinnitus helps the patient understand it is real, and distinguishes the 1) Tinnitus from the 2) Reactions to Tinnitus (The Psychological Model). Loudness and pitch ratings are straightforward, and masking the tinnitus can be useful for directing sound therapy. The Tinnitus Primary Functions Questionnaire determines which areas are needed for counseling....1) Thoughts and Emotions, 2) Hearing, 3) Sleep and/or 4) Concentration, in Tinnitus Activities Treatment. There are many subtypes of tinnitus, that are evident when measuring masking, post-masking effects, and post-masking recovery. There is now a greater appreciation that there are different subgroups of tinnitus patients, and the careful selection of subgroups needed to be applied to drug and other treatment trials.

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ROUND TABLE: HYPERACUSIS AND OTHER SOUND TOLERANCE DISORDERS

Chair: *Philippe Fournier*
Panel Members: *Myriam Westcott, Fatima Husain, Julie Campbell, David Eddins, Sylvie Hébert*

Summary: Publications about hyperacusis and other sound tolerance disorders have grown exponentially in the last decade. Unfortunately, the definitions, criteria, and tools for diagnosis and management are still scarce. In this round table, experts will share their experience with patients presenting with such symptoms and how they proceed to study, diagnose and manage them. Attendees will be invited to join the discussion and ask questions.

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A STUDY ON ELECTRODERMAL ACTIVITY UNDER ACUTE STRESS AND NOISE EXPOSURE IN TINNITUS INDIVIDUALS

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Background and Aim: High levels of stress, anxiety, depression, and noise hypersensitivity are common complaints in tinnitus sufferers. Previous work showed abnormal cortisol responses to stress in individuals with tinnitus, suggestive of maladaptive physiological adaptation. Stress responses are partly mediated by the autonomic nervous system (ANS), for instance cardiac and electrodermal activity.

Since tinnitus individuals often experience modulatory effect of noise and stress on tinnitus perception, the main objective of this study was to examine the relationship between ANS activity, namely heart rate, heart rate variability, and electrodermal activity, and tinnitus perception under acute stress and noise exposure, and to determine how tinnitus chronicity and psychological traits influence these responses.
Methods: Individuals with tinnitus and controls without tinnitus were exposed to a mental arithmetic task and a low-frequency broadband noise in a controlled laboratory environment, with interspersed rest periods. Cardiac and electrodermal markers of ANS activity were collected, alongside with subjective stress and tinnitus perception. Psychological profiles were identified through validated questionnaires on perceived stress (PSS), anxiety and depression (HADS), coping strategies (BRIEF-Cope), tinnitus distress (TFI) and noise sensitivity (HQ).
Results: Preliminary analyses indicate a strong increase in skin conductance levels after mental task, but not after noise exposure, which suggests that the noise did not induce stress in either group. Accordingly, stress ratings only increased after mental task compared to noise and rest periods. Interestingly, chronic tinnitus individuals did not report changes post-exposure, whereas participants with more recent tinnitus onset reported an increase in loudness after noise exposure, and a reduction in annoyance after mental stress. In accordance with our previous findings on healthy subjects showing maladaptive over-reactivity to noise exposure in noise sensitive and avoidant individuals, and lower reactivity to acute stress in chronic stressed and noise sensitive individuals, we expect a negative correlation between ANS reactivity (change between rest and task) and tinnitus duration for both mental and noise tasks. We also expect a co-modulation between ANS and tinnitus perception: the lower reactivity, the lower tinnitus modulation.
Conclusion: The current data imply adaptive changes in the ANS among those with tinnitus, particularly influenced by tinnitus duration. The findings indicate that recent tinnitus is more susceptible to modulation by stress and noise, whereas chronic tinnitus shows resilience, potentially indicating a compensatory mechanism of regions involved in stress response over auditory processing. Ongoing analyses focus on a potential co-modulation of tinnitus perception and ANS activity, including the impact of psychological factors on these interactions.
Kw: stress, autonomic nervous system, noise sensitivity, acute stress, tinnitus, sympathetic, parasympathetic

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ANGIOTENSIN II AND -(1–7) CONCENTRATIONS IN HUMAN HAIR SAMPLES REFLECT THE DEGREE OF TINNITUS-RELATED DISTRESS
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Background and Aim: Despite various attempts, no reliable biomarkers that objectively quantify the degree of tinnitus-related distress have been identified yet. Since the distress levels are at present primarily assessed via psychometric questionnaires, which are prone to subjective bias and require the active participation of the patient, such measures would represent a significant step forward in clinical practice.
Methods: Here, we introduce the inflammation-regulating peptide hormones angiotensin II and -(1–7) [Ang II and Ang-(1–7)] as potential biomarkers of tinnitus-related distress and present a newly developed method to determine their concentration in hair samples.
Results: Both concentrations were significantly lower in chronic tinnitus patients with higher distress levels, i.e., those for which the Tinnitus Questionnaire (TQ) indicated a de-compensated symptom severity. Regression modelling showed that out of a wide range of audiometric, psychometric, and sociodemographic variables, the TQ scores were the best predictors of the Ang II and Ang-(1–7) concentrations. Moreover, Ang-(1–7) concentrations, along with marital status, tinnitus type, and education level, significantly predicted the TQ scores.
Conclusion: Particularly Ang-(1–7) represents a promising biomarker candidate that may specifically reflect the degree of tinnitus-related distress sustained over extended periods of time.

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COMPARATIVE STUDY OF TUMOR NECROSIS FACTOR ALFA (TNF-A) AND IMPACT OF TINNITUS ON THE QUALITY OF LIFE OF OLDER ADULTS
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Background and Aim: Tinnitus is a common symptomatic manifestation, that can contribute to cognitive decline, anxiety, stress, and depression, impacting the quality of life of older adults more frequently. Aging-related inflammation may be one of the processes involved in the origin of this symptom, since inflammatory responses can occur in the inner ear under various damaging conditions, producing pro-inflammatory cytokines like tumor necrosis factor alfa (TNF-α). Therefore, this study aimed to investigate the serum levels of TNF-α and its association with the sensation and consequences of tinnitus on the quality of life of older adults.
Methods: This was a cross-sectional study with a sample of 103 independent older adults, aged 60 years or above, of both sexes, physically independent. Information about personal history was obtained through interviews containing data about gender, age, presence of diseases, and history of exposure to occupational noise. The participants were asked about the presence or absence of tinnitus, the duration of the manifestation, and the type of tinnitus (continuous or intermittent). Subjects underwent audiological evaluation with otoscopy and pure tone audiometry. They were invited to report how intensely they perceived tinnitus on the Visual Analog Scale (VAS), which assesses the level of intensity of the symptom, consisting of a visual graphic tool to determine the volume level or intensity or discomfort caused by the tinnitus, on a scale of 0-10. Flow cytometry was used to measure serum inflammatory markers like TNF-α, interleukin-2, interleukin-4, interleukin-6, interleukin-10, and interferon-gamma. For statistical analysis, the chi-square, Mann-Whitney, and Kruskal-Wallis tests were used, and the effect size was calculated.
Results: Six of the 10 older adults did not complete the assessment and were excluded from the sample. Thus, 97 participants, with a mean age of 70.6 ± 7.7 years, were analyzed. Tinnitus was reported by 50.1% (n = 50) of them and was associated with both hearing loss ($p = 0.007$; $\Phi = 0.272$) and previous noise exposure with $p < 0,05$ ($p = 0.049$; $\Phi = 0.202$). There were no differences between groups with and without tinnitus regarding cytokines ($p>0,05$). Additionally, there was a significant difference in TNF-α levels between VAS intense and mild groups ($p=0.041$; E2R=0.12), the intense group had higher values.
Conclusion: This study results show that TNF-α serum levels are higher in the intense group compared to the mild group in the VAS. Therefore, this demonstrates a correlation between the severity of tinnitus and the serum levels of TNF-α, suggesting that cytokines may play a role in the pathogenesis of tinnitus. It was also demonstrated that further studies with more robust designs should address the severity of tinnitus with cytokines and acquire more in-depth knowledge, as well as strategies to recover health conditions.
Keywords: cytokines, biomarker, aging, tinnitus, TNF-α

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HARMONIZING RESTING STATE FUNCTIONAL MRI DATA TO FIND MARKERS OF TINNITUS IN BRAIN CONNECTIVITY USING DEEP LEARNING

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Background and Aim: The neuroscientific understanding of tinnitus is limited at present, partly due to lack of neuroimaging data. Data collection is often impeded by low patient counts and doubled costs against scanning ample controls. However, with increase in data sharing trends, data scarcity can be overcome with 'harmonization' methods if scans from independent sites and studies are combined successfully. To achieve data harmonization with limited 'n' of tinnitus participants, we merge our modest MRI dataset (n=87) with matched samples from another large dataset of controls, the Lifespan Human Connectome Project (HCP; n=725). We measured whole-brain functional connectivity (FC) based on resting-state scans and used deep learning architecture in order to systematically pool individual FCs across datasets. We assembled and trained neural network modules to purge dataset-dependent factors from FC while simultaneously preserving connectivity patterns that effectively distinguish tinnitus from controls.
Methods: Preprocessed resting state functional MRI scans were used to measure correlation-based FC between brain regions, for tinnitus and control participants in our dataset as well as age and gender matched controls in HCP. A dataset identifier module was pre-trained using multivariate logistic regression to predict the data source from individual FC irrespective of tinnitus status. Next, a variational autoencoder was trained to encode and decode individual FC, with loss function set to penalize the error in estimated FC, along with the dataset identifier's prediction on the estimated FC. Training was performed over 500 epochs and 20 repetitions on randomly drawn and matched HCP data, and class-balance maintained with our data. Concurrently the estimated FC matrices were input to a binary tinnitus classifier, a feedforward fully-connected neural network module, which was trained to predict class labels (tinnitus/control) based on individuals' groups identity. In addition to training and testing data, performance was tracked for the left-out tinnitus and control data, and also other individuals having hearing loss with/without tinnitus.
Results: The dataset-identifier predicted the source data on FC with 99.4% accuracy for participants in our dataset, and 93.3% for HCP. Over the training period of autoencoder, the estimated FC showed steadily decreasing reconstruction error in conjunction with low dataset identifiability. The dataset-identifier predictions were closer to chance accuracy for estimated FC, in contrast to high accuracy for the actual FC. Lastly, the tinnitus classifier could predict labels with better accuracy on estimated FC than actual FC. Although the classifier was trained only on tinnitus and control data, the probability predictions for controls' estimated FC were significantly lesser not only than those for tinnitus', but also other non-control groups such as hearing loss with and without tinnitus.
Conclusion: Leveraging multiple databases can be a useful innovation around insufficient patient data in neuroimaging tinnitus studies - not only in relieving statistical demands, but also in introducing participant heterogeneity in the data. While combining independent datasets is not straightforward due to variability in a range of complex parameters across sites, deep learning-based methods are capable of eliminating irrelevant site-specific noise in the data, and amplifying the neural markers of interest in tinnitus.

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OUTCOME MEASURES THAT TINNITUS PATIENTS CARE ABOUT

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1 Tinnitus Hub

Background and Aim: Are we measuring the right things when it comes to assessing the success of clinical trials for tinnitus interventions? From a patient perspective, the answer is no.
Methods: We will be presenting several alternative self-report measures that are derived from survey data collected from the Tinnitus Talk community as well as qualitative analysis of posts on the Tinnitus Talk forum.
Results: We know from surveys that what patients care most about is loudness reduction. Yet, in most trials, there is no attempt to measure this, nor is the patient even asked about perceived loudness. Only one question out of 25 on the Tinnitus Functional Index questionnaire covers perceived loudness, while the Tinnitus Handicap Inventory (the most used tool for outcome measurement) does not include any such question. Furthermore, patients are often not asked directly "to what extent did this intervention help you?", thus negating the patient's own experience of the treatment. Finally, qualitative analysis of hundreds of thousands of posts on the Tinnitus Talk forum shows that some of the ways in which patients define improvement are not captured in standard tools, such as reduced variability of one's tinnitus, improvement in the type of phantom sound (e.g. frequency or tone), or reduced symptoms of co-morbidities like hyperacusis.
Conclusion: Loudness reduction, and an objective way of measuring this, would be the holy grail of tinnitus interventions for many tinnitus sufferers. In the absence of this, however, much can be done to improve the way we measure success and align more closely with patient expectations. Further development of new self-report measures will require a series of close consultations between the patient and research community.

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OUTCOME MEASURES IN TINNITUS RESEARCH: THE METHODOLOGICAL PERSPECTIVE

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Intervention studies in tinnitus research aim to improve the lives of tinnitus patients by assessing the effectiveness of treatments for tinnitus. Adequate methodology of those studies improves the implementation and usefulness of the results of these studies. An important part of the methodology of clinical studies is the measurement of the outcomes of a study. For tinnitus, this is often done with questionnaires, assessing the impact, burden or distress of tinnitus, or with VAS scores assessing for example loudness. Over the past decades many efforts have been made to develop those outcome measures. Also, first steps have been taken into making the use of the different outcomes more homogeneous in the field. In this presentation we will interactively discuss the statistical issues concerning outcome measurement. We will focus on the methodological and statistical issues of using outcome measures in tinnitus research. An example of those issues is the (mis)use of categorization of outcome measures. We will discuss the topic of categorization of outcome measures and provide statistical tips and tricks for the use of outcome measures.

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TINNITUS OUTCOME MEASURE; WHAT IT BROUGHT US, WHERE IT LEAVES US IN TINNITUS CARE.

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Background and Aim: Within tinnitus care and research, a large variety of tinnitus outcome measures are used. In clinical studies, assessing therapeutic interventions, tinnitus outcomes are mainly questionnaire based. These tinnitus (symptom) questionnaires provide a quantification of symptoms. However, since the introduction of the first questionnaire, a wide variety of validated, as well as non-validated, questionnaire has entered the field. The large variety and limitations of these measures hinders progress in the field of tinnitus health care.
Methods: In this presentation we will focus on the advantages made in recent years on the development of tinnitus outcome measures, their validation and the domains of outcomes which are assessed by these measures. Also, we will discuss the relation between these measures and outcomes which are of importance to patients. Methodological limitations will be discussed, and practical examples will be used to demonstrate the gap which needs to be filled to improve tinnitus health care in the future. Recommendations will be made how to make progress in this field

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THE POTENTIAL FOR OBJECTIVE TESTING OF TINNITUS IN HUMANS

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Tinnitus assessment in humans currently relies on questionnaires and self-reported loudness measurements. Contrastingly, in animals, objective assessment of tinnitus is the only method for detecting the presence of a phantom percept following either noise exposure or administration of a drug such as sodium salicylate. Development of objective assessments that can be used in both animals and humans would allow bridging of the o□-mentioned gap between animal and human studies. This would also crucially benefit intervention studies in terms of an objective outcome measure and potentially account for some of the heterogeneity in treatment efficacy across patients. Yet, how far from this possibility are we and is it realis□c? I will discuss studies that have attempted to develop objective assessments for tinnitus in both animals and humans, and report rare data that we recorded from an intracranially-implanted epilepsy

patient with intermittent tinnitus, using an adaptation of an animal measure. Finally, I will reflect on what we can do to potentially leverage data from other individuals with intermittent tinnitus to work towards objective biomarkers.

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THE 83 SYMPTOMS OF TINNITUS: CONTENT OVERLAP OF COMMONLY USED SCALES FOR TINNITUS DISTRESS

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Background and Aim: Tinnitus poses a challenge due to unclear etiology and diverse clinical manifestations. A variety of patient-reported outcome measures (PROMs) are being used to assess tinnitus distress without consensus on a gold-standard instrument. PROMs are often chosen based on practical criteria, but the implicit assumptions of interchangeability among instruments are untested. A comprehensive evaluation of tinnitus-distress PROMs is lacking. This study aims to investigate the overlap of symptoms between 8 commonly used tinnitus-distress PROMs.
Methods: A two-stage rating process was used to analyze 199 items from 8 psychometrically validated tinnitus distress questionnaires, namely the Iowa Tinnitus Activities Questionnaire (ITA), International Tinnitus Inventory (ITI), Subjective Tinnitus Severity Scale (STSS), Tinnitus Functional Index (TFI), Tinnitus Handicap Inventory (THI), Tinnitus Handicap Questionnaire (THQ), Tinnitus Questionnaire (TQ), and Tinnitus Reaction Questionnaire (TRQ). The Jaccard Index was used to measure pairwise content overlap between items from the PROMs.
Results: The analysis revealed 83 distinct symptoms. The TQ exhibited the highest number of idiosyncratic symptoms (i.e., not occurring in another PROM; 42.5%), while the THI had the least (4%). On average, each symptom appeared in 2 scales. 41 symptoms (49.4%) were unique to one scale, while “concentration” was the most frequently captured symptom (in 7 of 8 scales). The Jaccard Index revelated very weak/weak scale overlap between the PROMs. The highest overlap was observed between TFI and THI and both also had the highest mean overlap with the other PROMs.
Conclusion: The results demonstrate high symptom heterogeneity and limited content overlap among the investigated PROMs, as has been observed for other conditions. The TFI and THI exhibited the highest mean overlap with the other PROMs, suggesting most comprehensive coverage. The most featured symptoms were largely consistent with previously identified core outcome domains. However, somatic complaints and pain were underrepresented despite their known association with tinnitus distress. The findings suggest that tinnitus distress is not a unified construct across questionnaires, and researchers and clinicians should carefully consider the specific symptoms measured when selecting instruments for assessment and intervention evaluation.

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TINNITUS SUBGROUPS BASED ON SUPRA THRESHOLD HEARING CHARACTERISTICS

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Background and Aim: Hearing loss has been identified as the biggest risk factor for tinnitus and the majority of people with tinnitus have a measurable hearing loss. Hearing loss does not only lead to a reduction in audibility but can also cause supra threshold hearing deficits, such as impaired binaural, spectral or temporal processing abilities. M any tinnitus patients report difficulties with various supra threshold hearing abilities such as speech perception in noise. However, the majority of previous studies that investigated these difficulties were mainly based on self-reported challenges. Systematic and well controlled studies comparing these supra threshold hearing abilities between tinnitus patients and controls are therefore necessary to further increase the understanding of how tinnitus affects the hearing. Furthermore, a more comprehensive view of the hearing deficits based on an auditory test battery would allow for a classification of patients into subgroups that could be used for more personalized hearing aid fittings. The first aim of the study was to investigate if the supra threshold hearing abilities differed between a tinnitus group and a matched control group. The second aim of the study was to subgroup the tinnitus participants based on their supra threshold hearing abilities and investigate how the subgroups were related to the perceived tinnitus stress. This will be followed by an investigation of subgroup specific hearing aid fittings.
Methods: In this study, the supra threshold hearing abilities of tinnitus participants were measured with a test battery consisting of five psychophysical measurements in addition to standard audiometry. Moreover, the speech perception, the loudness perception, the spectro-temporal modulation sensitivity the temporal fine structure processing and the binaural pitch detection were measured. Furthermore, the tinnitus distress was evaluated with the Tinnitus Functional Index, while the tinnitus loudness and pitch were measured with psychoacoustic tests. The supra threshold hearing abilities of the tinnitus group were compared to a matched control group without tinnitus. The tinnitus participants were stratified into subgroups based on their supra threshold hearing abilities.
Results: The results showed that the tinnitus group were more sensitive to loud sounds, which was shown both in the self-reported hyperacusis evaluation and in the categorical loudness measurement. Suggesting that changes occur in the loudness perception with the onset of tinnitus. Furthermore, both the measured and self-reported speech perception were wors e in the tinnitus group compared to the matched control group. However, no differences were found between the groups when comparing the binaural processing abilities.
Conclusions: These results suggest, that the large individual differences in the supra threshold measurements in the tinnitus groups which can be utilized to subgroup the participants based on their hearing abilities.
abilities. Further investigation of the subgroups is needed to evaluate the possible clinical applications.

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LONG TERM TOTAL REMISSION OF TINNITUS: FACT OR MYTH?

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Background and Aim: Tinnitus sufferers aim to be cured, but there is a widespread disbelief among professionals about total remission of tinnitus. Randomized clinical trials with different approaches haven´t shown this outcome, but in disagreement, clinical practice reveals that it may occur unexpectedly. Thus, our study aims to interview and follow-up individuals who have experienced total remission of tinnitus to identify their common characteristics.
Methods: Volunteers were included with the following criteria: a) any gender and age; b) past daily perception of uni- or bilateral tinnitus for at least 3 months (subacute or chronic tinnitus); c) current total remission of tinnitus - defined in this study as "lack of tinnitus perception, even during silence and attention" - for at least 6 months. Eventual short reappearances that have last maximum 2 days and were related to upper airway infections, noise exposure, pain or stress were disregarded. The main exclusion criterion was the comfortable state of habituation / masking by daily sounds. Participants were interviewed about their ex-tinnitus characteristics and the current total remission status. Once included, follow-up has been made every 6 months.
Results: 1) The sample was composed by 162 participants (age 09-89, average 53±17.1; 69.1% females). Ex-tinnitus characteristics used to be: a) bilateral (50%); b) pure tone sound (49.4%); c) annoyance score (0-10 scale) 7.5±2.5, with predominance of high annoyance (scores 8-10) in 59.3%; d) average duration 43±62.3 months before entering in total remission. 2) So far, total remission: a) last 0.5 - 43 years (average 5.5 years); b) was possible to be reached disregarded of tinnitus duration or subject's age and gender; c) was mostly reached by maximum of 2 treatment attempts (58.6%); d) occurred gradually (76.5%). Additionally, semestral follow-up was made for 6 to 66 months after inclusion, and the tinnitus relapse rate over time was 22.2% (36/162).
Conclusion: Long term total remission of tinnitus, for more than 6 months, is a fact which may be achievable in patients with any age, gender or tinnitus duration, localization, type of sound or degree of annoyance. From the neuroscience perspective, the predominance of gradual disappearance and the tendency to keep the status of total remission may suggest that tinnitus-related neuronal activity slowly, but firmly, loses strength in central auditory pathways till the point of complete no perception, even in silence and paying attention to it. These and future data about total tinnitus remission may trigger a change in the widespread disbelief among professionals about total remission of tinnitus.
Keywords: Tinnitus remission, follow-up, treatment, rehabilitation, cure

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THE SIZE ANALYSIS OF STAPEDIUS AND TENSOR TYMPANI MUSCLES IN CT SCAN IN PATIENTS WITH MIDDLE EAR MYOCLONIC TINNITUS

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Objectives: This study was performed to analyze the sizes of the stapedius and tensor tympani muscles using a temporal bone CT (TBCT) scan in patients with middle ear myoclonic tinnitus (MEMT) and to investigate its clinical value for the diagnosis and management of this rare and unique cause of objective tinnitus.
Methods: The medical records and TBCT scans of patients diagnosed with MEMT who underwent middle ear tendon resection, and vascular tinnitus (VT) at The Catholic University of Korea, Seoul St. Mary's Hospital from January 2012 to December 2022 were retrospectively reviewed. The stapedius and tensor tympani muscle dimensions were measured in TBCT and an an analysis comparing the pathologic sides of the MEMT and VT group as a control was performed. A correlation study of the patient demographics, clinical characteristics, and muscle dimensions was also performed.
Result: A total of 38 patients with unilateral MEMT (n=24, 63.2% men, n=14, 36.8% women) who underwent middle ear tendon resection for intractable tinnitus and 39 patients with vascular tinnitus (n=8, 20.5% men, n=31, 79.5% women) were included in the study. More males were in the MEMT group when compared to the VT group (MEMT: n=24, 63.2%, VT: n=8, 20.5% p=0.001). The MEMT group was younger when compared to the VT group (MEMT: 35 ± 12 years, VT: 44 ± 14.3 years, p=0.005). The BMI for the MEMT group was less than the VT group (MEMT: 22.3 ± 2.5, VT: 24.8 ± 4.36 p=0.010). The duration of symptoms before the first consult for the MEMT and VT groups were 27.8 ± 29.4 months and 23 ± 33.3 months respectively. The length and width of the stapedius in the MEMT group were significantly larger than that of the VT group (stapedius length: MEMT 1.47 ± 0.60mm, VT 0.98 ± 0.24mm, p=0.001; stapedius width: MEMT 0.89 ± 0.32mm, VT: 0.72 ± 0.19mm, p=0.009). The length and width of the tensor tympani in the MEMT group were significantly larger than that of the VT group (tensor tympani length: MEMT 3.10 ± 0.50mm, VT: 2.27 ± 0.42, p=0.001; tensor tympani width: MEMT 2.02 ± 0.36, VT: 1.75 ± 0.26 p=0.001).
Conclusion: The length and width of the stapedius and tensor tympani muscles measured in TBCT in the MEMT group were significantly longer and wider than those of the VT group. This suggests a possible value of the TBCT scan as a diagnostic tool for MEMT when used as an adjunct with other clinical findings. Further studies with thinner TBCT cuts and a larger study group to validate the results of this study will be needed.
Key words; Middle Ear Myoclonic Tinnitus, Size Analysis, Muscles, CT Scan

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SHORT AND SWEET: LONG-LASTING THERAPY SUCCESS AFTER INTERDISCIPLINARY TINNITUS TREATMENT - A 5-YEAR FOLLOW-UP STUDY

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Background and Aim: This study focused on the five-year follow-up of the Jena Interdisciplinary Treatment for Tinnitus (JITT), which is a comprehensive day-care approach for treating chronic tinnitus patients. The therapy program consists of a five-day intensive treatment involving cognitive behavioral therapists, hearing aid acousticians, ENT doctors, and specialists for medical rehabilitation. This study aimed to assess the 5-year effectiveness of JITT in reducing tinnitus-related distress.
Methods: To evaluate the effectiveness of JITT, tinnitus-related distress was measured using the Tinnitus Questionnaire (TQ) before therapy (t0) at the beginning and end of treatment (t1, t2) as well as two weeks, six months, and five years after treatment (t3, t4, t5). The study involved a representative group of 297 patients who underwent the JITT program at the Jena University Hospital. Data were analyzed using repeated measures and mixed model ANOVAs, as well as Little's test, considering the missing data mechanism.
Results: The results showed a significant improvement in tinnitus-related distress after therapy, with a large effect size. On average, patients experienced a 19-point improvement on the TQ scale, which transformed decompensated to compensated symptom levels in most cases. The improvement remained stable after two weeks and up to 5 years. Patients benefited from therapy regardless of the initial severity level of tinnitus-related distress. Only one group of patients with medium decompensated severity levels showed a significant early change (improvement between t0 and t1).
Conclusion: These findings provide strong evidence for the effectiveness of JITT in reducing tinnitus-related distress. The program has the potential to promote long-lasting changes, regardless of the initial severity level of tinnitus-related distress and despite the brevity of the intervention. The robustness of effects cannot be attributed to responder bias

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WHAT IS THE ROLE OF THE HIPPOCAMPUS AND PARAHIPPOCAMPAL GYRUS IN THE PERSISTENCE OF TINNITUS?

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The hippocampus and parahippocampal gyrus have been implicated as part of a tinnitus network by a number of studies. These structures are usually considered in the context of a "limbic system," a concept typically invoked to explain the emotional response to tinnitus. Despite this common framing, it is not apparent from current literature that this is necessarily the main functional role of these structures in persistent tinnitus. Here, we highlight a different role that encompasses their most commonly implicated functional position within the brain-that is, as a memory system. We consider tinnitus as an auditory object that is held in memory, which may be made persistent by associated activity from the hippocampus and parahippocampal gyrus. Evidence from animal and human studies implicating these structures in tinnitus is reviewed and used as an anchor for this hypothesis. We highlight the potential for the hippocampus/ parahippocampal gyrus to facilitate maintenance of the memory of the tinnitus percept via communication with auditory cortex, rather than (or in addition to) mediating emotional responses to this percept.

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UTILIZATION OF TRANSCANAL RECORDINGS FOR OBJECTIFICATION OF PULSATILE TINNITUS

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Background and Aim: Pulsatile Tinnitus (PT) is a type of tinnitus which can be produced by underlying vascular pathologies of arterial or venous origins. PT can sometimes be heard through bare-listening or auscultation, however, sensitivity is poor. Many research groups, including ours, have begun implementing in-clinic transcanal recordings to better understand the categorization of the sounds perceived. Patients with PT caused by an arterial source, such as a fistula, often describe their tinnitus as high pitched, whereas PT caused by a venous source is often described as a whooshing, humming, or buzzing sound. Transcanal recordings offer a promising approach to objectively assess PT sounds and correlate them with underlying anatomical anomalies. Our study investigated the utility of transcanal recordings and corresponding spectrograms to objectively classify PT sounds and correlate them with underlying venous anatomical anomalies.
Methods: A cohort study was conducted involving 89 patients with PT. Transcanal recordings were performed during patient clinic visits using a microphone placed within the ear canal, capturing sound pressure waves generated by PT. Spectrograms obtained from these recordings were analyzed to classify PT sounds and were correlated with venous anatomical features identified from contrast enhanced, venous phase diagnostic imaging, such as magnetic resonance venography (MRV), computed tomography venography (CTV), and digitally subtracted angiography (DSA).
Results: Four distinct patterns of PT sounds were identified based on spectrogram appearance of transcanal recordings: broadband, narrowband, heartbeat, and negative. Broadband sounds were found to be associated with venous anomalies such as transverse sinus stenosis and mastoid bone dehiscence/diverticulum. Narrowband sounds were predominantly identified for patients with a dural arteriovenous fistula (dAVF).

Conclusion: These findings suggest that transcanal recordings can be a valuable diagnostic tool for PT objectification and characterization the structural causes and hemodynamic mechanisms underlying PT. Broadband sounds may be indicative of venous anomalies, while narrowband sounds could signal a dAVF. Transcanal recordings offer a promising adjunctive tool for objectively assessing PT sounds from their spectral characteristics and correlating these with underlying anatomical anomalies. This approach holds potential for improving diagnostic accuracy and guiding personalized treatment strategies for patients with PT.

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UNDERSTANDING THE SOUND PRODUCTION MECHANISM OF PULSATILE TINNITUS USING COMPUTATIONAL FLUID DYNAMICS

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Background and Aim: Pulsatile Tinnitus (PT) is a debilitating symptom of a rhythmic "whooshing" sound perceived in the absence of an external stimulus. Vascular PT often stems from underlying pathologies of the blood vessels nearing the cochlea resulting in audible turbulent blood flow. Venous pathologies such as transverse sinus stenosis, high riding jugular bulbs and prominent emissary veins may cause PT. Turbulent blood flow can be observed through vascular imaging as high-pressure gradients and high velocity measurements, and clinically through auscultation and transcanal recordings. Recent work has shown that computational fluid dynamics (CFD) can be used as a noninvasive diagnostic tool to assess the hemodynamics of these vessels and assess the distinct sounds produced. It provides high spatiotemporal resolution where conventional anatomic imaging, such as computed tomography venogram (CTV) and magnetic resonance imaging venogram (MRV), cannot. In 2021, our research group demonstrated a landmark case which the CFD derived PT sound matched the patients self-reported PT, highlighting its potential utility as a non-invasive diagnostic tool. Since then, we have simulated 12 transverse sinus stenosis models with different stenosis morphologies.
Methods:
This study included medical images from patients presenting with unilateral pulsatile tinnitus caused by transverse sinus stenosis who were treated with endovascular stenting. High-fidelity CFD was performed on 3D models digitally segmented from CTV, using patient-calculated flowrates. Spectral power index (SPI) was calculated from the CFD wall shear stress data to visualize areas experiencing flow instabilities. Data-driven sonification of the velocity data was performed from spectrograms at regions of interest.
Results: In this study, we present the results from those 12 CFD simulations highlighting the distinct and complex flow patterns giving arise to diverse PT sounds in patients. SPI maps revealed localized regions of flow disturbances, particularly in the sigmoid-jugular region, downstream of the stenosis, corresponding with site of sound production of PT. Comparison of spectrograms unveiled distinct acoustic signatures corresponding to the unique PT sounds reported by patients. This auditory analysis further corroborates the link between hemodynamic alterations and subjective PT perception.
Conclusion: Our results highlight the multifaceted relationship between vascular hemodynamics and PT generation, emphasizing the potential of CFD as a non-invasive diagnostic tool for assessing PT and guiding therapeutic interventions

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THE APPLICATION OF DISTORTION PRODUCT OTOACOUSTIC EMISSION FOR THE OBJECTIVE MEASUREMENT OF VASCULAR PULSATILE TINNITUS

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Background and Aim: The development of an objective method for the assessment of vascular pulsatile tinnitus (VPT) may be of great value during the diagnosis and evaluation. During the distortion product otoacoustic emission (DPOAE) measurement, some noise in the ear canal is inevitably recorded. We aimed to find out whether VPT can be objectively measured using noise measured during the DPOAE test.
Methods: We retrospectively reviewed the medical records of patients with unilateral VPT who visited Seoul St. Mary's hospital between March 2019 and May 2023 and had radiologically confirmed vascular abnormalities. A standard audiologic workup including DPOAE was performed. DPOAE noise data were obtained at six frequency bins (1, 1.4, 2, 2.8, 4, and 6 kHz) for both ear.
Results: A total of 29 patients was included in the study. The mean age was 41.3 years with three months of mean symptom duration. The laterality of the lesion was 24 on the right ear and 5 on the left ear. The DPOAE noise on the VPT side was 1.27 ± 2.04 dB louder at 1 kHz, 0.84 ± 2.87 dB louder at 1.4 kHz, 0.73 ± 2.54 dB louder at 2 kHz, 0.33 ± 2.19 dB louder at 2.8 kHz, 0.11 ± 2.64 dB louder at 4 kHz, and 0.97 ± 2.09 dB louder at 6 kHz than the ears without tinnitus. The incidence of pseudo-low frequency hearing loss (pseudo-LFHL) was observed in 7 individuals (24%). In cases with pseudo-LFHL, the measurement values of OAE noise were higher compared to cases without pseudo-LFHL, although this difference did not reach statistical significance. Following the water occlusion test (WOT), 17 individuals (59%) exhibited a positive result, 8 individuals (28%) showed a partial result, and 4 individuals (14%) had a negative result. There was no statistically significant correlation between the presence of noise and WOT results, even though noise levels were higher in positive or partial cases compared to negative cases.
Conclusion: Although the DPOAE noise on the VPT side was generally higher than that of the ear without tinnitus, it was not a statistically significant difference. Also, greater noise was measured at frequencies below 2 kHz than at higher frequencies. The feasibility of the application of DPOAE noise for the objective measurement of VPT requires more clinical data.

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LIVING WITH PULSATILE TINNITUS: A SELF-NARRATIVE USING MCADAM'S LEVELS OF PERSONALITY MODEL

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Background and Aim: Personality research on tinnitus has been quantitative and focused on the trait correlates (e.g., Baguley et al., 2013) of tinnitus distress. Apart from the various case studies or anecdotes that can be found on various social media sites, little research exists that has provided an integrative approach to understanding how tinnitus is tied to personality and well-being. Given this state, the aim of this self-narrative is to provide an account of the author's lived experiences with tinnitus through McAdam's holistic (2006) Levels of Personality Model.
Methods: The participant of this self-narrative study is an older, married adult male who developed bilateral pulsatile tinnitus in 2019. The participant is a professor versed in several areas of psychology (e.g., health and positive psychology), all of which informed his experiences. Testing suggested normal hearing with hyperacusis, stenosis, and temporomandibular disorder. Personal data (e.g., questionnaires) supplemented both primary (e.g., angiogram) and complementary care data (e.g., chiropractic). To assist the author in meeting his goals (habituation, decreased tinnitus/hyperacusis distress, remission), a multi-modal treatment approach was undertaken that included primary (e.g., stenting), complementary (e.g., tinnitus retraining therapy, acupuncture), and self-care (e.g., behavioural activation, acceptance) approaches.
Results: Dispositional traits characterize the first level of McAdam's model. The tinnitus-relevant traits and signature character strengths were Openness, Conscientiousness, Emotionality, Love of Learning, Appreciation of Beauty and Excellence, Creativity, and Hope. These traits/strengths informed the second and third levels of McAdam's model in relation to the author's tinnitus and well-being. The second level refers to contextually-based adaptations developed in response to unique life experiences (e.g., tinnitus). The author notes his goals as being influenced by several adaptations, including values (e.g., achievement), mindsets (e.g., hypothesis testing, toughness), and coping modalities (e.g., approach). These appear influenced by the traits and have evolved overtime in impacting the participant's well-being and tinnitus (e.g., habituation, distress reduction). The third level, Narrative Identity, is a detailed lived experience narrative focusing on the participant's stories and experiences. An overall narrative which evolved appears related to overcoming stress/adversity/returning to some state of normality. Analysis of several redemptive moments (e.g., 'realizing tinnitus can be lived with'), suggested underlying themes of coping and personal growth, and several life lessons (insights; e.g., importance of multiple treatment modalities) pertinent to his narrative identity. These redemptive elements and outcomes seem connected to the participant's traits and adaptations, in particular, openness and approach coping.
Conclusion: This self-narrative explored a novel approach to understanding the tinnitus experience and points to several takeaways including: (1) the benefits of using McAdams 'holistic' model to provide a holistic accounting of the tinnitus journey; (2) the use of various positive psychology strategies to bolster coping; (3) the sociocultural factors that 'freeze and unfreeze' behavioural change; and (4) the importance of a multi-modal approach in coping with tinnitus. Although the self-narrative has its merits (e.g., rich context for understanding tinnitus), issues of generalizability and potential for emphasizing and downplaying certain aspects of an experience are possible. Data checks and research data may help to minimize these concerns.

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FOREST FOR THE TREES: PRELIMINARY RESULTS OF NOVEL SIGMOID SINUS RESURFACING IN SUBJECTS WITH SIGMOID SINUS DEHISCENCE AND ADJACENT BROAD-BASED DIVERTICULUM

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Background and Aim: Pulsatile tinnitus (PT) is often associated with anomalies such as sigmoid sinus dehiscence (SS-Deh). Although sigmoid sinus resurfacing (SSR) surgery has been proven to be effective in subjects with SS-Deh, there are still cases of insufficient improvement after surgery. Based on the fact that SS-Deh frequently accompanies adjacent diverticulum (Div), we modified the surgical principle in subjects with combined SS-Deh/Div and report the preliminary surgical outcomes.
Methods: A retrospective case series of patients undergoing SSR at a single tertiary center by a single surgeon was reviewed. A total of 54 patients with SS-Deh were reviewed, of which 33 patients were treated with previously reported SSR with bone chip insertion and 21 patents treated SSR with smoothing of adjacent Div. Pre- and postoperative visual analog scale (VAS) loudness, VAS distress, and Tinnitus Handicap Inventory (THI) scores were compared.
Results: In the bone chip insertion group, the mean VAS loudness, VAS distress, and THI scores improved from 6.8 to 2.0, from 6.9 to 2.1, and from 51.7 to 16.8, respectively (all $P<0.001$). Meanwhile, in the SSR with adjacent Div smoothing group, the mean VAS loudness, VAS distress, and THI scores decreased from 7.5 to 1.6, from 7.4 to 1.7, and from 63.3 to 21.9, respectively (all $P<0.001$). Although the RM-ANOVA analysis did not reveal any statistically significant differences between the two groups, SSR with adjacent Div smoothing was superior to previous SSR with bone chip insertion because the latter had a higher rate of partial remission compared to the former. Conclusion: Judging from the current preliminary analysis, resurfacing the Deh and reducing the adjacent Div to the normal contour of the SS provides more stable surgical outcome probably because this novel surgical method removes the source of PT and blocks the route of PT transmission simultaneously.

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KEYNOTE ADDRESS: WAR ON TINNITUS

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Traditional evidence-based approaches have so far failed to develop any FDA or CE approved treatments after many years of tinnitus research. Thus, a new strategy is required.

Can we learn from the concept of war to develop better tinnitus treatments? In combined arms warfare the complementary strengths of the air force, ground troops and navy are used in concert to exert a maximal effect. Translating combined arms tactics to tinnitus we should adapt a multimodal approach. This means combining different ways to attack tinnitus, a combination of auditory, pharmacological, neuromodulatory, and psychology approaches, rather than limiting oneself to a unimodal approach. And within each modality multiple approaches may be combined, for example medication cocktails, hearing aids plus sound therapy, electrical stimulation combined with magnetic plus light-based neuromodulation. The pharmacological approach has been proven highly successful in fighting AIDS. By using 4 different drugs that each work on a different mechanism survival has increased from 5 years with 1 drug, to 20 years with 2, 40 with 3 and a normal life expectancy with 4 drugs.

The war on tinnitus concept leads to many novel multimodal treatment possibilities that need to be explored scientifically and clinically, in order to finally silence tinnitus.

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EXPLORING THE MULTIDIMENSIONAL NATURE OF LOUDNESS PERCEPTION

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Keywords: Hyperacusis, noise sensitivity, loudness, psychoacoustics, sound tolerance

Background and Aim: Conventional psychoacoustic measures lack sensitivity and specificity in diagnosing hyperacusis or other sound tolerance conditions. This limitation may stem from the predominant use of artificial stimuli and reliance on unidimensional scales in audiologic assessments. To address this gap, we propose assessing loudness across two distinct dimensions—sensory and affective—through the rating of natural sounds. Drawing from pain research, where intensity and unpleasantness are independently evaluated, we hypothesize that similar distinctions can be applied to loudness perception. For instance, music might be perceived as very loud but still pleasant, whereas screeching sounds could be rated as soft yet unpleasant. Our study aims to investigate how intensity, emotional valence of sound stimuli, and individual characteristics influence participants' ratings on sensory and affective scales. Here we investigate the multidimensional nature of loudness perception in the general, non-clinical population.
Methods: A sample of 102 young adults with normal hearing to mild hearing loss rated 32 sound stimuli categorized into four valences (pleasant, unpleasant, neutral, and artificial) presented at 10 different intensities (40 to 100 dBA) through headphones. The pleasant, unpleasant, and neutral sounds were sourced from the International Affective Digitized Sounds (IADS-2) stimuli bank, whereas the artificial stimuli consisted of pure tones or white or pink noise. Participants rated each sound on sensory (inaudible to too loud) and affective (pleasant to unpleasant) scales. Additionally, participants completed the Hyperacusis Questionnaire (HQ), Noise Sensitivity Scale (NSS), and Hospital Anxiety and Depression Scale (HADS). Mixed linear models with repeated measures were employed to analyze relationships between ratings, intensity, and questionnaire scores.
Results: A significant interaction between intensity, valence, and scale reveals that the impact of intensity on ratings fluctuates depending on the specific valence and scale being considered. On the sensory scale, as stimuli increase in intensity, they are, on average, rated louder, with minimal discernible differences between valences. On the affective scale, there's a noticeable difference between valences, but the trend remains—louder stimuli tend to be perceived as more unpleasant. Ratings between valences differ at all intensities except between artificial and unpleasant from 85 to 100 dBA, suggesting that artificial sounds were perceived as unpleasant sounds. Higher NSS scores predict louder ratings across all valences, and more unpleasant ratings for unpleasant and neutral but not pleasant sounds. HQ scores do not significantly affect ratings for any valence on either scale. Higher depression scores predict softer ratings for artificial sounds and less pleasant ratings for pleasant sounds.
Conclusion: This study underscores the importance of adopting multidimensional approaches to loudness assessment. This is the first study to challenge the use of unidimensional scales and artificial stimuli in loudness assessment. Noise sensitivity and depression scores emerge as valuable predictors of sensory and affective perception in a non-clinical sample. This new approach has the potential to differentiate between sub-types of hyperacusis and other sound tolerance conditions, paving the way for personalized treatment options. Moving forward, future research in loudness perception should consider integrating sensory and affective scales for a more comprehensive understanding.

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AUDITORY EMOTION PROCESSING IN HYPERACUSIS AND MISOPHONIA: A COMPREHENSIVE BEHAVIORAL AND FMRI STUDY

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Background and Aim: Hyperacusis, marked by an intolerance to a wide array of sounds, shares similarities with other sound tolerance disorders, such as misophonia. The latter is characterized by reduced tolerance to specific sounds or trigger stimuli, eliciting negative emotions, physiological reactions, and behavioral responses. Studies indicate the involvement of an altered auditory-limbic network in both hyperacusis and misophonia. Given the overlapping symptomatology and the shared neural regions implicated, differentiation between these disorders remains challenging and can lead to misdiagnosis. Our study aims to investigate emotion processing disparities between the two disorders. Furthermore, we aim to explore emotion processing in individuals experiencing both disorders, thereby contributing to a more nuanced understanding of the shared and distinct aspects of these disorders.
Methods: In this study, 92 participants aged 18 to 25 completed questionnaire assessments, psychological interviews, audiological valuations, and task-based functional magnetic resonance imaging (fMRI). All participants were classified into four groups based on the results of the hyperacusis questionnaire and psychological interviews: controls (C: N=25), hyperacusis (H: N=19), misophonia (M: N=29), and co-morbid hyperacusis and misophonia (MH: N=19). Pure tone audiometry was conducted to evaluate participants' hearing thresholds. Subsequently, participants engaged in an fMRI task where sounds from the International Affective Digitized Sounds-2 database were presented. Specifically, 30 sounds from each category—pleasant, unpleasant, and neutral—were extracted from the database and presented to the participants. They were instructed to evaluate the valence of each sound and categorize them accordingly. Simultaneously, we recorded their decision-making times, while their brain activity was continuously monitored through fMRI.
Results: Audiometric assessment revealed normal hearing thresholds (<25 dB HL) for all participants. Utilizing a linear mixed effects model, we found that hearing thresholds did not vary between groups. We analyzed the behavioral valence ratings using repeated measures ANOVA. The results indicate that H and MH groups rated significantly more sounds as unpleasant when compared to both C and M groups. Notably, the valence ratings of the H and MH group did not demonstrate a statistically significant difference. Furthermore, the time taken to categorize sounds did not differ across all four groups. It is important to note that the fMRI data is currently pending analysis.
Conclusion: Our study investigates the interplay of auditory and emotion processing in individuals with hyperacusis, misophonia, and their co-morbidity. The behavioral analysis of affective sounds has highlighted differences between groups, suggesting that emotional processing of sounds is affected when you have hyperacusis to a greater extent than if you have misophonia alone. With the planned fMRI data analysis, we intend to investigate the neural correlates of the observed behavioral differences.

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LOUDNESS AND AFFECTIVE RESPONSES TO NATURAL SOUNDS IN HYPERACUSIS

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Background and Aim: Reduced sound tolerance is a pathological condition for which tolerance to sounds is so reduced that normal tolerable everyday sounds induce discomfort. This general term encompasses different forms of reactions and responses to sounds including hypersensitivity to loud sounds (loudness hyperacusis) and aversion to specific sounds (misophonia). According to epidemiological studies, around 10 to 15% of the general population suffers from these disorders. They can greatly affect the quality of life and the socio-economic integration of individuals affected. A test using natural sounds at three intensities through headphones and asking the patient to rate their pleasantness on a visual analog scale (VAS) demonstrated very good accuracy in detecting loudness hyperacusis: the patients with hyperacusis significantly rated pleasant sounds as less pleasant than controls. To transfer these tests to clinicians and facilitate clinical applicability, a tablet application was developed. The main objective of the study was to validate previous findings using this new tablet version of the test. A second objective was to compare the loudness ratings of the natural sounds between the two groups of participants by adding a loudness visual analog scale (VAS).
Methods: A total of 50 participants were recruited, 21 presenting with loudness hyperacusis (HS: n = 21, mean age = 32, female/male = 11/9) and 29 controls (CT: n = 21, mean age = 26, female/male = 16/13). Patients with loudness hyperacusis were determined by three criteria: self-complaints of hypersensitivity to loud sounds, a score of ^{3} 22 on the Hyperacusis Questionnaire (HQ) and mean loudness discomfort levels of £ 77 dB HL at the worst ear. The natural sounds test battery was performed in a quiet room with the tablet application in a binaural mode of presentation under headphones for the most discriminant pleasant sounds of loudness hyperacusis (n=7) at three sound intensity levels (60-70-80 dB SPL). Ten misophonic trigger sounds (n=10) were also included. Each sound was presented randomly twice, and patients were asked to rate the sounds on two VAS scales, one going from ^{2}very pleasant to very unpleasant^{2} (affective ratings) and one from ^{2}very soft to very loud^{2} (loudness ratings).
Results: The affective ratings confirmed the previous findings: the pleasant sounds were significantly rated as less pleasant by the HS group compared to the CT group for all sound levels (overall mean score of 39 vs 25, respectively, p = .002). The loudness ratings revealed that pleasant sounds were significantly rated louder by the HS group compared to the CT group but only for sounds presented at 70- and 80-dB SPL (mean VAS score of 73 vs 63, p = .017 and 86 vs 73, p = .01, respectively), suggesting abnormal loudness in HS. No significant differences were found between the groups for either the pleasantness or the loudness of the misophonic trigger sounds.
Conclusion: Both sensory and affective responses are impacted by loudness hyperacusis, particularly following the presentation of pleasant sounds. These findings suggest that pleasant sounds may serve as optimal stimuli for diagnosing loudness hyperacusis. The tablet version of the test is suitable for clinical purposes.

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EXPERIMENTALLY MEASURING THE FUNCTIONAL IMPACT OF NOISY ENVIRONMENTS ON INDIVIDUALS WITH AND WITHOUT HYPERACUSIS

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Background and Aim: While there is ample epidemiological evidence suggesting an association between noise exposure and functional impact such as cognitive and/or reading deficits, the results of experimental research in humans are contradictory on this issue. The classical approach consists of testing a participant in silence and noise at fixed levels and then comparing the performances. This approach is problematic for several reasons: 1) it does not always reflect ecologically valid noise-affected situations, including daily activities, 2) it does not easily allow testing of different noises, 3) the individual noise sensitivity is not considered, despite a wide heterogeneity of noise sensitivity within the general population and among those suffering from auditory pathologies such as hyperacusis (hypersensitivity to loud sound). The current project proposes a novel individualized approach to assess the functional impact of noise: measuring the sound level required to disrupt a daily activity using common everyday immersive soundscapes.
Methods: A total of 50 participants were recruited, 21 presenting with hyperacusis symptoms (HS: n = 21, mean age = 32, female/male = 11/10) and 29 controls (CT: n = 21, mean age = 26, female/male = 16/13). All participants were sitting in the middle of a circle of speakers and were asked to read a book while a soundscape was presented and gradually increased (+2 dBA) until they reported not being able to read, called annoyance level (AL). The sound level was maintained for 30 seconds to confirm the inability to read and then further increased until the loudness discomfort level (LDL) was reached. Reading was chosen as it is a common daily activity known to be affected by noise and engaging cognitively. Participants were randomly tested in four soundscapes: cafeteria, kindergarten, car, and babble. Finally, participants were tested on a working memory updating task (2-back) in silence and all soundscapes (set at AL level).
Results: A significantly higher proportion of HS participants self-reported being bothered by noise when reading with 76 vs 38 % of HS and CT participants, respectively ($p = .007$). Annoyance level was obtained in at least one of the four tested soundscapes for all participants irrespective of their group. For LDL, similar findings were obtained. The sound intensity level for AL and LDL varied considerably across environments (e.g., mean Al of 64 vs 43 dB LAeq for car and babble noise, respectively). HS individuals exhibited lower annoyance and discomfort levels than CT (13 dB mean difference) across all environments, $F(1, 48) = 18.457$, $p < .001$. Moreover, a significantly decreased performance for the working memory update task of 3% was observed in all participants for all soundscapes compared to the silence condition, $F(1, 48) = 15.143$, $p < .001$.
Conclusion: Everyone can be functionally impacted by noise if the appropriate type and level of noise is used. Overall, hyperacusics are bothered by daily life sound environments at much lower levels than controls suggesting that they are potentially more impacted by noise day-to-day than normal individuals. The decrease in performance on the working memory updating task suggests the involvement of cognitive mechanisms in noise-related annoyance

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WORKSHOP: CONTRIBUTION OF MIDDLE EAR AND MULTIMODAL PLASTICITY TO TINNITUS AND HYPERACUSIS.

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Abstract (Arnaud Norena): In this presentation, I will present the hypothesis, as well as the data collected in patients, suggesting that the middle ear (especially the middle ear muscles) and the multimodal plasticity can account for specific sub- types of tinnitus and hyperacusis. I will also present the tools and approaches that can be used to assess the middle ear function, including a sensor pressure device that we have developed to objectify the tensor tympani contraction.

Abstract (Myriam Westcott): I will present a clinical perspective with case studies on the role of Tensor Tympani Syndrome (TTS) in hyperacusis and tinnitus patients. TTS symptoms have been associated with acoustic shock, are prevalent in most hyperacusis patients but also in tinnitus patients, and can frequently be sound-induced. The presentation, evaluation and effective treatment of TTS symptoms in a clinical setting has revealed insights into TTS triggers, the underlying somatic, neurological and psychological pathways and more broadly into hyperacusis mechanisms and tinnitus reactivity. This highlights the importance of TTS diagnosis and treatment, and the therapeutic benefit of identifying and demystifying the associated pathways.

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THERE IS WHERE I HEAR TINNITUS.

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Background and Aim: Critical to our understanding of tinnitus is how it is separated from other ongoing neural activity. The localization, “where”, of auditory events is an essential component of this process.
Methods: A scoping review was undertaken to determine the role of the perceived spatial location of tinnitus on neurophysiology and how this can be manipulated to reduce its perception.
Results: The literature indicates that: a tinnitus neural network influenced by perceived location of tinnitus exists, and that spatial tinnitus masking, auditory, multisensory, and virtual reality training can harness spatial cues to improve tinnitus treatment.
Conclusion: It is concluded that where tinnitus is heard may be equally, if not more, important in tinnitus management than other characteristics such as tinnitus pitch and loudness

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MIGRAINE ENHANCES TINNITUS PERCEPTION LEADING TO LOUD TINNITUS

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Background and Aim: While 10% of the U.S. population has experienced tinnitus, approximately 1-3% of the population experiences loud or fluctuating tinnitus. We propose the hypothesis that fluctuating tinnitus in some patients can be a migraine or central sensitivity disorder phenomenon, given the mechanistic and epidemiological associations between tinnitus and migraine.
Methods: English literature from PubMed with the keywords of “migraine” and “tinnitus” has been reviewed.
Results: Our proposed hypothesis stands on four pillars: 1) Migraine is more common in patients with tinnitus and vice versa. 2) Migraine causes enhanced tinnitus perception by increasing central sensitivity and thus attention to the tinnitus percept. Migraine also alters blood flow to the cochlea through the stimulation of the trigeminal ganglion leading to blood flow changes of the cochlear blood supply. This process leads to an enhancement of the perception of tinnitus by causing changes to hearing. 3) Migraine and tinnitus have common triggers including stress, sleep disturbances, dietary factors (caffeine, wine, etc.), weather changes, and exposure to loud sounds. 4) Most patients with fluctuating tinnitus have benefited from a treatment approach directed to treating an underlying atypical migraine process.
Conclusion: Otologic migraine, which is the effects of migraine on the ear and is often not accompanied by headaches, may be partly responsible for the link between tinnitus and migraine. Given the complex association between tinnitus and migraine, further investigation is needed to identify the underlying mechanisms and determine the optimal treatment strategies for managing migraine-related tinnitus patients

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COCHLEAR MIGRAINE: A NEW CONCEPT TO TREAT TINNITUS

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Background and Aim: Cochlear migraine (CM) is an often overlooked yet common condition linked to idiopathic tinnitus and hearing loss, sharing pathophysiological traits with vestibular migraine (VM), which is known for episodic vertigo and dizziness. A significant overlap exists, as treatments effective for VM have also been beneficial for tinnitus, pointing towards a shared "migraine mechanism" at play. This study aims to explore this mechanism's role in CM, particularly in its contribution to acute idiopathic tinnitus and the potential for targeted migraine management strategies.
Methods: This retrospective study reviewed the medical records of patients presenting with headache, vestibular, and cochlear symptoms at a community hospital's outpatient department from December 2016 to December 2017. Sixty-two patients who met the hypothetical criteria for CM were selected, excluding those with possible retro-cochlear lesions confirmed by magnetic resonance imaging. Data on demographics, audiometric findings, and clinical symptoms were collected, focusing on hearing loss characteristics, tinnitus, ear fullness, and their recurrence and severity. The clinical presentations of CM were categorized into four types through cluster analysis.
Results: Among the 62 patients analyzed, 20 were men and 42 women, aged between 27 to 72 years (mean age of 50). The study found a female to male ratio of 3.1, with peak incidence occurring between 30-60 years. Key findings include that 70% of patients experienced tinnitus, 60% had mild hearing loss, and a smaller percentage reported aural fullness, auditory allergy, and otalgia. Most hearing loss was mild and frequency-specific, with a significant portion of patients responding positively to migraine treatment.
Conclusion: We propose that the "migraine mechanism" serves as a unique mechanism for stress release in the brain, manifesting primarily through tinnitus, vertigo, and headache. Clinical observations indicate that these symptoms occur independently 80% of the time, suggesting that tinnitus or vertigo can be considered strong indicators of migraine activity. The chronic manifestation of tinnitus, identified as cochlear migraine (CM) with persistent prolonged-perceptive tinnitus (PPPT), shares pathophysiological similarities with vestibular migraine (VM), which is associated with persistent postural-perceptual dizziness (PPPD). Both conditions are thought to involve chronic neuroinflammation of the limbic system. Understanding this shared neuroinflammatory pathway opens new avenues for treating tinnitus through various migraine management strategies, focusing on the auditory system's top-down neuroinflammation

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RELATION BETWEEN DOMINANT TIME PERSPECTIVES AND TINNITUS ANNOYANCE

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Background and Aim: The construct of time perspectives is associated with a specific attitude towards the past, present and future. Zimbardo and Boyd distinguished five different time perspectives, including: past-negative, past-positive, present-hedonistic, present fatalistic and future. Time perspective plays a significant role in the context of mental health. Past research showed a positive correlation between the past-negative perspective and symptoms of depression and anxiety. Time perspective is also important among people with serious mental illnesses, such as severe depression or schizophrenia, especially in the context of a negative view of the past and present (past-negative, present fatalistic). Additionally, relationships between time perspectives and psychological distress among chronic pain patients were identified. Higher scores on the past-negative scale were associated with greater symptoms of anxiety and depression, while higher scores on the future scale were associated with lower symptoms of depression. The relationship between specific time perspectives and depression or chronic pain established the starting point for this study. Its aim is to try to answer the question whether having a specific dominant time perspective (especially past-negative) in patients with tinnitus is associated with greater tinnitus annoyance.
Methods: To measure tinnitus annoyance, Polish adaptations of the Tinnitus Handicap Inventory and Tinnitus Functional Index questionnaires, as well as the VAS annoyance scale were used. The Polish Short Version of the Zimbardo Time Perspective Inventory questionnaire consisting of subscales corresponding to particular time perspectives was used to determine time perspectives profile and dominant time perspective(s), defined as subscale(s) with the highest score. The study additionally measured the degree of satisfaction with life (Satisfaction with Life Scale) and the occurrence of depressive symptoms (Center for Epidemiologic Studies Depression Scale).
Results and Conclusions: The analysis of the obtained results can help to understand whether and how time perspectives may influence the occurrence of specific medical symptoms, in this case the tinnitus annoyance. The work may establish a contribution to a better understanding of the psychological mechanisms influencing the experience of tinnitus and hence propose novel aspects within the psychological approach to treatment that should be addressed.

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PREDICTION MODELS IN TINNITUS RESEARCH: HOW WE DO IT, AND WHAT WE NEED TO CREATE IMPACT.

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Background and Aim: Clinical prediction models are developed widely across medical disciplines. Three steps have to be taken before a model can be used in clinical practice: model development, validation and impact analyses. Regrettably, most models don't make it any further than the development phase. In this presentation we will discuss the status of prediction models in tinnitus research.
Methods: We conducted a systematic review of excising prediction models assessing tinnitus presence and tinnitus impact on daily live. We systematically searched the PubMed and EMBASE databases for articles published up to January 2021. We included all studies that reported on multivariable prediction models for tinnitus presence or the impact of tinnitus on daily life. Risk of bias was assessed with PROBAST. Secondly, we developed a multivariable prediction model using elastic net logistic regression with data from the Dutch Lifelines Cohort Study. This is a multigenerational cohort study on adults who are located in the northern parts of the Netherlands. The model was internally validated using 10-fold cross-validation. The outcome of the model was tinnitus presence, for which we used 24 candidate predictors on different domains (among others demographic, hearing specific, and mental health variables). We assessed the overall predictive performance, discrimination, and calibration of the model.
Results: In the systematic review twenty-one development studies were included, with a total of 31 prediction models. Seventeen studies made a prediction model for the impact of tinnitus on daily life, three studies made a prediction model for tinnitus presence and one study made models for both. The risk of bias was high and reporting was poor in all studies. The most used predictors in the final impact on daily life models were depression- or anxiety-associated questionnaire scores. Demographic predictors were most common in final presence models. No models were internally or externally validated. For the development of the prediction model data on 122.884 different participants were included, of which 7,965 (6.5%, 0 missing) experienced tinnitus. Nine variables were included in the final model: sex, hearing aids, hearing limitations, arterial blood pressure, quality of sleep, general health, symptom checklist of somatic complaints, cardiovascular risk factors, and age. In the final model, the Brier score was 0.056 and 0.787 in internal validation.
Conclusion: From the systematic review we concluded that all published prediction models were poorly reported and had a high risk of bias. The prediction model which was created in the current was based on nine variables with a good model performance. In the presentation the usability of the current prediction models will be discussed, and methodological recommendations will be made to further develop and validation prediction models for tinnitus. Researchers should consider the importance and clinical relevance of the models they develop and should consider validation of existing models before developing new ones

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A SCHEMA MODE-MODEL APPROACH FOR UNDERSTANDING CHRONIC TINNITUS-RELATED DISTRESS

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Background and Aim: Chronic tinnitus denotes a persistent, often medically unexplained symptom, which is not attributable to any verifiable, conventionally defined disease process. The most commonly investigated type of psychotherapy are cognitive behavioural

therapies (CBT). This umbrella of treatments conceptualize distress via self-perpetuating cycles of patients' (autobiographically and environmentally influenced) thoughts, feelings, and behaviours. Amongst CBTs, schema therapy Is gaining momentum as a promising approach for treating emotional distress across a variety of symptom presentations 1. Here, vicious cycles are formulated and treated using a dynamically shifting cognitive-affective "schema mode" framework. The paper presents two studies examining the schema mode model in patients with chronic tinnitus.
Methods: Paper 1 (a) compares schema mode expressions in a large sample of patients with chronic tinnitus with published reference values and (b) examines correlations of the schema mode constructs with other established distress measures. Paper 2 (a) uses factor analysis to identify underlying variables in a variety of common emotional distress measures in chronic tinnitus patients, and (b) aims to link the emerging factors to the schema mode model.
Results: Paper 1: Patients reported mild-to-moderate levels of emotional distress. Compared to healthy controls, patients showed (1) high relative expressions of the child-, detachment and compliant coping modes and (2) a conspicuously low relative expression of the 'punitive parent' mode. Correlational patterns suggested strong associations between (1) parent as well as angry child modes and perceived stress and anxiety, (2) the vulnerable child mode and all measured constructs and (3) emotional distress and - intrapersonally - emotional detachment as well as - interpersonally - alleged compliance. Paper 2: A three-factor solution explained 37.4% of variance and represented 78% of the originally included items. Following item content examination, the factors represented (1) General emotional distress, (2) Tinnitus-attributed emotional distress, and (3) Socio-audiological impairment. Factors 1|2 correlated highly ($r = 0.70$), Factors 2|3 moderately ($r = 0.62$). Linked to the schema mode model, Factor 1 correlated highly with the "vulnerable child" mode ($r = 0.78$), and moderately with the "parent", "angry child", and "detached protector" modes ($0.53 < r < 0.65$). Factor 2 correlated moderately with the "vulnerable child" mode ($r = 0.53$). Factor 3 was largely uncorrelated with SMI-r scores – although a low correlation with the "detached protector" mode warrants further examination.
Conclusion: Initial clinical evidence suggests relevance and applicability of schema-mode based formulation and treatment planning in patients with chronic tinnitus. "General" and "tinnitus-attributed" emotional distress correlate highly – warranting holistic (not symptom-specific) psychological case conceptualization and treatment planning. Within the schema mode model, the "vulnerable child" explains substantial variance across both dimensions. Thus, psychological distress experiences, which reflect biographically anchored, unmet emotional needs, may constitute a transdiagnostic psychological key treatment target.
Keywords: chronic tinnitus, psychological therapy, schema therapy, emotional avoidance

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ANALYSIS OF LOUDNESS DISCOMFORT LEVEL TESTS IN TINNITUS PATIENTS
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Background and Aim: We aimed to investigate the clinical significance of loudness discomfort level (LDL) test in tinnitus patients and its relationship with pure-tone audiometry, tinnitogram and questionnaires.
Methods: We retrospectively reviewed the medical records of 320 tinnitus patients who visited a tertiary university hospital's tinnitus clinic and completed LDL tests between March 2020 and December 2022. Epidemiological data and psychoacoustic test results were collected.
Results: LDL showed no significant differences between frequencies for both ears. Mean LDL did not correlate with mean pure-tone average or hearing thresholds at each frequency. The hearing loss group had higher LDL at 8 kHz compared to the normal hearing group ($p<0.01$). Objective sound intolerance was found in a quarter, correlating with subjective hyperacusis, anxiety, and depression. Weak negative correlations were found between most of questionnaire's scores and LDL on the left side. Tinnitus loudness weak negatively correlated with LDL at most frequencies, except 8 kHz.
Conclusion: Our findings suggest a notable association between LDL levels and emotional factors in tinnitus patients, rather than with auditory thresholds. While lateralized differences in LDL responses were observed, specifically on the left side, these preliminary results do not confirm a causal link and thus do not warrant changes to current clinical testing protocols without further research

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TINNITUS DISTRESS AND THE STEELING/SENSITIZATION HYPOTHESES: A SECONDARY DATA ANALYSIS
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Background and Aim: It is commonly believed that stress has linear effects on health (Sensitization Hypothesis) such that greater levels of stress lead to greater health problems. An alternative perspective is that a moderate degree of stress toughens, and emboldens one with a sense of mastery over the adversity, in part, by strengthening one's coping skills (Steeling Hypothesis; e.g., Holtge et al., 2018). Research further suggests that those with tinnitus are variable in their coping responses and that stress can exacerbate their tinnitus experience. One explanation is that individuals reporting low and high levels of past stress relative to those who have experienced moderate levels of stress, would be more likely to experience greater tinnitus distress, less resiliency, and poor health. The present study set out to compare the steeling hypothesis with the sensitization model in those who report experiencing 'ringing in the ears.' In accordance with the steeling hypothesis, it was hypothesized that those experiencing moderate life stress and tinnitus distress would also report more adaptive coping, greater resiliency, and better health.
Methods: Three-hundred and twelve young adults participated in this study (Mean Age = 19 years). All participants filled out a battery of questionnaires including measures of life stress/hassles, a personality questionnaire, a coping measure, self-regulation, self-compassion,

time perspective, symptom ('ringing in the ears'), health behaviours, affect, and health status. All of the personality variables were selected using McAdams (1995) Levels of Personality Model of traits and characteristic adaptations. The study (secondary evaluation), which was conducted in a lab setting, conformed to the Tri-Council Policy Ethical Guidelines of Canada, and was reviewed by an institutional Research Ethics Board.

Results: Preliminary secondary analyses indicated that tinnitus distress was positively correlated with family health history, negative life stress, daily hassles (2) and perceived stress, denial/substance use/humour/self-blame/music/distraction coping, negative affect, physical problems, neuroticism, and past negative time perspective. The ringing in the ears variable was also negatively correlated with emotional stability, mental health, preventive health behaviour, life satisfaction, positive affect, self-compassion, and self-regulation. Further analyses will include hierarchical multiple regression analyses with squared stress and tinnitus distress scores (Steeling) as predictors and coping, tinnitus distress, self-compassion and regulation, health behaviour, and well-being as criteria.

Conclusion:

The preliminary findings from this study supports past research (e.g., coping) and sheds new light on the relationship of tinnitus distress to personality (e.g., self-compassion) and stress. Further analyses in support of the Steeling Hypothesis would help to explain why some individuals with tinnitus are more resilient relative to other sufferers. One implication is that moderate levels of stress exposure may be helpful in 'toughening' (Dienstbier, 1989) individuals with tinnitus, consistent with a cognitive-behavioural model of tinnitus avoidance. Although this cross-sectional research is correlational and warranting the usual caveats surrounding causality, the research suggests that tinnitus is a biopsychosocial experience. The research also demonstrates a significant test of two stress models with appropriate controls in a young population.

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CORRELATION BETWEEN TINNITUS SEVERITY AND THE BIG FIVE PERSONALITY TRAITS

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Introduction: Psychological factors were previously related to tinnitus perception and distress, playing a modulatory role. Previous work demonstrated that personality traits may be a predictor of the severity of tinnitus, with impact on the individual response to tinnitus. Aim: To analyze tinnitus severity amongst different personality traits.

Method: Fifty tinnitus patients with tinnitus lasting for at least 6 months filled out the questionnaires NEO-FFI and THI, and also VAS scales for volume and distress. The THI and VAS scores were statistically correlated to the personality traits. Results: Most frequent personality trait scored was neuroticism (36% high and 32% very high). For the other four personality traits, high and very high scores ranged from 16% to 18%. There was a positive correlation between higher THI scores and VAS for volume values and neuroticism (p= 0.011 and 0.012 respectively), but not for VAS distress (p=0.19). A negative correlation between THI scores and conscientiousness level was also found (p= 0.014). Severe and catastrophic THI scores were positively correlated to neuroticism (p=0.028).

Discussion: Neuroticism trait is related to anxiety and fear and has been previously related to tinnitus severity. It is a well-established fact that tinnitus distress is related to anxiety and depression, so that was an expected correlation. On the other hand, conscientiousness was negatively correlated to THI scores, meaning that individuals who are organized and dependable seem to cope better with their tinnitus.

Conclusion: Tinnitus distress is positively correlated to neuroticism trait and negatively correlated to conscientiousness trait. The analysis of personality traits may be helpful to subtype tinnitus and, consequently, improve therapeutic strategies.

Key words: Tinnitus, Tinnitus Handicap Inventory, Personality traits

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TINNITUS CHARACTERISTICS IN PATIENTS WITH IDIOPATHIC SUDDEN SENSORINEURAL HEARING LOSS AND ACUTE TINNITUS

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Background and Aim: Tinnitus is a common symptom of idiopathic sudden sensorineural hearing loss (ISSHL). This study aimed to investigate the characteristics and outcomes of acute tinnitus in patients with ISSHL.

Methods: A total of 59 patients with ISSHL and acute tinnitus were enrolled. All patients underwent audiological assessment, tinnitus matching for loudness and frequency, and steroid treatment for sudden hearing loss. Tinnitus-related distress was assessed using the tinnitus handicap inventory (THI) questionnaire. The outcomes of hearing recovery and tinnitus remission were investigated retrospectively.

Results: The loudness and pitch of acute tinnitus were 63.2 ± 22.4 dB HL and 2010.63 ± 2368.99 Hz, respectively. Complete and partial recovery rates of acute tinnitus in ISSHL patients were 32.2% and 39% according to the THI scores. The group with complete recovery of hearing showed significantly greater improvement in tinnitus distress than the group with no improvement in hearing. The loudness and pitch of tinnitus did not correlate with tinnitus remission.

Conclusion: Hearing recovery is more important for tinnitus remission than the psychoacoustic characteristics of acute tinnitus. Timely identification and proper treatment of hearing loss are important to improve tinnitus remission in patients with ISSHL.

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RELATION OF SOUND LEVEL TOLERANCE TO TINNITUS IN HUMAN: A COMPARATIVE ANALYSIS OF UNILATERAL, BILATERAL, AND CONTROL GROUPS

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Background and Aim: Several studies have demonstrated that individuals with tinnitus exhibit significantly reduced sound level tolerance compared to control subjects. However, these studies did not differentiate between groups with unilateral and bilateral tinnitus during the analyses. We aim to investigate and evaluate the relationship between sound level tolerance and tinnitus in humans by conducting separate comparisons of subjects with unilateral tinnitus, subjects with bilateral tinnitus, and control subjects.
Materials and Methods: The human subjects in this study comprised 33 individuals with bilateral tinnitus and 33 individuals with unilateral tinnitus, all with normal and symmetric hearing thresholds. We compared the loudness discomfort level (LDL) with 500 and 3000 Hz pure tones among the tinnitus ears and non-tinnitus ears of those with unilateral tinnitus, the tinnitus ears of those with bilateral tinnitus, and the control ears of normal subjects. Additionally, we compared LDL between tinnitus subjects who reported hyperacusis and those who did not.
Results: Both the tinnitus ears (108.18 ± 10.22 dB HL and 103.03 ± 11.04 dB HL) and non-tinnitus ears (108.94 dB HL ± 12.61 and 104.24 ± 11.60 dB HL) in the unilateral tinnitus subjects showed significantly lower LDLs at 500 Hz and 3000 Hz than the control ears (115.91 ± 6.78 dB HL and 111.52 ± 8.88 dB HL, $p < 0.008$; $\alpha = 0.05/6 = 0.008$). However, there was no difference in the LDLs of the tinnitus ears of the bilateral tinnitus subjects (111.52 ± 10.42 dB HL or 106.36 ± 11.34 dB HL) and the control ears. The tinnitus ears without hyperacusis (110.59 ± 9.73 dB HL and 105.98 ± 10.77 dB HL) and the tinnitus ears with hyperacusis (107.33 ± 12.37 dB HL and 100.33 ± 12.02 dB HL) showed significantly lower LDLs at 500 Hz and 3000 Hz than the control ears (500 Hz, $p = 0.003$ and 0.002, respectively; 3000 Hz, $p = 0.012$ and 0.002, respectively; $\alpha = 0.05/3$). Non-tinnitus ears with hyperacusis (105.50 ± 11.89 dB HL and 101.00 ± 9.66 dB HL) exhibited significantly lower LDL than the control ears at 500 Hz and 3000 Hz, respectively (500 Hz, $p = 0.004$; 3000 Hz, $p = 0.004$; $\alpha = 0.05/3$). However, there were no significant differences in the LDLs at 500 Hz or 3000 Hz between the non-tinnitus ears with hyperacusis and those without hyperacusis ($p > 0.05/3$).
Conclusions: These results support the existing hypothesis that tinnitus and hyperacusis are commonly caused by an increase in central gain. Reduced sound level tolerance was found not only in tinnitus ears but also in non-tinnitus ears, which might be caused by the loudness balance mechanism through the lateral olivocochlear efferent. Different patterns of sound level tolerance were found between subjects with unilateral tinnitus and bilateral tinnitus.

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IMPROVING AUDIOLOGY STUDENT TRAINING BY CLINICAL SIMULATION OF TINNITUS: A GLIMPSE OF TINNITUS LIVED EXPERIENCE

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Background and Aim: Student audiology training in tinnitus evaluation and management is heterogeneous and has been found to be insufficient. To encourage better training in this field, we have designed a new clinical simulation laboratory for training students on psychoacoustic measures of tinnitus including pitch and loudness matching, minimum masking level and residual inhibition. One student plays the role of the tinnitus patient wearing a device producing a sound similar to tinnitus on one ear while another student plays the role of the audiologist evaluating his condition. The objective of the study was to test this new clinical simulation laboratory for training students in assessing the psychoacoustic measures of tinnitus, as perceived by a sample of second year audiology students.
Methods: This study reports the findings from twenty-one audiology students (20 female and 1 male, mean age = 29, SD = 7.7) who participated in this laboratory for a mandatory audiology class at the Laval University of Quebec. The simulated tinnitus was produced by a Bluetooth bone conduction headphone (HBQ-Q25, Ashata, China) on either the left or the right ear. The simulated tinnitus was generated using Audacity audio software set at 6 kHz and 10 dB SL. All students played the role of the clinician and the patient, alternatively. The student playing the role of the audiologist was required to perform the four typical psychoacoustic measures of tinnitus, that is, tinnitus pitch and loudness matching, the minimum masking level (MML), and the residual inhibition (RI) using standard clinical methods. At the end of the laboratory, they had to fill out a questionnaire about their experience of being the audiologist and the simulated patient.
Results: The qualitative analysis revealed three main themes: "Benefits of the laboratory on future practice", "Barriers and facilitators of the psychoacoustic assessment", and "Awareness of living with tinnitus". From the student's perspective, this method allowed them to practice performing these measurements in a controlled environment with the counselling of educators and without the pressure of facing a real patient. In addition, being the patient allowed them to experience tinnitus and be tested for tinnitus. Regarding accuracy, the average results for pitch and loudness matching were 6727 Hz (SD: 1285) and 9 dB SL (SD: 5), respectively.
Conclusion: This approach was found valuable for developing psychoacoustic testing skills (simulated audiologist) as well as developing a better comprehension of the lived experience of tinnitus (simulated tinnitus patient). This fast, cheap, and effective clinical simulation method could be used by audiology educators and other healthcare educators to strengthen students' skills and confidence in tinnitus evaluation and management. The protocol is made available to all interested parties.

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AN ICF BASED CONTENT ANALYSIS OF THE OVERLAP BETWEEN TINNITUS AND DEPRESSION QUESTIONNAIRES

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Background and Aim: The experienced severity of tinnitus varies significantly among the vast population of people experiencing this phantom sound. Psychological factors have been identified as major contributors to this perceived severity, and numerous studies have demonstrated a correlation between (symptoms of) depression and tinnitus severity. However, the assessment of tinnitus and depressive symptoms often relies on self-report questionnaires, which show content overlap. This can pose challenges in accurately distinguishing both conditions, interpreting their relationship and applying the right treatment to reduce symptoms. To address these challenges, and to further examine and understand the relationship between tinnitus and depression, it is imperative to critically examine the methodology for measuring these constructs. The current study therefore examines the overlap between tinnitus and depressive symptom questionnaires by analyzing their content based on the International Classification of Functioning, Disability and Health (ICF) framework.
Methods: The content analysis includes six widely-used, multi-item, self-report questionnaires measuring perceived tinnitus severity (THI, mTQ, THQ, TRQ, TFI) and seven multi-item, self-report, depressive symptom questionnaires (BDI-II, HADS depression subscale, SDS, PHQ-9, CES-D, SCL-90-R depression subscale, DASS depression subscale) that are commonly used in research on tinnitus. The ICF framework is used to systematically link each questionnaire item to the most relevant and precise ICF category using established linking rules. Item overlap based on the second level ICF categories between the tinnitus and depressive symptom questionnaires will be analyzed.
Results: While the definitive results are not yet available at the time of submission, the results will delve into the underlying ICF categories embedded within the multiple tinnitus and depression questionnaires, as well as present their overlap.
Conclusion: By exploring the overlap between depression and tinnitus questionnaires using a standardized and internationally recognized framework, this study seeks to enhance the comprehension of the intricate relationship between tinnitus and depression, by distinguishing between shared content and independent constructs of symptom scores and shedding light on the factors influencing their measured severity.

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STEADY-STATE AUDITORY EVOKED FIELDS REFLECT LONG-TERM EFFECTS OF REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION IN TINNITUS

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Background and Aim: Evidence of plastic changes in tinnitus has been demonstrated in functional brain imaging. Although repetitive transcranial magnetic stimulation (rTMS) has been shown to decrease steady-state auditory evoked fields (SSAEFs) in tinnitus, the long-term consequence remained unknown. In addition, association between plastic changes as reflected by hemispheric asymmetry and tinnitus handicap inventory (THI) before and after rTMS have not been addressed.
Methods: Twelve tinnitus patients received rTMS and 12 received sham stimulation. Another 12 healthy participants served as the normal hearing controls. Patients responded to the THI before the 1st session and at one month after the final session of rTMS/sham stimulation. Changes in brain activity were assessed by measuring SSAEFs.
Results: SSAEFs remained decreased one month after rTMS compared to before treatment, along with a significant reduction in THI score. There was no significant effect between the index of hemispheric asymmetry and THI score.
Conclusion: The current study objectively demonstrated the long-term effects of rTMS on tinnitus using SSAEFs. A longitudinal study to develop an index using SSAEFs to assess the subjective severity of tinnitus is warranted.

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COMPARATIVE STUDY OF OLFACTORY AND OTONEUROLOGICAL SYMPTOMS AMONG PEOPLE POST COVID-19

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Background and Aim: The World Health Organization (WHO) consensus definition states that post-COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19, with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis, but the complicated sequelae, the correlations between the various symptoms, long-term health effects, and health outcomes among adult COVID-19 patients remain unknown. Although olfactory symptoms such as anosmia have been identified as one of the best predictors of a good prognosis for COVID-19, it has been associated with the persistence of neurological and otoneurological symptoms in people after COVID-19. Aim: In this study, it was decided to verify the probable association between anosmia, headache, tinnitus, and ear fullness in people after COVID-19.

Methods: This cross-sectional study is part of broader research named "Post-COVID-19 Project". The inclusion criteria for this study were as follows: being 19 to 65 years old; having been positively diagnosed with COVID-19 via qualitative molecular test (RT-PCR), presenting the test result and/or hospital discharge after COVID-19 treatment; having contracted COVID-19 between March 1 and July 1, 2021; having received the first dose of the COVID-19 vaccine. Data were collected between August and December 2021 by trained assessors of the multi-professional team, guided by physicians, physical therapists, speech-language-hearing therapists, nutritionists, and physical educators. Patients were recruited via referral from the municipal hospital, after their discharge. On their first visit to the research laboratory, participants were clinically assessed and answered a standardized questionnaire with 90 open-ended and closed-ended items, encompassing data on medical history, preexisting diseases, need for hospitalization, length and type of hospital stay, symptomatology (tinnitus, dizziness, aural fullness, headache, anosmia) during and/or after COVID-19, and duration of symptoms after hospital discharge. The chi-square test was used. The significance level adopted of 0.05.
Results: The responses of 201 participants with a mean age of 44.7 ± 12.7 years were analyzed, 52.2% (n = 105) were males, 67.7% had been hospitalized (n = 136), 55.7% (n = 112) reported anosmia, 49,1% (n = 55) dizziness, 46,4% (n = 52) headache, 46,4% (n = 52) tinnitus, 14,6% (n = 16) ear fullness. In the group with anosmia, significantly higher prevalence was found for dizziness (RR = 1.69; 95%CI 1.17 - 2.44), tinnitus (RR = 1.44; 95%CI 1.02 - 2.04), headache (RR = 1.44; 95%CI 1.02 - 2.04) and ear fullness (RR = 1.45; 95%CI 1.08 - 1.97).
Conclusion: There was a higher frequency of dizziness, headache, tinnitus, and ear fullness in the group with anosmia. These findings suggest the need for studies with a more robust design to verify the real association between olfactory and otoneurological symptoms in patients after COVID-19 and with long COVID. A better understanding of the correlations between various symptoms and the long-term health effects among adult patients with COVID-19 will certainly help in the management of these symptoms by healthcare professionals and a better quality of life for these patients.
Keywords: tinnitus, anosmia, COVID-19, dizziness

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ANALYSIS BETWEEN SUBJECTIVE SLEEP QUALITY AND LEVEL OF INTENSITY OF THE TINNITUS IN PEOPLE POST COVID-19
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Background and Aim: Although the physiological and psychological mechanisms involved in the development of sleep disorders have remained similar throughout history, factors that enhance these mechanisms are closely related to the sociocultural, technological, and lifestyle trends that characterize an era. Four in ten individuals reported a sleep disorder during the COVID-19 pandemic. People with severe COVID-19 are a specific group susceptible to tinnitus complaints and changes in sleep quality. The subjectivity of symptoms and the wide etiological variety that is often observed in post-COVID people can make it difficult to obtain good treatment results. Classifying the type, quality and intensity of tinnitus in this population is useful for its assessment and treatment - which may include cognitive behavioral therapy, tinnitus retraining therapy, sound therapy, hearing aids, cochlear implants, pharmacotherapy and brain stimulation. Therefore, this study aims to compare the complaint of tinnitus and the level of tinnitus intensity with the subjective perception of sleep quality in people after COVID-19.
Methods: Cross-sectional study approved by the Ethics Committee, which is part of a broader research with people post-COVID-19. People were recruited through referral from the municipal hospital institution after medical discharge between 03/01/2021 and 07/01/2021 and having received the 1st dose of the COVID-19 vaccine. The tinnitus complaint was verified in the questioning carried out during the anamnesis. To assess the intensity level of tinnitus, a visual analogue scale (VAS) was used, which consists of a visual graphical tool to determine the level of volume or
intensity, or discomfort caused by tinnitus, on a scale of 0 to 10. To check for sleep quality, the Pittsburgh Sleep Quality Index was used, checking the subjective quality of sleep, considering all those who had a poor or very poor response as having an unsatisfactory perception of sleep. Statistical analysis was performed using the chi-square test with a 95% confidence interval and a 5% significance level. Spearman's correlation test was performed to analyze the correlation between VAS and subjective sleep quality parameters.
Results: 192 people participated, with a mean age of 47.8 ± 12.6 years. The prevalence of self-reported tinnitus was 27.1% (n = 52). Of the 52 patients with tinnitus, 27 people started with the symptom during or after the diagnosis of COVID-19. During the application of the anamnesis, the prevalence of self-reported restful sleep was 55.2% (n = 106). There was an association between tinnitus and unsatisfactory sleep quality in this population with p = 0.003. There was no correlation between the VAS scale for the degree of tinnitus and subjective sleep quality.
Conclusion: In this study it was found that the individual perception of subjective sleep quality was related to the complaint of persistent tinnitus after COVID-19. Therefore, these aspects must be considered in the evaluation of tinnitus in people after COVID-19. Also, further studies with a population of long COVID are needed to expand knowledge on the subject.
Keywords: tinnitus, sleep, COVID-19
Support: Araucaria Foundation

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CLINICAL MANAGEMENT OF MYOCLONIC TINNITUS FOR A CURE : FROM BOTOX INJECTION TO SURGERY

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Background: Myoclonic tinnitus (MT) can be divided into two types; middle ear myoclonic tinnitus (MEMT) and palatal myoclonic tinnitus (PMT). It is rare, but should not be missed due to its high cure rate once properly treated. We reviewed our clinical data of MEMT and PMT in large case series. Clinical characteristics, diagnostic and therapeutic modalities of MT will be introduced based on our 15-year experience.
Methods: More than 200 patients diagnosed as MEMT and more than 50 patients diagnosed as PMT at our tinnitus clinic were enrolled in this study. Their clinical, audiologic characteristics and the therapeutic responses to conservative management, botox injection and surgery were thoroughly evaluated.
Results: Patients with MEMT and PMT were relatively young and had a tendency of female predominance. MEMT associated with forceful eyelid closure were more frequently observed in children than in adults. Impedance audiogram and otoendoscopic examinations of the tympanic membrane were helpful tools for diagnosing MEMT. Voluntary or involuntary myoclonic motion of the soft palate was a typical sign of PMT. With medical/behavioral therapy and proper counseling, more than 70% of the patients with MT exhibited complete or partial remission of their tinnitus. Patients with MEMT who underwent intratympanic BOTOX injection(n=57) showed successful outomes (40.3% of complete remission, 91.7% of improvement) and the sectioning of the middle ear tendons (n=37) showed the successful surgical outcomes (91.9% of complete remission) with no remarkable complications during their long-term follow up period. Botox injection of the soft palate in patients with intractable PMT (n=15) also showed complete remission of symptoms with acceptable short term complications of hypernasal voice and velopharyngeal insufficiency.
Conclusion: Understanding of the clinical characteristics, diagnostic methods and therapeutic results of MT will be truly helpful to manage the patients with these curable type of tinnitus. Surgical resection of middle ear tendons and botox injection seem to be viable and safe for intractable MEMT and PMT.

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STUDY ON PROTECTIVE EFFECT OF NOVEL CHEMICAL COMPOUND AGAINST ACQUIRED HEARING LOSS

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Background and Aim: Cisplatin is an effective anti-cancer drug widely used in the treatment of solid cancer, but side effects such as neurotoxicity, nephrotoxicity, and ototoxicity have been reported. In particular, in the case of ototoxicity, an increase in hearing threshold of 20 dB or more has been reported in more than two-thirds of administered patients, and it adversely affected communication ability, causing a problem in the patient's quality of life after treatment. However, until now, a drug capable of treating or alleviating ototoxicity caused by cisplatin has not been developed, so the need to discover a protective or therapeutic drug is emerging.
Methods: To investigate the possibility of alleviating ototoxicity by cisplatin, six new drug candidates were pre-treated to the House Ear Institute-Organ of Corti 1 cells, a mouse auditory organ-derived cell line for 1 h, and then 30 μM of cisplatin was treated for 30 h.
Results: As a result, I found Compound X with 30% protection. To investigate the protective mechanisms of Compound X in the apoptosis pathway, the expression of Bax, Bcl-2 and cleaved caspase-3, a key protein for apoptosis, was analyzed by western blot, this drug effetely protective form instinct apoptosis pathway. DNA fragmentation following the cleaved caspase-3 activity was also confirmed by the TUNEL (terminal deoxynucleotidyl transferase dUTP nick-end labeling assay), confirming that the pre-treatment group decreased. As a result of analyzing cells undergoing apoptosis with Annexin V-PI (propidium iodide) staining, it was found that Compound X had a protective effect against apoptosis by more than 15%. Previous studies have shown that cisplatin-induced ototoxicity is caused by oxidative stress that excessively accumulated reactive oxygen species (ROS) produced by dysfunctional mitochondria. To find out the protective mechanism of this drug, the ROS level of mitochondria, mitochondria membrane potential, intracellular ROS and interaction with the antioxidant system by glutathione were analyzed. As a result, it was confirmed that the mitochondrial ROS decreased by 15% or more in the pre-treatment group compared to the cisplatin-treated group, and it was inferred that Compound X plays a role related to the antioxidant system. Therefore, the level of oxidation/reduction status of glutathione, a representative antioxidant in cells, and the expression rates of Glutathione Reductase(GR), a protein involved in the reduction of glutathione, and Glutathione Peroxidase(GPx), involved in oxidation, were analyzed. Compared to the cisplatin group with a high ratio of oxidized glutathione, the pre-treated group showed the ratio of reduced state glutathione was the same as that of the control group, the expression of GR was not significantly different between the cisplatin and pre-treatment groups, but the expression of GPx was significantly increased in the pre-treatment group and the Compound X alone treatment group.
Conclusion:
The results of this study demonstrated that Compound X is an effective protective agent against ototoxicity caused by cisplatin, suggesting the possibility that it can be used as an effective therapeutic agent through additional research.

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SMARTPHONE-BASED COGNITIVE BEHAVIORAL THERAPY AND CUSTOMIZED SOUND THERAPY FOR TINNITUS: A RANDOMIZED CONTROLLED TRIAL

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Background and Aims: Cognitive behavioral therapy and sound therapy are the basis of many forms of tinnitus treatment. The aim of this study was to evaluate the efficacy of a smartphone-based application providing tinnitus-specific cognitive behavioral therapy (CBT) and customized sound therapy for tinnitus.
Study Design: Prospective randomized controlled trial (RCT) was performed using a custom-designed smartphone application. The treatment group participated in daily sound therapy and weekly interactive CBT modules, and the control group did not receive the program (waitlisted). Outcome measures after eight weeks included Tinnitus Functional Index (TFI), Generalized Anxiety Disorder (GAD-7), Patient Health Questionnaire (PHQ-9), Perceived Stress Scale (PSS), and Pittsburgh Sleep Quality Index (PSQI). The CBT included tinnitus education, psychoeducation, meditation, as well as lifestyle and sleep modification components.
Results: Ninety-two patients (mean age 57.2±11.9 years) were included. The treatment (n=47) and control (n=45) cohorts had similar THI, PHQ-9, GAD-7, PSS, and PSQI scores at presentation (all p>0.05). Treatment-group patients had significantly higher improvements than controlled patients in their TFI (41.7±37.4 vs. 4.7±27.1, p<0.001), PHQ-9 (1.9±4.2 vs. -0.7±3.4, p=0.002), GAD-7 (1.1±3.6 vs. -0.9±3.3, p=0.009), and PSQI scores (2.5±3.2 vs. -1.1±2.1, p<0.001). Treatment-group subjects also had significantly higher improvements in seven of the eight TFI domains (all p<0.05). TFI improvements of ≥20 and ≥50 points occurred in 36 (76.6%) and 19 (40.4%) of the treatment subjects, respectively. Of the nine treatment-group patients presenting with moderate-severe depression, 4 (44.4%) improved to minimal depression. Of the four treatment-group patients with moderate-severe anxiety, 2 (50.0%) improved to minimal anxiety. Of the 17 treatment-group patients with moderate-severe sleep difficulties, 10 (55.6%) had considerable sleep improvement.
Conclusion: This novel smartphone application providing CBT and customized sound therapy was effective in reducing symptom severity and improving anxiety, sleep, and mood for tinnitus patients. While internet-based sound therapy and CBT have been described separately, the combination of the two applications in one allows for better compliance for the patient. The improvement in TFI is far better than previous reports of either CBT or sound therapy alone.

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KEYNOTE ADDRESS: TINNITUS AND THE STRESS FACTOR

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Summary: Individuals with tinnitus often report that their tinnitus has been triggered by stress or that it is modulated by it. The evidence supporting these self-reports, however, is not very strong. In this talk, I will present an overview of the study findings on stress and tinnitus. More specifically, I will concentrate on the physiological correlates of stress, that is, the Hypothalamic-Pituitary-adrenal axis (HPA) and the Autonomic Nervous System. I will also present some new work from the laboratory that aims to expand the way the relationship between stress and tinnitus is studied.

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CORTICAL RESPONSES TO TINNITUS-LIKE STIMULI: ELECTROPHYSIOLOGICAL INSIGHTS

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Background and Aim: Tinnitus, a prevalent disorder affecting a significant portion of the population, manifests as an internal sound perception without external stimulus. Currently, no standardized objective measure exists for tinnitus diagnosis. This study aims to explore passive cortical activity in response to sound onset in individuals with tinnitus, investigating its potential as an indicator of tinnitus presence. We hypothesize that exposure to pitch- and intensity-matched sounds resembling the tinnitus percept will result in reduced activity to stimuli containing silent gaps.
Methods: Thirty participants, including 15 individuals with tinnitus individually matched with 15 controls for age, sex, and hearing loss, underwent standard and high-frequency hearing tests and behavioral tasks to ascertain tinnitus intensity and pitch. Based on these parameters, stimuli containing six 20-ms gaps were generated and presented bilaterally via ER2 earphones during electrophysiological recording. A 62-electrode electrophysiological acquisition system was used while participants watched a silent film. EEG recordings were processed using EEGLab software, filtered, and segmented with respect to sound and gap onset. The amplitude of N1 ERP component was measured, and a time-frequency analysis was conducted to quantify N1 power, up to 50 Hz, relative to controls without tinnitus.
Results: Behavioral tasks revealed increased tinnitus intensity with higher pitch, with the T+ condition significantly louder than others. However, stimulus perception did not significantly differ between tinnitus and control groups. The tinnitus group showed a larger N1 amplitude in response to stimuli in T- and T conditions than in the T+ condition. Time-frequency analysis revealed that stimuli at the tinnitus frequency (T condition) evoked significantly increased power in the 4-12 Hz frequency band over the left temporal region in the tinnitus relative to control participants.
Conclusion: Contrary to expectations, no decrease in cortical N1 response to gaps was observed in the tinnitus group. However, time-frequency analysis revealed increased power in the 4-12 Hz frequency band, akin to findings in psychiatric disorders such as ADHD and

schizophrenia. Remarkably, this difference was particularly pronounced in response to tinnitus-like sounds with gaps, suggesting a unique pathological activation in the presence of such stimuli. This study sheds light on acute responses to tinnitus-like stimuli and underscores the potential significance of lower frequency band abnormalities in tinnitus pathology.

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P300 LATENCY CORRELATES WITH SUBJECTIVE TINNITUS SEVERITY ON A BETWEEN-SUBJECT AND WITHIN-SUBJECT BASIS

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Background and Aim: In the search for neural correlates of tinnitus, cortical auditory evoked potentials have gained attention in recent literature. Earlier work by our research group has revealed an important role for the P300, a cortical response to unexpected but relevant stimuli. We showed that the amplitude of the P300 can be employed as a marker for the presence of tinnitus. However, no cortical measures correlating with individual tinnitus severity have yet been identified. Here, we use data collected in previous studies by our group to explore whether evoked potentials may serve as objective correlates of subjective tinnitus severity.
Methods: Data from two longitudinal studies, investigating the effects of transcranial direct current stimulation and eye movement desensitization and reprocessing, performed at the tinnitus center of the Antwerp University Hospital in Belgium were analyzed. A total of 203 participants with chronic (> 3 months) subjective tinnitus completed a baseline assessment (T1). At T1, cortical auditory evoked potentials (CAEPs) were recorded using a standard auditory oddball paradigm, and subjective tinnitus severity was evaluated via the Tinnitus Functional Index (TFI) questionnaire. At a follow-up time point 2 to 3 months after completion of the treatment under investigation (T2), these measurements were repeated. One hundred and thirty participants completed all measurements at both time points. Amplitudes and latencies of the CAEP components were extracted automatically to prevent bias.
Results: At baseline, latencies of the P300 component were significantly affected by age and TFI scores (linear regression: $N = 203$, $p < 0.0001$, $R^2 = 11.5\%$). Shorter P300 latencies were associated with lower TFI scores. P300 amplitudes were not associated with subjective tinnitus severity. Difference scores were calculated for P300 latencies (i.e. ΔP300 latency) and TFI scores (i.e. ΔTFI) by subtracting the values at T2 from the values at T1. ΔP300 latency values were significantly correlated with ΔTFI scores ($N = 130$, $p < 0.0001$, $R^2 = 15.3\%$), indicating a within-subject relationship between P300 latency and subjective tinnitus severity. This effect was found regardless of (1) whether or not participants received any active treatment in the meantime, and (2) the type of treatment they received, if applicable.
Conclusion: Latencies of the P300 component were significantly associated with subjective tinnitus severity, both on a between-subject and within-subject basis. As tinnitus severity decreases, P300 latencies were shown to shorten. To the best of our knowledge, this is the first study to demonstrate the potential of cortical auditory evoked potentials as an objective marker of subjective tinnitus severity.

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SOCIO-DEMOGRAPHIC, PSYCHOLOGICAL, AND HEALTH FACTORS IN TINNITUS: PREDICTORS OF AWARENESS AND DISTRESS ACROSS NINE YEARS

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Background and Aim: Managing and preventing tinnitus poses a significant challenge due to limited knowledge about associated risk factors beyond hearing loss and age, as well as factors predicting the progression of tinnitus over time. The study of tinnitus presents a substantial challenge due to its complex nature, resulting from interactions among socio-demographic factors, psychological aspects, the hearing and physical health. A comprehensive understanding necessitates the incorporation of all these facets through extensive datasets with longitudinal assessments, a perspective rarely explored in existing literature. This study aimed to determine socio-demographic, psychological, and health-related risk factors predicting both tinnitus awareness and distress separately and their evolution over time.
Methods: We used the UK Biobank dataset, which encompasses detailed information on the sociodemographic, physical, mental and hearing from more than 170,000 participants, including longitudinal evaluations. As tinnitus awareness is not always associated with distress, we established two distinct models to predict tinnitus awareness level (how often individuals perceive tinnitus) and tinnitus

distress level separately, using the NIPALS machine learning algorithm. Subsequently, these models were used to predict the evolution of awareness and distress over a nine-year period.
Results: Our models efficiently predicted tinnitus awareness and distress, with awareness primarily predicted by hearing health levels and distress influenced by mental health, neuroticism, hearing health, and sleep. Interestingly, the awareness model did not predict its evolution over time, while the distress model efficiently predicted the evolution over nine years, with a large effect size for individuals developing severe tinnitus (Cohen's d= 1.1, AUC-ROC= .70). Based on this, we developed and validated a six-item questionnaire to detect individuals at risk of developing severe tinnitus.
Conclusion: This study is the first to clearly identify risk factors for tinnitus awareness and distress, revealing a dissociation between the two. Hearing health emerged as a major predictor of awareness, while mental health played a crucial role in distress. The inability to predict the evolution of awareness suggests that it may not be mediated by socio-demographic, physical, and psychological factors. Conversely, the successful prediction of distress evolution over nine years based on socio-emotional factors, hearing health, and sleep implies that modifying these factors may mitigate tinnitus's emotional impact. The newly established questionnaire represents a significant advancement in identifying individuals at risk of severe tinnitus, offering potential progress in tinnitus prevention and clinical management.

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RISK FACTORS FOR THE DEVELOPMENT OF TINNITUS AND CHANGE OF IMPACT – RESULTS FROM THE BUSSELTON HEALTHY AGEING STUDY

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Background and Aim: The prevalence of tinnitus is high and its impact on daily life diverse. To date, risk factors for the development of tinnitus have predominantly been examined in cross-sectional study designs, focusing on both otologic and non-otologic risk factors. However, due to the nature of these designs, no definite answer can be provided on causality based on these studies. In order to identify causal mechanisms, which is a pivotal step in the prevention of tinnitus and its consequences, risk factor analysis of longitudinal data is crucial. Furthermore, assessing the impact of tinnitus and exploring factors associated with changes in this impact is essential in order to further develop interventions aimed at reducing tinnitus distress, which ultimately enhances the overall well-being and quality of life of people with tinnitus. The current study therefore aims to assess the incidence of tinnitus onset over a 6 year period and longitudinally evaluate risk factors associated with the development of tinnitus during this time. Moreover, it aims to assess the impact of tinnitus and explore factors influencing changes in this impact. Through these objectives, the study aims to provide valuable insights in preventing the onset of tinnitus and tinnitus burden.
Methods: This study is conducted with data from the Busselton Healthy Ageing Study (BHAS), a longitudinal study of community dwelling adults born between 1946 and 1964 residing in the Busselton shire, Western Australia. At phase I of the study (n=5107) and at the follow up phase 6 years later (n=3888), participants filled in questionnaires and underwent physical assessments. Data on the presence and impact of tinnitus, demographics, general health factors, mental health factors and hearing levels were obtained from these measurements. Incidence of tinnitus over the 6 year interval is calculated and logistic regression is applied to examine potential risk factors for new tinnitus cases. Change in tinnitus impact is categorized in reduced, increased and same impact. Multinomial logistic regression is applied to examine factors associated with this change of impact.
Results and Conclusion: Although final results and conclusions are not yet available at the time of submission, we will present insights at the conference that may contribute to the prevention of tinnitus and the
improvement of quality of life for people with tinnitus

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WORKSHOP: MISOPHONIA AND TINNITUS

Presenter: Margaret Jastreboff, Jastreboff Hearing Disorders Foundation

Summary: This workshop will summarize the foundation and method of misophonia treatment in conjunction with tinnitus based on the neurophysiological model of tinnitus. General rules of an assessment, main points explained to patients and everyday challenges to consider in the treatment of tinnitus, hyperacusis and misophonia will be discussed.

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SPONSOR: NEOSENSORY – RESEARCH AND CLINICAL PROTOCOLS

Presenter: Allison Treseder (Aud), Head of Partnerships, Neosensory Inc.

Summary: Learn more about Neosensory's ground breaking bimodal solution for tinnitus as we dive into the latest research and clinical protocols as well as how to identify candidates, and to leverage all our solutions to treat hearing loss and tinnitus in a clinical setting.

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TINNITUS, DREAMS AND AWAKENING : NEW INSIGHTS AND THEORETICAL IMPLICATIONS

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Background and Aim: Tinnitus is the perception of phantom sound in the absence of a corresponding external source. Tinnitus can cause significant distress when it persists continuously. However, previous studies have discovered an intriguing phenomenon: in nearly all individuals with tinnitus, the presence of tinnitus is notably absent during dreams. Furthermore, patients occasionally mention that tinnitus is not experienced during nocturnal awakenings. The objective of the current investigation is to validate previous findings regarding tinnitus-free dreams in the majority of individuals with tinnitus, while also gaining a deeper comprehension of the connection between tinnitus, dreams, and awakening.
Methods: 128 tinnitus patients answered an online survey on the mutual-help community Siopi.
Results: Out of the 108 patients who can recall their dreams, a significant majority of 93% state that they do not experience their tinnitus while dreaming, and 77% claim that their tinnitus is never a topic of their dreams. Interestingly, 13% of the participants frequently experience lucid dreams. Among this subgroup, 60% reported that they do not perceive their tinnitus or any external sounds during their lucid dreams, while 40% mentioned that they can hear their tinnitus and external sounds within their lucid dreams. Upon awakening, the majority of the 128 patients, specifically, 57% during nocturnal awakening and 62% during morning awakening, instantly perceive their tinnitus. However, there are various other patterns reported by the participants. Notably, 15% mentioned that their tinnitus can temporarily cease during nocturnal awakenings, while 5% reported that it can temporarily cease when awakened in the morning.
Conclusion: Our findings validate the previous observation that the majority of individuals with tinnitus do not perceive their tinnitus during their dreams. Furthermore, our research demonstrates that tinnitus is not a common subject matter in dreams. Remarkably, our study is the first to document the case of tinnitus lucid dreamers. Within this small subset, all participants reported that they could only hear their tinnitus if they were also able to hear external sounds. Interestingly, a significant majority of these individuals (60%) reported not hearing either. Consequently, these patients can experience a state that encompasses numerous aspects of consciousness while simultaneously experiencing a tinnitus-free state. Theoretical implications arising from these findings will be thoroughly examined.

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CAN PHYSICAL ACTIVITY DECREASE THE TINNITUS SEVERITY? -A LONGITUDINAL OBSERVATIONAL STUDY

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Background and Aim: Around 14% of people worldwide have experienced tinnitus, with over 2% facing severe cases. Factors like hearing loss, exposure to loud noises, and anxiety contribute to the severity. Recent studies indicate a potential link between physical activity, lifestyle factors, and tinnitus severity. Thus, our research aims to explore how physical activity and specific lifestyle factors may influence tinnitus severity.
Methods: A total of 2,751 participants (1,526 men and 1,225 women) who reported experiencing tinnitus at the initial assessment in May-July 2022 were followed up for one year. The participants completed the International Physical Activity Questionnaire (IPAQ) every six months and provided information on their lifestyle and medical history. The tinnitus severity was evaluated by the question, "How do you rate the severity of your tinnitus?". Responses included barely audible, mild, moderate, serious, and extreme. Potential risk factors were analyzed using discrete-time proportional hazard ratio (HR) models, adjusting for age, sex, hearing loss, noise exposure, anxiety, depression, and stress.
Results: Individuals who initially engaged in less than 2.5 hours of moderate or vigorous leisure-time physical activity and later increased their activity to surpass this threshold within six months or a year were found to be 25% more likely to experience an improvement in their tinnitus (HR=0.744, 95% Confidence Interval [CI] [0.606, 0.914], p=0.004). Conversely, those who initially participated in more than 2.5 hours of such activity but subsequently reduced their engagement below this threshold within the same timeframe were 43% more likely to experience an escalation in tinnitus severity (HR=1.436, 95% CI [1.010, 2.042], p=0.044). Additionally, for each additional hour of vigorous leisure-time physical activity, there was an 8% increase in the likelihood of an improvement in tinnitus severity (HR=0.949, 95% CI [0.932, 0.966], p<0.001). Notably, lifestyle factors did not significantly impact tinnitus severity.
Conclusion: In conclusion, our study provides valuable insights into the interplay between physical activity, lifestyle factors, and tinnitus severity. Notably, increased engagement in moderate or vigorous leisure-time physical activity shows promise in tinnitus management. Transitioning from insufficient activity to surpassing the 2.5-hour threshold is associated with improved tinnitus outcomes while reducing activity below this threshold is linked to heightened tinnitus severity. Further exploration in this area is warranted to refine treatment approaches and deepen our understanding of the complex dynamics involved in tinnitus.

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HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH SOMATIC TINNITUS: A CROSS-SECTIONAL STUDY

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Background and Aim: Earlier research has shown that tinnitus-related distress significantly impacts health-related quality of life (HRQoL) compared to subjects without tinnitus. No previous research has examined the HRQoL in patients with somatic tinnitus, which might even be higher, as jaw or neck pain might further burden the HRQoL. This study, therefore, aims to assess whether the severity or distress of somatic tinnitus is negatively correlated with the level of HRQoL and at what specific aspects of their HRQoL. In addition to tinnitus distress, the following factors are also considered as potential influencers of HRQoL: jaw or neck complaints, hyperacusis, anxiety and or depression symptoms, the level of hearing loss and speech understanding in noise, and psycho-acoustic tinnitus measures.
Methods: Adult patients (+18years old) diagnosed with ST by an experienced multidisciplinary team of Ear Nose Troat (ENT) specialists, audiologists, physiotherapists and psychiatrists at the University Hospital of Antwerp (UZA) (Belgium) were included in the study. Participants completed a set of audiometric measures, physiotherapeutic test and questionnaires. Differences in HRQoL, measured by the EuroQol-5D-5L (EQ-5D-5L), between subgroups of somatic tinnitus patients were examined and correlation analysis for potential influencing factors was performed. A regression model was built to investigate which factors might negatively influence the HRQoL of somatic tinnitus patients.
Results: In total, 130 patients (mean age = 45,11 (+/- 13,462) years) diagnosed with ST were included for analysis. Patients with ST showing moderate to very severe tinnitus-related distress indicated a
significantly lower HRQoL in comparison to the norm values of the Belgian population. The score on the Visual Analogue scale (VAS) of the EQ-5D-5L differed significantly (p=<0.001) between patients depending on the level of tinnitus distress as measured by the Tinnitus Functional Index (TFI) grades. The scores on the TFI (r= 0.625) and VAS EQ-5D-5L (r= 0.444) were strongly correlated with the severity of the neck complaints as measured by the Neck Bournemouth Questionnaire (NBQ). The EQ-5D-5L was also reasonably strongly correlated with the potential presence of anxiety or depression symptoms according to the Hospital Anxiety and Depression Scale (HADS) (r= [0.401-0.689]). The most impacted components of patients' HRQoL were activities of daily living experiencing pain/discomfort, experiencing symptoms of anxiety or depression and overall perception of quality of life.
Conclusion: Somatic tinnitus patients with moderate to very severe tinnitus-related distress scored significantly lower on HRQoL. The HRQoL scores of ST patients were reasonably strongly or strongly correlated with the level of tinnitus related distress, the severity of neck complaints and the presence of potential anxiety or depression symptoms

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THE EFFECT OF OROFACIAL TREATMENT ON TINNITUS COMPLAINTS IN PATIENTS WITH SOMATOSENSORY TINNITUS

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Background and aim: Somatosensory tinnitus (ST) is pathophysiologically explained by activity in connecting fibers between the dorsal cochlear nucleus (DCN) and the somatosensory medullary nuclei. This mechanism can explain the relatively large prevalence of tinnitus in patients with temporomandibular disorders (TMD) (30.4%-64%) and may imply that TMD treatment might benefit patients with ST.
Our aim is to provide an overview of a previously conducted randomized trial investigating the effect of non-invasive orofacial treatment on tinnitus annoyance and severity in patients with ST and TMD, and of the subsequent search for prognostic and mediation factors.
Methods: Adult patients with a combination of moderate to severe subjective tinnitus (Tinnitus Functional Index (TFI) score: 25 – 90 points) and TMD were recruited from a tertiary tinnitus clinic. All patients received information and advice about tinnitus and underwent orofacial treatment consisting of physical therapy and, in case of bruxism, an occlusal splint applied by the dentist. Patients were randomized in an early-start therapy group (n= 40) and a delayed-start therapy group (n=40). In the first 9 weeks, the early-start group received the orofacial treatment, while the delayed-start group entered a wait-and-see period. After 9 weeks, the delayed-start group started with the orofacial treatment. The treatment effect on tinnitus was investigated using the Tinnitus Questionnaire (TQ) and TFI that were documented at baseline, after the wait-and-see period in the delayed-start group, after treatment and after 9 weeks follow-up. A mediation analysis was performed and the proportion of the mediating effect was calculated for the potential mediator 'change in TMD pain'. Predictors for positive treatment outcomes were identified using univariate and multiple logistic regression analyses with the TQ and the TFI as dependent variables.
Results: In total, 80 patients were included in the study. In week 9 of the study, the early-start group showed an average decrease of 4.1 points in the TQ-score, compared to 0.2 points in the delayed - start group. This change in TQ-score was not significantly different between both groups (p=0.099). On the other hand, the change in TQ-degree in week 9 of the study was significantly larger in the early start-group than in the delayed-start group (p=0.006). On TFI, a significantly larger decrease (13.8 points) was found in the direct-start group compared to the delayed-start group (5.0 points) (p=0.042). The mediation analysis showed that 35% of the observed decrease in tinnitus severity can be attributed to a reduction in TMD pain. A multivariate model comprising 'female gender', 'younger age', and 'shorter duration of the tinnitus' was able to predict a clinically significant decrease in TFI after follow-up in 68.1%.
Conclusion: A multidisciplinary, non-invasive orofacial treatment reduced tinnitus severity in patients with TMD-related somatosensory tinnitus. Reduction of TMD pain mediates this decrease. 'Younger female patients' with a 'shorter duration of their tinnitus' appear to have the best prognosis after orofacial treatment

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SOMATOSENSORY TINNITUS: WHO GETS TOTAL REMISSION?

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Background and Aim: For the last few years, we have researched the long-lasting total remission of tinnitus in a prime study. It consists of finding and interviewing ex-tinnitus sufferers who consider themselves cured, to verify common characteristics of their past history of tinnitus and which treatments they consider as having led them to the total remission. The objective of this presentation is to describe the small subset of patients who used to have somatosensory tinnitus and now consider themselves as cured.
Methods: Due to lack of definition about total remission of tinnitus, our prime study has included patients with the following criteria: any etiology of tinnitus that had been daily present for at least 3 months and has not been perceived for at least the past 6 months. Such cases were initially selected from our databank and then expanded as we communicated our research to other health professionals from whom we have received their similar cases. All subjects were interviewed by the same team. We excluded subjects who were in a comfortable level of masking or habituation. From the inclusion on, subjects have been followed-up every 6 months to check whether total remission was kept stable. So far we have found 149 subjects, have interviewed 120 and have selected 108 cases with total remission that were described elsewhere. Out of all the etiologies, 6 fit the criteria for somatosensory tinnitus.
Results: The subset of patients who had somatosensory tinnitus was composed by 5 females and 1 male, with average age 43.1 years (25 to 58 years). The duration of tinnitus ranged from 6 to 36 months (average 19.6 months), and the extent of total remission varied from 6 to 480 months (average 108.1 months). Localization was equally distributed between uni and bilateral cases. The type of sound was similar to a pure tone (n=4) or narrow band sound (n=1) or rhythmic (n=1). Annoyance with tinnitus was evaluated by using the visual analogue scale, and it averaged 7.1 (5 to 10). Remission occurred gradually in 4 cases and suddenly in 2. Three subjects reached this status by trying up to 2 treatment options.
Conclusion: The growing sample of subjects that reached the long-term total remission of tinnitus so far contains a small sample of cases with somatosensory tinnitus. Analysis of such patients hasn't revealed defined patterns for age, gender, localization, type of sound or degree of annoyance when tinnitus was present. In other words, total remission remains an unpredictable condition for patients with somatosensory tinnitus. Keywords: Tinnitus recovery, somatosensory system, modulation, therapy, cure.

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SPONSOR SESSION: NAVIGATING OTICON'S TINNITUS SOUND SUPPORT IN GENIE 2.0 – A STEP-BY-STEP GUIDE WITH A REVIEW OF CLINICIAN AND PATIENT RESOURCES, INCLUDING THE NEW OTICON COMPANION APP.

Lia Best Au.D., R.AUD, R.HIP. Aud(C),
Audiology Field Trainer Oticon Canada

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SPONSOR SESSION: LENIRE TINNITUS TREATMENT REAL WORLD SUCCESS

Speaker: Tish Ramirez, Au.D.,
Global CommercializatIon Officer, Neuromod USA

Summary: Tinnitus, a common global health issue affecting life quality and mental well-being, has a new solution: Lenire. This at-home device, the first to receive FDA approval for tinnitus treatment, uses bimodal neuromodulation to alleviate symptoms. Following a large-scale, FDA-compliant clinical trial where 83% of participants recommended it, Lenire has shown consistent positive outcomes in both clinical and real-world settings, marking a significant advancement in tinnitus treatment.

Learner Objectives (3)

1. Attendees will be able to explain the concept of bimodal neuromodulation as it relates to tinnitus treatment.
2. Attendees will be able to summarize results of clinical trials demonstrating use of bimodal neuromodulation to treat tinnitus.

Attendees will be able to summarize real-world results with the Lenire tinnitus treatment device.

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SPONSOR SESSION: SCIENTIFIC AND CLINICAL IMPACT OF THE AMERICAN TINNITUS ASSOCIATION'S MISSION TO TRANSFORM TINNITUS PATIENT OUTCOMES

Speaker: *Jinsheng Zhang*, PhD, ATA Board of Directors Chair and *Patrick A. Lynch*, ATA CEO

Summary: Since 1971, ATA has been dedicated to raising awareness of tinnitus patient struggles and improving patient outcomes by funding research and improving access to healthcare professionals proficient in tinnitus management. This presentation delves into ATA research grant opportunities for investigators pioneering novel research areas, and the role a public charity can play in transforming these outcomes, with the proper amount of support.

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THE EFFECTIVENESS OF A 6-WEEK LIVE, ONLINE MINDFULNESS-BASED INTERVENTION FOR TINNITUS DISTRESS

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Background and Aim: Eight studies have demonstrated the effectiveness of mindfulness training in reducing tinnitus distress. In the latest study, Jennifer Gans (2023) stated that the bulk of the improvement came after the first four weeks of an 8-week intervention, suggesting that this provided rationale for studying shorter mindfulness interventions than the traditional eight-weeks. The goal of this study was to test the effectiveness of a briefer (6-week) mindfulness-based intervention.
Methods: The author enrolled a dozen people in a live, online 6-week Mindfulness for Tinnitus class. Each session lasted 90 minutes. Participants were given a Tinnitus Reaction Questionnaire (TRQ) before the start of class and again at the end of class. Participants were sent a three-month follow up questionnaire.
Results: Two people did not return the final questionnaire and two people showed no improvement or mild increase. Of the 8 that showed improvement, one result was not included in the final calculation due it its extreme nature (changing from 67 to 5). The average starting score was 59.5. The average of the TRQ after the class was 31. The average improvement on the TRQ was 28 points. There was an insufficient return rate on the three-month follow to draw any conclusion.
Conclusion: A shorter, mindfulness-based intervention shows promise in reducing tinnitus distress. This was a small study and there was no control group. As well, there was failure to gather information on the long-term impact of the intervention.
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ANALYSIS AND COMPARISON OF CLINICAL PRACTICE GUIDELINES REGARDING TREATMENT RECOMMENDATIONS FOR CHRONIC TINNITUS IN ADULTS

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Background and Aim: To determine if, and to what extent, published clinical practice guidelines for the treatment of chronic tinnitus vary in their recommendations.
Methods: A systematic review of published clinical practice guidelines for the treatment of chronic tinnitus was performed. Data sources PubMed, EMBASE and GIN electronic databases were searched till June 2023. We included clinical practice guidelines that gave recommendations on the treatment of tinnitus. No language restrictions were applied. Two independent reviewers extracted the data and used the AGREE checklist to report on reporting. Outcomes and recommendations were compared between guidelines.
Results: A total of 10 guidelines were included, published between 2011 and 2021. Recommendations for 13 types of tinnitus treatments were compared. Large differences in guideline development and methodology were found. Seven of the 10 guidelines included a systematic search of the literature to identify the available evidence. Six of the 10 guidelines used a framework for the development of the guideline. Reporting was poor in multiple guidelines. Counselling and cognitive behavioral therapy were the only treatments that were recommended for treating tinnitus associated distress by all guidelines that reported on these topics. Tinnitus retraining therapy, sound therapy, hearing aids and cochlear implantation were not unanimously recommended either due to the lack of evidence, a high risk of bias or judgement of no beneficial effect of the specific treatment.
Conclusions: There were notable differences with respect to whether guidelines considered the available evidence sufficient to make a recommendation. Notably, we identified substantial differences in the rigor of guideline design and development. Reporting was poor in many guidelines. Future guidelines could benefit from the use of reporting tools to improve reporting and transparency and the inclusion of guideline experts and patients to improve the quality of clinical practice guidelines on tinnitus.

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CLINICAL CHARACTERISTICS OF CURED SENSORINEURAL TINNITUS PATIENTS AFTER TINNITUS RETRAINING THERAPY - A LARGE CASE SERIES

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Objectives: To analyze the clinical features of sensorineural tinnitus patients who were cured after tinnitus retraining therapy (TRT) and to identify significant factors that affect recovery.
Methods: A retrospective review of 1027 patients diagnosed with sensorineural tinnitus who received TRT and achieved a cure from 2017 to 2023 at Seoul St. Mary's Hospital was done. Review of records extracted important clinical features including patient demographics, Jastebroff's tinnitus category, tinnitus duration before consult, hearing evaluation, visual analogue scores (VAS), and tinnitus handicap inventory (THI), All patients underwent TRT which consists of ENT specialists' group directive counseling and appropriate sound therapy and

were followed up with 3-, 6-, and 12-month intervals until cured. Cured status was defined as tinnitus heard less than five minutes a day with a substantial decrease in tinnitus questionnaires.
Results: A mean age of the patients who achieved cure status of tinnitus was 54±16.5 years (range: 12-92 years). There were more females than males (n=672, 65.4% females, n=355 34.6% males). Most of the patients had unilateral tinnitus (n=753, 73.3%). Jastebroff's category 2 of SNTN with hearing loss (n=416, 40.5%) managed by hearing aids or implantable hearing devices for sound therapy and category 1 of SNTN with significant impact (n=336, 32.7%) managed by environmental sound for sound therapy comprised the majority. The mean cure time was 23.9±17.6 months (range: 1-96 months). Significant correlation between cure time and age ($r=0.38$, $p<0.01$) as well as between cure time and duration of tinnitus before TRT were observed ($r=0.36$, $p<0.01$). Severity of tinnitus measured by tinnitus questionnaire including loudness, awareness, annoyance and an effect on life as well as THI scores were not significantly correlated with cure time of tinnitus.
Conclusion: TRT seems to be effective therapeutic modality for patients with SNTN to achieve a cure at a mean of 23.9±17.6 months. Age as well as duration of tinnitus before initial consult were positively correlated with a longer cure time.

Keywords: Tinnitus, Tinnitus retraining therapy, Sound therapy, Treatment, Cure time

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PILOT TINNITUS STUDY INVESTIGATING BIMODAL NEUROMODULATION WITH VIRTUAL SESSIONS AND ADDITIONAL USER-CONTROLLED SETTINGS

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Background and Aim: Bimodal neuromodulation is emerging as a new type of treatment approach for treating tinnitus based on multiple clinical trials and real world evidence across several independent groups. This bimodal approach consists of combining sound stimulation with electrical stimulation of a body region intended to drive neural plasticity in the brain for treating tinnitus symptoms. The first bimodal device that was approved for clinical use in the United States is called Lenire, which obtained FDA De Novo approval in 2023 and was based on a multi-site clinical trial with in-person follow-up visits. The aim of our pilot study was to measure adherence to the recommended protocol and participant satisfaction when leveraging virtual follow-up visits, as well as allowing for a wider range of control of sound and electrical intensities by the user than is available in the FDA-approved device. Allowing for these additional features could provide greater access and options for a larger number of patients burdened by tinnitus.
Methods: For our study, we enrolled 21 participants, who were required to have moderate to severe tinnitus according to the Tinnitus Handicap Inventory (THI) with a score of 36 to 72, and no additional auditory diagnoses or retrocochlear pathologies. All eligible participants were asked to use the intervention device for twelve weeks, with a minimum compliance criterion of 36 hours. Participants were instructed on device use in the office and attended virtual sessions at three follow-up visits (at the 6-week and 12-week assessments and a 3-month post-intervention follow-up). A series of questionnaires and assessments were performed at the in-person and virtual visits monitoring their tinnitus and health condition.
Results:
Across 21 participants, 20 (95%) were compliant to the intervention protocol. Questionnaire results indicated an average decrease of 19 points on the THI and 17 points on the Tinnitus Functional Index (TFI). On the THI, 17 out of the 21 participants showed a decrease by more than 7 points, which is considered a clinically meaningful change, and on the TFI, 14 out of 21 showed a clinically meaningful change with a decrease of more than 13 points. The decrease in tinnitus severity was sustained at the 3 months post-intervention period across participants, with an average decrease of 21 points on the THI and 17 points on the TFI. In terms of satisfaction rates, 67% of participants indicated they benefited from bimodal stimulation and 90% of participants would recommend the intervention device to other tinnitus sufferers.
Conclusion: The outcomes with bimodal stimulation intervention device, leveraging virtual follow-up visits and providing wider control of sound and electrical intensities, showed high levels of adherence and satisfaction. Additionally, outcomes were consistent with the clinical benefit demonstrated in previous Lenire clinical trials, including the outcomes reported for the recent FDA TENT-A3 study. While further study in a larger population is needed, these findings may support efforts to provide greater access and stimulation options for bimodal neuromodulation for patients suffering from tinnitus who are currently underserved.

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ACCEPTABILITY AND EFFECTIVENESS OF REMOTE COUNSELING FOR TINNITUS

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Background and Aim: Tinnitus Activities Treatment (TAT) is well established tinnitus management program to help patients with bothersome tinnitus. TAT provides counseling on tinnitus and related problems like depression + anxiety, concentration, hearing, and insomnia; suggests coping strategies for tinnitus; and recommends sound therapy via partial masking for tinnitus relief.
In 2020, after updating TAT materials, we realized the potential in providing remote tinnitus management therapy, especially given the rise in cost of healthcare and anticipated expansion of audiological services via over-the-counter hearing aids. We developed a remote counseling

program, TAT-Online, based on our experience with in-person therapy. We aim to test the acceptability and effectiveness of our remote counseling program in adults with tinnitus.
Methods: Participants completed weekly modules that included 2-3 recorded videos, homework to practice strategies, and quizzes to assess learning. Participants completed the sessions in a self-paced manner according to following 6-week schedule: Week 1 - Questionnaires and Introduction; Week 2: Thoughts and Emotions; Week 3: Sleep; Week 4: Hearing; Week 5: Concentration; and Week 6: Relaxation Techniques and Sound Therapy. We included adults with chronic tinnitus who had access to a smartphone, tablet or computer. We recruited a large sample of 316 adults with chronic tinnitus via radio and newspaper advertising in our local community as well as from the American Tinnitus Association. Of these, 243 participants were enrolled and 73 participants fully completed the study. Participants completed four outcome measures (Tinnitus Handicap Questionnaire, Tinnitus Primary Functions Questionnaire, tinnitus and loudness estimations, and Meaning of Life Questionnaire) before and after remote counseling. Feedback about the program, including its acceptability, was determined based on an exit survey. Statistical analysis was conducted using a doubly multivariate MANOVA approach.
Results: The self-paced format of TAT-Online was reportedly acceptable and easy to follow, and effective for learning strategies for coping with their tinnitus. Mean ratings of effectiveness for the various TAT-Online activities were as follows: 9.2/10 for the videos, 7.1/10 for the homework, and 7.5/10 for the quizzes. Participants' ratings for effectiveness of TAT-Online was 70/100 (range: 10-100). Tinnitus severity as measured by the Tinnitus Handicap Questionnaire improved from 40.54 to 32.97 which was statistically significant. We also found a significant improvement in all four subscale scores on the Tinnitus Primary Functions Questionnaire. Loudness and annoyance ratings were also significantly improved. There was no observed change in Meaning of Life ratings.
Conclusion: Remote, self-paced tinnitus counseling provides a general basis for learning how to cope with it. Asynchronous educational videos, reflection exercises and sound therapy recommendations is acceptable and effective in reducing tinnitus symptoms for many people with tinnitus. However, we did not provide sound therapy in this study. Research should continue to investigate use of remote counseling for tinnitus including long-term effectiveness with sound therapy.

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DEVELOPMENT OF AN AUTOMATIC ONLINE TINNITUS EVALUATION PLATFORM FOR CUSTOMIZED SOUND THERAPY
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Background and Aim: It is well-known that sound therapy can effectively suppress tinnitus in some people. Different types of sounds, like white noise and natural sounds, have been used to mask tinnitus in various ways. However, selecting the appropriate audio signal to maximize the suppression of the ringing or buzzing sound is quite challenging. This study aims to develop an online self-testing procedure to identify the most effective frequency bands where tinnitus ringing dominates and then automatically find a set of best-matched sound signals using machine learning algorithms.
Methods: We created a set of narrow-band masking sounds using filtered white noise to target a specific auditory frequency region. As an alternative, we also generated random tone sequences within a specified frequency range for suppressing tinnitus sound. We constructed a multistage tinnitus sound therapy survey form with Jotform to collect patient inputs on a range of different audio frequencies ranging from 362 Hz to 7132 Hz. The audio samples were generated with the Python computing environment. After listening to the played narrow-band noise or random tone sequence, users will rate each audio segment on a linear scale from 0 to 10, with higher scores indicating greater masking of audio ringing caused by tinnitus. Our results formed the basis of our recommendation stage, where higher-rated audio segments are curated and recommended to tinnitus patients as a form of sound therapy. A simplified machine learning algorithm was used to aid the selection of frequency-matched sounds from a sound library.
Results: Our initial results with tinnitus subjects tested at Qilu Hospital (China) showed that our testing process is able to identify the most effective narrow-band noise or tone sequences that can mask their tinnitus sensation. Extensive data collection on a larger group of ubjects has been planned, and statistical results from both clinic and online users will be reported.
Conclusion: As a group of enthusiastic high school students, we have successfully implemented sound testing and sound selection functions through our testing platform. Our work is only a small step in our larger direction and goal creating a database system capable of recommending even more precisely tailored audio treatment capable of successfully targeting and masking tinnitus for larger numbers of patients.

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ROUND TABLE: HETEROGENIETY OF TINNITUS
Moderator: Arnaud Norena
Panel: Berthold Langguth, Pawel Jastreboff, Richard Tyler, Sylvie Hébert

Summary: Since tinnitus is a symptom that can arise from different etiologies (e.g., noise trauma, aging, brain injury), in this session experts will discuss whether there is enough evidence to distinguish subtypes of tinnitus, and why it would be wise to do so. Different point of views from both clinicians and researchers will be presented and the attendees will be invited to join the discussion and ask questions

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ASSESSING LISTENING EFFORT IN DISRUPTIVE TINNITUS (THE ALERT STUDY)
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Background and Aim: Tinnitus complaints are very prevalent (10-15% of the general population) and, besides emotional distress and cognitive dysfunction ('tinnitus disorder') can give rise to an experienced increased listening effort in daily life situations. Literature suggests that an attention shift towards tinnitus may reduce cognitive capacity, increasing listening effort in tinnitus patients. However, only small differences are found in these studies. Our current ALERT study's primary goal is to assess and compare listening effort between two groups, that is, in normal hearing subjects with severe tinnitus disorder and controls without tinnitus. Our secondary goal is to compare the effect of tinnitus disorder on listening effort with the effect of a simulated tinnitus percept.
Methods:
In this prospective study 60 adults (18-70 year) with symmetric normal hearing to mild hearing loss (PTA <35 dB HL) are included in two study populations: a tinnitus group (TG) consisting of 30 subjects with severe tinnitus disorder (Tinnitus Questionnaire score > 46) and a control group (CG) with 30 subjects without tinnitus. Patients will be recruited from seven audiological centers across the Netherlands. During a single visit subjects perform several audiological tests and fill out questionnaires related to tinnitus, psychiatric and fatigue (TQ/TFI/HADS/MFIS). Speech intelligibility in adaptively changing noise levels is measured using the Dutch Matrix sentence test, while subjectively scoring listening effort over a range from zero effort to maximum effort using Adaptive Categorical Listening Effort Scale (ACALES) measurements. Listening effort in three groups will be compared: Subjects with severe tinnitus disorder (TG), subjects without tinnitus (CG) and subjects with a simulated tinnitus percept (CG with an 8 kHz bone conducted pure tone at 15 dB sensation level).
Results:
At abstract submission, 35 subjects (19 TG and 16 CG) have been included. Inclusion is still ongoing and will be completed by May 2024. Analysis of preliminary data already indicates statistically significant and clinically relevant differences in the signal-to-noise ratio (SNR) at which a moderate listening effort is experienced comparing the tinnitus group and the control group (ΔSNR = 2.69 dB, p=0.004). When correcting for speech perception in noise, the difference in signal-to-noise ratio decreases slightly and is still near significant (ΔSNR = 2.01 dB, p=0.052). Complete and final results along with statistical analyses will be presented at the TRI conference.
Conclusion:
Preliminary results of the ALERT study suggest statistically significant and clinically relevant differences in the experienced listening effort between near-normal hearing subjects with severe tinnitus disorder or without tinnitus. By comparing the effect of tinnitus disorder and tinnitus percept separately, this study will help to identify and objectify the complaints that tinnitus patients experience in daily life.

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TINNITUS SUPPRESSION BY MEANS OF COCHLEAR IMPLANTATION: DOES IT AFFECT COGNITION?

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Background and Aim: Literature suggests that tinnitus can affect cognition. However, research results are varied, due to a diversity in investigated aspects of cognition and utilized tests as well as the possible influence of confounding factors. The purpose of this study was to assess the impact of tinnitus loudness on cognition by use of a within-subjects design in patients with a cochlear implant (CI). In this population, tinnitus loudness can be modulated by switching the CI on or off as CI is known to highly suppress tinnitus.
Methods: A total of 18 CI users (9 women) completed two versions of the Repeatable Battery for Assessment of Neuropsychological Status for Hearing Impaired individuals (RBANS-H), once in unaided condition and once in best aided condition. Tinnitus suppression was defined as a difference in score on a visual-analogue scale (VAS) of at least one point out of ten between these two conditions.
Results: Thirteen out of 18 participants experienced tinnitus suppression in the best aided condition. No significant differences in RBANS-H scores were found between the suppression and no suppression group. Within the suppression group, no significant differences in RBANS-H scores were found between unaided and best aided conditions. No significant correlations between tinnitus loudness and RBANS-H were found, neither for the suppression group alone, nor for the group as a whole.
Conclusion: The current study shows no significant effect of tinnitus loudness as modulated by cochlear implantation on cognition. The discrepancy with earlier literature could be explained by the use of a within-subjects design, which controls for confounding factors in a unique population. Future research should include a larger and more diverse study sample to draw definitive conclusions on this topic

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SPEECH COMPREHENSION AND EXECUTIVE DYSFUNCTION IN TINNITUS

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Background and Aim: Individuals with tinnitus often struggle to comprehend speech amidst noise, a challenge not fully explained by auditory deficits alone. This study investigates the role of central executive dysfunctions in speech-in-noise (SIN) comprehension difficulties within the tinnitus population. As part of a larger research project, this study chimes into the current discussion on the impact of tinnitus on daily functioning by investigating an extensive and focused set of psychometric and audiological tests.
Method:
In the matched case-control design, 25 chronic subjective tinnitus sufferers and 25 controls underwent a comprehensive audiometric assessment and cognitive testing focusing on executive functions. Tests ranged from basic auditory thresholds to complex SIN tasks, complemented by tinnitometry and health-related questionnaires.
Results:
Tinnitus participants underperformed in complex speech tasks in the absence of elemental auditory perception impairments (speech in noise and gated speech task). Cognitive tests showed specific deficits in the Stroop task, indicating problems with interference control, while other executive functions were not found to be different between groups.
Conclusion:
In line with most of current literature, tinnitus individuals in this study exhibited speech comprehension deficits under adverse conditions, likely due to impaired central executive mechanisms rather than basic auditory dysfunction. Our findings suggest that central processing inefficiencies may contribute significantly to the daily challenges of individuals with tinnitus.

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A COMPREHENSIVE EVALUATION OF ATTENTIONAL AND EXECUTIVE FUNCTIONS DEFICITS LINKED TO TINNITUS

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Background and Aim: In the literature, chronic tinnitus has been linked to deficits in the executive functions and attentional system (Clarke 2020, Kok 2022). However, tinnitus is often linked to other auditory pathologies such as hearing loss and hyperacusis. The aim of this project is to disentangle the effects of tinnitus from hearing disorders on the attentional subsystems and the executive functions.
Methods: 100 participants with tinnitus (tinnitus group, age 45 ± 12) and 100 matched control participants (control group,43 ± 13) took part in a three-hour test, assessing the functioning of the different attentional networks thanks to the Attentional Network Test (ANT, Fan 2009), and the executive functions with the Trail Making Test (TMT) and the Stroop Test. An auditory evaluation including an audiogram with high frequencies, measures of oto-emission, and hyperacusis was also performed A subgroup of 25 participants with tinnitus (age 42 ± 11) and 25 matched controls (age 42 ± 11) also underwent a resting state fMRI, that was analyzed in regards to the behavioral evaluations.
Results: A mixed model analysis showed a significant group effect (tinnitus/control) on the alerting sub-score ($p<0.05$), controlling for hearing loss, hyperacusis and emotional states (depression, anxiety, stress, sleep disorders). Analysis also revealed that individuals with tinnitus had more variable and slower reaction times than controls, and that this effect increased over time during the ANT. Those effects reflect a deficit in sustained attention. On the Stroop task, we evidenced a hearing loss effect ($p < .05$), with better functioning for better hearing thresholds. No group effect was observed on the Stroop or the TMT. fMRI analyses are in progress, with the aim to identify the cerebral networks associated with the observed attentional dysfunctions.
Conclusion: Tinnitus presence is linked to a deficit in phasic alerting, and in sustained attention. Unlike reported in the literature, it appears that executive functions are affected by hearing loss, but not by tinnitus. Overall, it seems that that chronic tinnitus does not have a global impact on cognition, but only on subcomponents of the attentional system