



Promoting Healthy Hearing Over the Lifespan

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Promoting Healthy Hearing Over the Lifespan

- **Intersection of Audiology and Public Health**
- **Considering Hearing Related Comorbid Conditions is Critical**
- **Healthy Living = Healthy Hearing**
- **Diagnostic Hearing Assessment: Enhancing Sensitivity and Specificity in Detection of Auditory Dysfunction**
- **Updated Diagnostic Audiology Approach: Case Scenario**
- **Practicing Preventive Audiology: Multi-Disciplinary Strategy**

Promoting Healthy Hearing Over the Lifespan

Current Reference

Aud Vestib Res (2021);30(2):74-94.

REVIEW ARTICLE

Promoting healthy hearing over the lifespan

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Promoting Healthy Hearing Over the Lifespan: *Intersection of Audiology and Public Health*

- **Examples of Public Health in Audiology: Children**
 - **Universal early hearing detection and intervention (EHDI) programs**
 - **Reducing incidence of ear infections**
 - **Educational programs about sound (noise and music) induced hearing loss and tinnitus**
- **Examples of Public Health in Audiology: Adults**
 - **Preventing sound (noise and music) induced hearing loss**
 - **Mitigating and preventing bothersome tinnitus**
 - **Preventing ototoxicity related hearing loss**
 - **Promoting healthy hearing over the lifespan**

Promoting Healthy Hearing Over the Lifespan: *Intersection of Audiology and Public Health*

How Can Public Health Approaches and Perspectives Advance Hearing Health Care?

Kelly M. Reavis,^{1,2} Kelly L. Tremblay,³ and Gabrielle Saunders^{1,4}

This commentary explores the role of public health programs and themes on hearing health care. Ongoing engagement within the hearing professional community is needed to determine how to change the landscape and identify important features in the evolution of population hearing health care. Why and how to leverage existing public health programs and develop new programs to improve hearing health in older individuals is an important topic. Hearing professionals are encouraged to reflect on these themes and recommendations and join the discussion about the future of hearing science on a population level.

Key words: Hearing, Hearing loss, Population health, Public health.

(Ear & Hearing 2016;37;376–380)

Improved Hearing Technologies” by the President’s Committee of Advisors on Science and Technology (2015), VA RR&D National Center for Rehabilitative Auditory Research biennial conference “Hearing Loss as a Public Health Concern” (2015), and the establishment of a special interest group called Population Hearing Health Care Group. The purpose of this article is to highlight some major themes, concerns, and future directions as it regards hearing health at the population level.

Older US adults are disproportionately afflicted with hearing loss, with as many as one-third of adults over age 65 having hearing loss (Hoffman et al. 2012). According to the Administration of Aging (2011), the number of adults in the US over age



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Access to health services

Arthritis and Osteoporosis

Blood disorders and safety

Chronic kidney disease

Diabetes

Environmental health

Food safety

Global health

Health related quality of life

Heart disease & stroke

Chronic back conditions

Cancer

Dementias

Disability and health

Education/community programs

Family planning

Genomics

Health communication Infections

Hearing and communicative disorders

HIV Immunization/infectious diseases

Injury/violence prevention LGBT health

Maternal & infant health

Nutrition/weight status

Mental health and disorders

Occupational safety & health

Oral health

Older adults

Physical activity

Sexually transmitted diseases

Sleep health Substance abuse

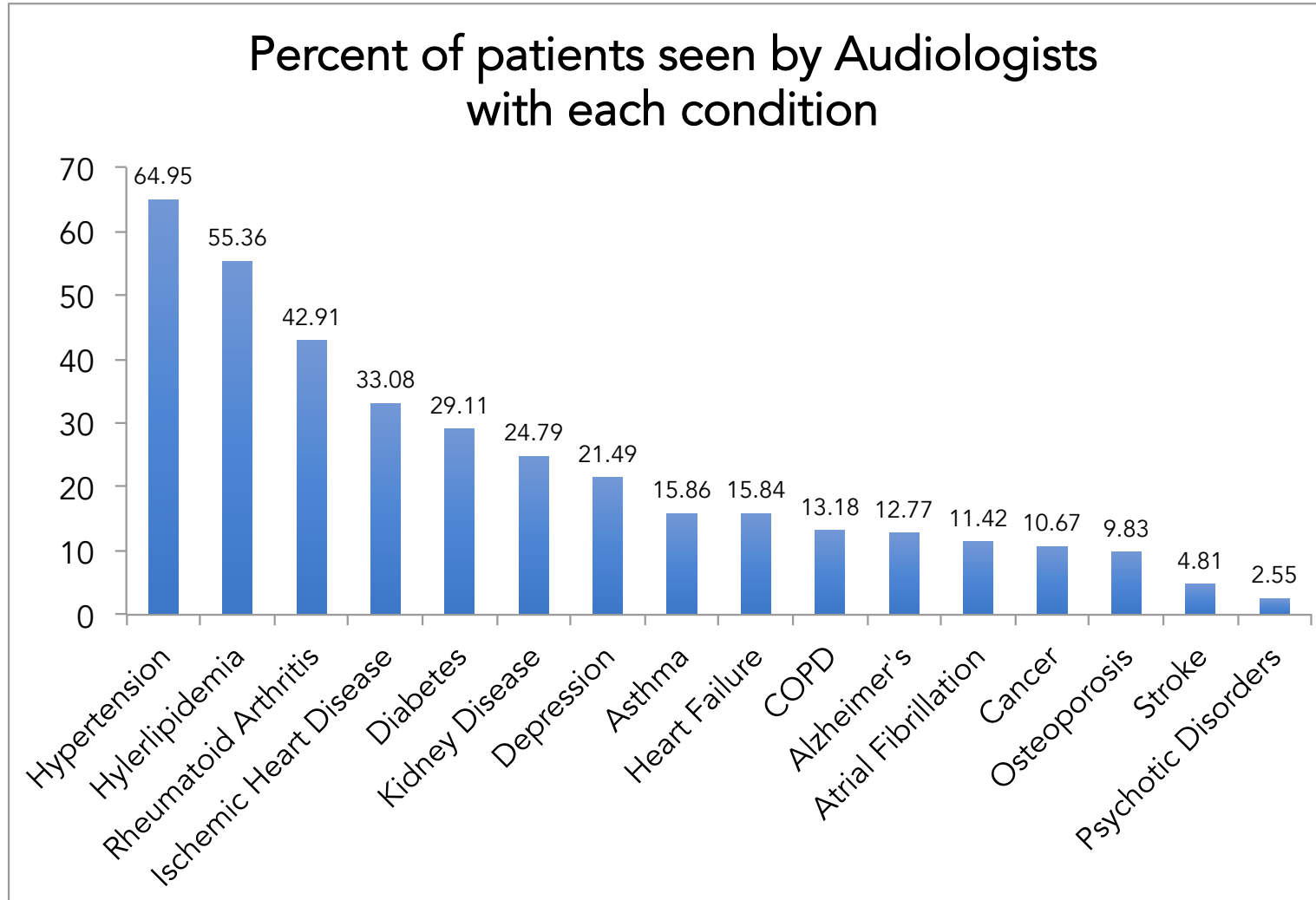
Tobacco use

Vision

Promoting Healthy Hearing Over the Lifespan:

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- **Healthy Living = Healthy Hearing**
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Promoting Healthy Hearing Over the Lifespan: Considering Hearing Related Comorbid Conditions is Critical (Windmill & Freeman, 2019)



**Medicare Data
(Age ≥ 65 years)**

N = 1,319,639

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*

informa
healthcare

International Journal of Audiology 2014; 53: 392–401



International
Journal of
Audiology

Original Article

Comorbidity in adults with hearing difficulties: Which chronic medical conditions are related to hearing impairment?

Mariska Stam*, Piet J. Kostense[†], Ulrike Lemke[‡], Paul Merkus*, Jan H. Smit[#], Joost M. Festen*
& Sophia E. Kramer*

**Department of Otolaryngology-Head and Neck Surgery, section Audiology, VU University Medical Center and EMGO Institute for Health and Care Research, Amsterdam, The Netherlands, [†]Department of Epidemiology and Biostatistics, VU University Medical Center and EMGO Institute for Health and Care Research, Amsterdam, The Netherlands, [‡]Phonak AG, Science and Technology, Stäfa, Switzerland, and [#]Department of Psychiatry, VU University Medical Center/GGZ in Geest and EMGO Institute for Health and Care Research, Amsterdam, The Netherlands*

Promoting Healthy Hearing Over the Lifespan *Hyperlipidemia (High Cholesterol) and Hearing*

2020

The Journal of Clinical Investigation

CLINICAL MEDICINE

Atorvastatin is associated with reduced cisplatin-induced hearing loss

Katharine A. Fernandez,¹ Paul Allen,² Maura Campbell,² Brandi Page,³ Thomas Townes,⁴ Chuan-Ming Li,¹ Hui Cheng,¹ Jaylon Garrett,³ Marcia Mulquin,¹ Anna Clements,¹ Deborah Mulford,⁵ Candice Ortiz,⁴ Carmen Brewer,¹ Judy R. Dubno,⁶ Shawn Newlands,² Nicole C. Schmitt,^{1,7} and Lisa L. Cunningham¹

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Promoting Healthy Hearing Over the Lifespan

Hyperlipidemia (High Cholesterol) and Hearing

- **Liu et al (2012). Irreversible atorvastatin-associated hearing loss. *Pharmacotherapy*, 32, 27-34 [Case Report: 32-year-old male; 20 mg daily; “cookie bite” hearing threshold loss; tinnitus]**
- **Lee et al (2020). Atorvastatin prevents hearing impairment in the presence of hyperlipidemia. *Biochem Biophys Acta Mol Cell Res*, 1867 (doi: 10.1016/j.bbamcr.2020.118850. Epub 2020 Sep 9). [Mouse model for hyperlipidemia; atorvastatin mitigated sensorineural hearing loss]**
- **Olzowy et al (2007). Effect of atorvastatin on progression of sensorineural hearing loss and tinnitus in the elderly; Results of a prospective, randomized, double-blind clinical trial. *Oto Neurotol*, 28, 455-458 [50 patients aged 60 to 75 years; follow up pure tone audiometry at 7 and 13 months; no hearing threshold differences between groups; tendency for reduced tinnitus]**

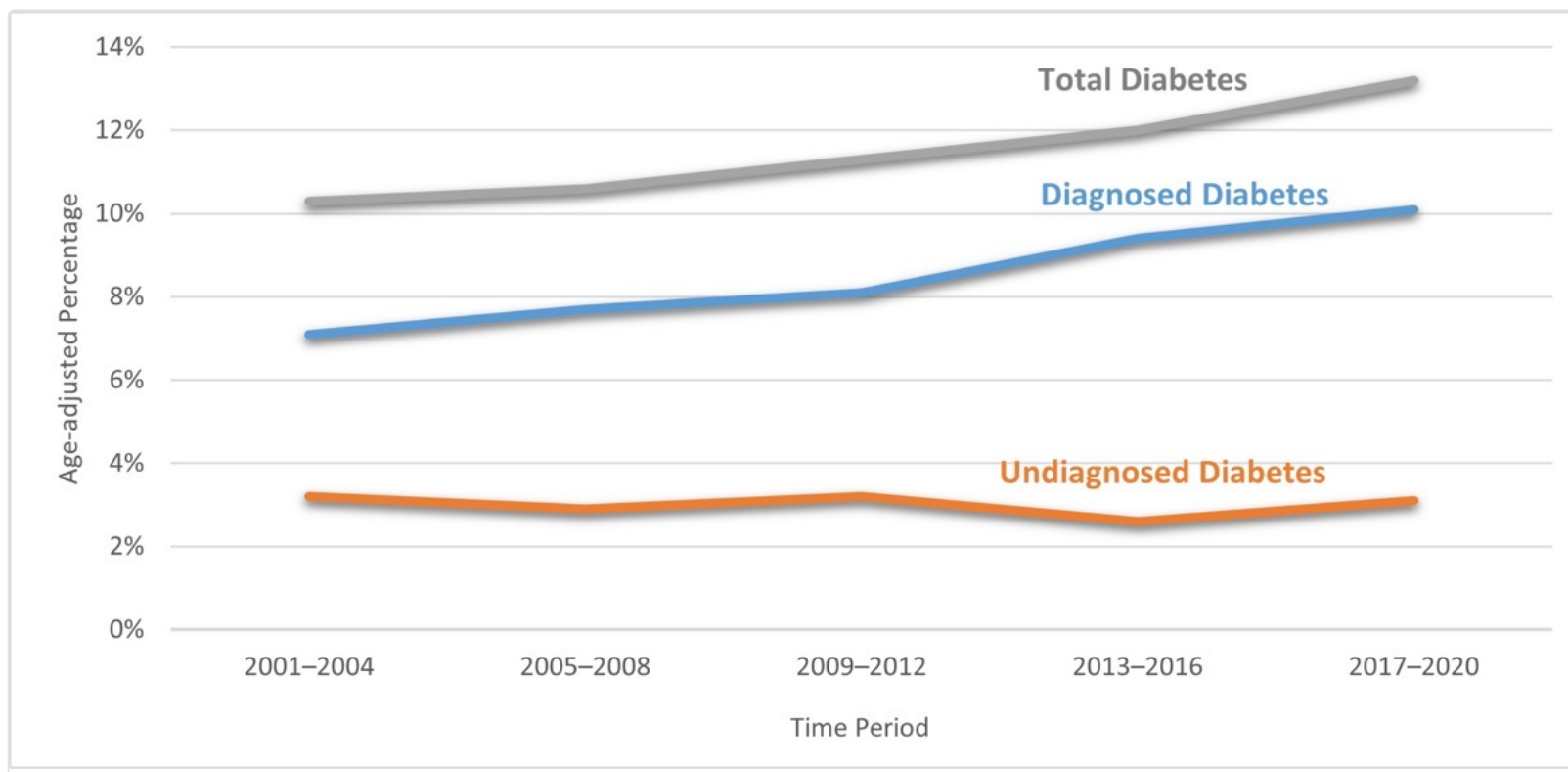
Promoting Healthy Hearing Over the Lifespan *Hyperlipidemia (High Cholesterol) and Hearing*

- Hamid et al (2014). Atorvastatin in the management of tinnitus with hyperlipidemias. *J Coll Physicians Surg Pak*, 24, 927-930 [98 patients with SNHL; 40 mg; reduced tinnitus on THI after 8 mos.
- Yucel et al (2019). Effect of statins on hearing function and subjective tinnitus in hyperlipidemic patients. *Rom J Intern Med*, 57, 133-140 [84 patients 18 to 94 years old; 20 or 40 mg; no change in hearing; reduced tinnitus]

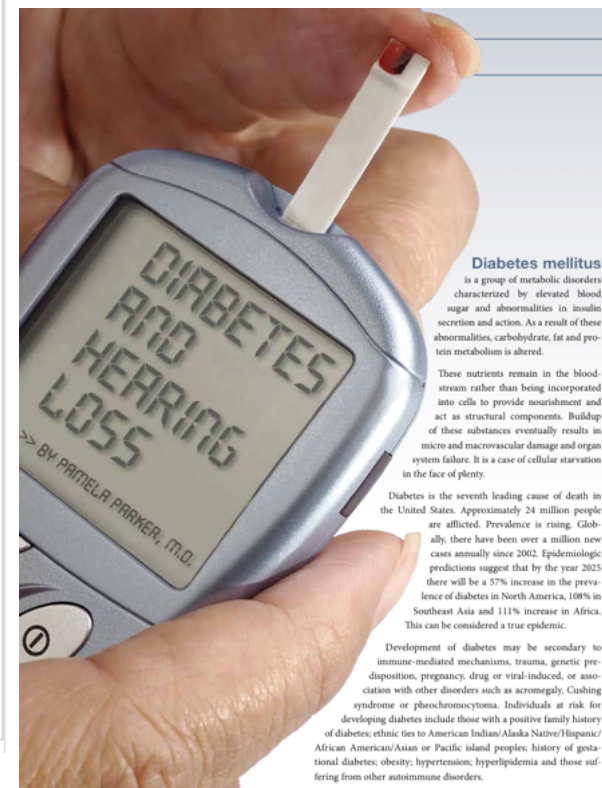


Promoting Healthy Hearing Over the Lifespan

Diabetes



Source: CDC



Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*

1. Asthma or Chronic obstructive pulmonary disease (COPD)
2. Infection of the nose or nasal sinuses
3. Severe heart disease or heart infarction
4. High blood pressure
5. (Consequences of) stroke
6. Stomach ulcer or bowels ulcer
7. Severe bowel problems, longer than 3 months
8. Gallstones or gallbladder infection
9. Liver disease or liver cirrhosis
10. Kidney stones
11. Severe kidney disease
12. Chronic bladder infection
13. Prolapses of uterus, bladder, or rectum (only for women)
14. Diabetes
15. Thyroid disease
16. Chronic back pain, longer than 3 months or spinal disc herniation
17. Osteoarthritis of knees, hips, or hands
18. Rheumatic arthritis of hands, and/or feet
19. Other chronic arthritis, longer than 3 months
20. Epilepsy
21. Other conditions affecting nervous system like Parkinson's disease
22. Multiple Sclerosis
23. Migraine
24. Dizziness causing falling
25. Malignant condition or cancer
26. Burn-out, depression or serious nervousness
27. Chronic skin disease or eczema

- **1900 subjects**
- **18 to 70 years**
- **Poor hearing ability most associated with**
 - **Diabetes**
 - **Arthritis (not osteoarthritis or rheumatoid arthritis)**

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*

	<p>HHS Public Access Author manuscript <i>Diabetologia</i>. Author manuscript; available in PMC 2019 May 01.</p>
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Published in final edited form as:

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Type 2 diabetes and the risk of incident hearing loss

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- **N = 139,909 women**
- **Self-reported hearing loss**
- **Moderate or worse hearing loss associated with type 2 diabetes**
- **Longer duration diabetes associated with higher risk of hearing loss**

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*



Original Research 337

Probable Association of Hearing Loss, Hypertension and Diabetes Mellitus in the Elderly

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Int Arch Otorhinolaryngol 2018;22:337–341.

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Abstract

Introduction The aging process causes changes in body structure in a continuous manner, and contributes to clinical disorders. Life expectancy is increasing, especially in developing countries.

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*

Hearing loss and type 2 diabetes: is there a link?

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RGN, BA (Hons), MSc, Diabetes & CSII Specialist Nurse

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³Diabetes Centre, Royal Liverpool University Hospital, Liverpool, UK

Abstract

Recent meta-analysis has confirmed an association between hearing loss and diabetes. The cause remains uncertain and open to academic debate.

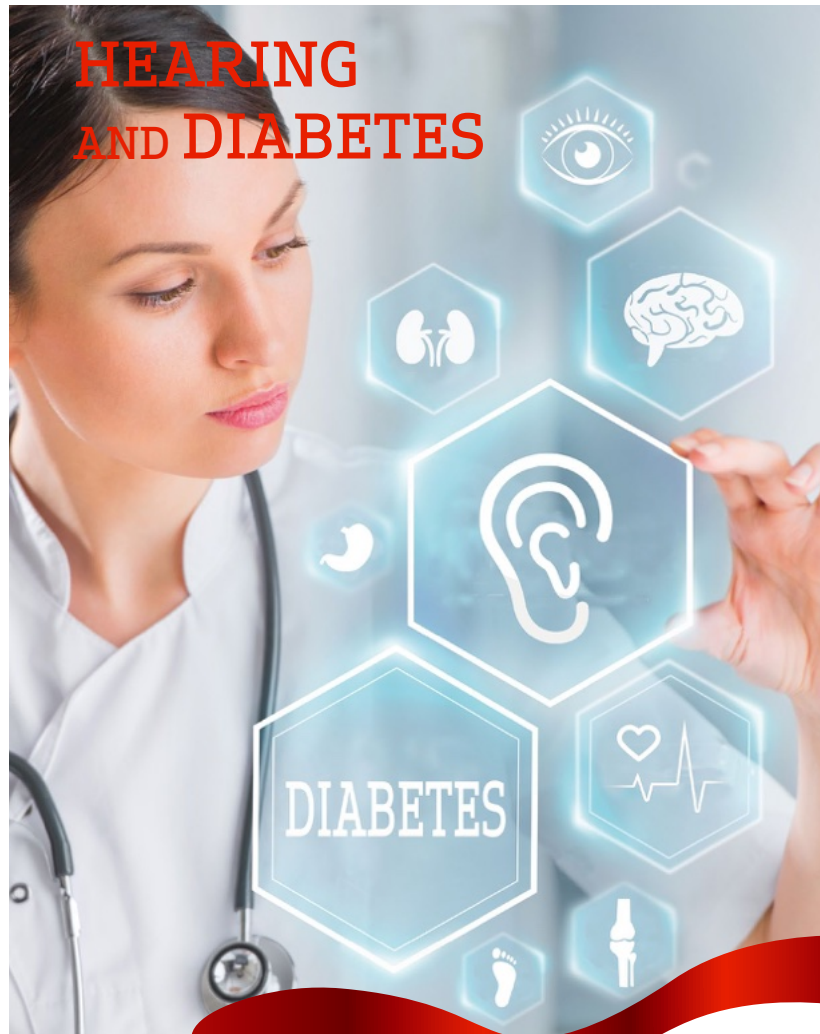
This five-year retrospective study examined the outcomes of patients referred for audiological investigations from a large primary care diabetes clinic. Audiological assessment included pure-tone audiometry, and the presence of neuropathy was identified by foot examination and risk stratification.

Referral rates of patients with diabetes were nearly twice those seen in the non-diabetic population (7.5% [107/1428] vs 4% [499/12422]). Hearing loss was identified in 77 patients. The majority (84.1%) had high-frequency sensorineural hearing loss. Loss of protective sensation on the 10g monofilament test (OR 3.2, CI 1.6–6.5) and vibration sense (OR 2.6, CI 1.2–5.6) was significantly higher in the hearing loss group when compared with a group with type 2 diabetes and normal hearing (n=219). The hearing loss group had almost twice the rate of at-risk feet (37.7% vs 20.1%); (OR 2.4, CI 1.4–4.2). Pre-existing cardiovascular disease was the only pre-morbid condition that was associated with hearing loss (OR 1.8, 95% CI 1.1–3.2). There were no differences in HbA_{1c} and lipids.

This is the first study from primary care to show that hearing loss is prevalent and has a strong association with peripheral neuropathy.

There are no effective strategies yet identified that can prevent or reverse diabetes-related hearing loss. Clinicians should recognise the association between diabetes and hearing loss, and engage in preventative health education and hearing conservation strategies. Copyright © 2014 John Wiley & Sons.

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*



How Can Diabetes Harm Your Ears?

- Diabetes damages small blood vessels in your inner ear and disrupts the hearing signals to the brain
- Hearing loss is 30% higher in people with diabetes. 80% of residents in nursing homes have trouble hearing.
- You have a greater chance of falling with diabetes due to vision loss, foot neuropathy and the effects in the vestibular system.

The Audiology Project

www.theaudiologyproject.com

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The Open Rheumatology Journal, 2016, 10, 26-32

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The Open Rheumatology Journal

Content list available at: www.benthamopen.com/TORJ/

DOI: 10.2174/1874312901610010026



Is Hearing Impairment Associated with Rheumatoid Arthritis? A Review

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Abstract:

Background:

Rheumatoid arthritis (RA) is a systemic, inflammatory disease that affects 1% of the population. The auditory system may be involved during the course of disease; however the association of RA and hearing impairment has not been clearly defined.

- 18267 RA subjects
- 73068 control subjects
- Men and elderly at higher risk
- Cardiovascular comorbidities increase the risk of hearing loss
- Suspected mechanisms:
 - Systemic vascular involvement and inflammation
 - Immune response against inner ear proteins
 - Drugs used to treat RA



Promoting Healthy Hearing Over the Lifespan: Considering Hearing Related Comorbid Conditions is Critical

International Journal of COPD

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REVIEW

Is COPD associated with alterations in hearing? A systematic review and meta-analysis

This article was published in the following Dove Medical Press journal:
International Journal of COPD

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Nader Saki²
Soheila Nikakhlagh²
Golshan Mirmomeni³
Hanieh Raji⁴
Hossein Soleimani¹
Fakher Rahim⁵

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²Department of Otorhinolaryngology, Hearing Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz Iran; ³Department of Biostatistics and Epidemiology, School of Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran; ⁴Department of Internal Medicine. Air Pollution

Background and aims: COPD is an irreversible or persistent airflow obstruction, which affects up to 600 million people globally. The primary purpose of this systematic review was to explore the COPD-based alteration in the auditory system function by conducting a quantitative analysis of presently published data.

Materials and methods: We systematically searched seven diverse electronic databases and manual searching of references to identify relevant studies. Data from the selected studies were rated by two investigators independently in a blinded fashion. Meta-analysis was done on pooled data using Cochrane's Review Manager 5.3.

Results: Sixteen articles received suitable scores and were thus included for further processes. Hearing loss (HL) was defined as a change in pure tone audiometry (PTA) thresholds, auditory brainstem response (ABR), and auditory P300 parameters. ABR wave was significantly elongated in patients with COPD than in controls (standardized mean difference [SMD]=0.27, 95% CI: 0.05–0.48, $P=0.02$). PTA was significantly higher in patients with COPD when compared with controls (SMD=1.76, 95% CI: 0.43–3.08, $P=0.0004$). We found that patients with COPD had a significantly higher latency than controls (SMD=1.30, 95% CI: 0.79–1.80, $P=0.0001$).

Conclusion: COPD patients had considerably greater incidence of HL when compared with controls. Interestingly, although the mean PTA thresholds at every frequency for COPD patients

- “COPD patients had considerably greater incidence of HL when compared with controls.
- Prolonged ABR wave latencies in the COPD patients suggest retro-cochlear involvement.
- COPD most frequently clusters with HL, but it is worth noting that alteration in hearing is not always recognized by medical experts as a frequent comorbidity associated with COPD.”

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*



[AMJ 2015;8(2):41-46]

Prevalence and patterns of hearing loss among chronic kidney disease patients undergoing haemodialysis

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3. Department of Biostatistics, Pondicherry Institute of Medical Sciences, Pondicherry, India

- Mild sensorineural hearing loss is common in CKD.
- Hearing loss has no specific pattern ... high and low frequencies.
- Hearing loss may be inversely associated with the number of hemodialysis sessions but not with duration of disease.

Promoting Healthy Hearing Over the Lifespan: Considering Hearing Related Comorbid Conditions is Critical

Journal of Gerontology: MEDICAL SCIENCES

Cite journal as: *J Gerontol A Biol Sci Med Sci*. 2011 October;66A(10):1131–1136

doi:10.1093/gerona/qlr115

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Hearing Loss and Cognition Among Older Adults in the United States

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Background. To investigate the association between hearing loss and cognitive function in a nationally representative sample of older adults.


Methods. We analyzed data from the 1999 to 2002 cycles of the National Health and Nutritional Examination Survey during which participants aged 60–69 years ($n = 605$) underwent both audiometric and cognitive testing. Hearing loss was defined by a pure tone average of hearing thresholds at 0.5, 1, 2, and 4 kHz in the better hearing ear. Cognitive testing consisted of the Digit Symbol Substitution Test (DSST), a nonverbal test that assesses executive function and psychomotor processing. Data on hearing aid use, demographics, and medical history were obtained from interviews. Regression models were used to examine the association between hearing loss and cognition while adjusting for confounders. Analyses incorporated sampling weights to yield results that are generalizable to the U.S. population.

Results. Greater hearing loss was significantly associated with lower scores on the DSST after adjustment for demographic factors and medical history (DSST score difference of -1.5 [95% confidence interval: -2.9 to -0.23] per 10 dB of hearing loss). Hearing aid use was positively associated with cognitive functioning (DSST score difference of 7.4 [95% confidence interval: -0.62 to 15.4]). The reduction in cognitive performance associated with a 25 dB hearing loss was equivalent to the reduction associated with an age difference of 7 years.

Conclusions. Hearing loss is independently associated with lower scores on the DSST. Further research is needed to determine whether hearing loss is a modifiable risk factor or an early marker of cognitive decline.

- Published in 2011
- N = 605
- Age 60 to 69 years
- Hearing loss is independently associated with lower scores on the DSST (Digit Symbol Substitution Test).
- Further research is needed to determine whether hearing loss is a modifiable risk factor or an early marker of cognitive decline.

Promoting Healthy Hearing Over the Lifespan: Considering Hearing Related Comorbid Conditions is Critical

 *Laryngoscope Investigative Otolaryngology*
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Hearing Loss as a Risk Factor for Dementia: A Systematic Review

Rhett S. Thomson, BA; Priscilla Auduong, MD; Alexander T. Miller, BS; Richard K. Gurgel, MD

Objectives: To review evidence of hearing loss as a risk factor for dementia.

Data Sources: PubMed

Review methods: A systematic review was conducted using the PubMed database using the search terms (hearing loss OR presbycusis) AND (dementia OR cognitive decline). Initially, 488 articles were obtained. Only those studies evaluating an association between hearing loss and incident dementia or cognitive decline were included in the analysis. This resulted in 17 articles which were thoroughly evaluated with consideration for study design, method for determining hearing loss and cognitive status, relevant covariates and confounding factors, and key findings.

Results: All of the 17 articles meeting inclusion criteria indicate that hearing loss is associated with dementia or cognitive decline. The methods used among the studies for ascertaining hearing loss and dementia were notably varied. For hearing loss, peripheral auditory function was tested far more than central auditory function. For peripheral audition, pure tone audiometry was the most commonly reported method for defining hearing loss. Only a few studies measured central auditory function by using the Synthetic Sentence Identification with Ipsilateral Competing Message test (SSI-ICM) and the Staggered Spondaic Word Test (SSW). Dementia was most often defined using the Mini Mental State Exam (MMSE). However, many studies used extensive batteries of tests to define cognitive status, often including a neuropsychologist. Confounding variables such as cardiovascular risk factors were measured in 17 studies and family history of dementia was only evaluated in 1 study. Overall, the methods used by studies to ascertain hearing loss, cognitive status and other variables are valid, making their evaluation appear reliable.

Conclusion: While each of the studies included in this study utilized slightly different methods for evaluating participants, each of them demonstrated that hearing loss is associated with higher incidence of dementia in older adults.

Key Words: age-related hearing loss, dementia, cognitive decline, Alzheimer's disease, presbycusis.

Level of Evidence: Level V, systematic review.

- Findings for 17 peer reviewed articles
- Pure tone audiometry
- Central auditory processing tests (SSW and SSI-ICM)
- Each study demonstrated that hearing loss is associated with a higher incidence of dementia in older adults

NOTE: > 550 peer reviewed articles found with key terms “dementia” “hearing loss”

www.nlm.nih.gov/PubMed


January 12, 2020

Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*

Review Article

The Association Between Cognitive Performance and Speech-in-Noise Perception for Adult Listeners: A Systematic Literature Review and Meta-Analysis

Adam Dryden^{1,2}, Harriet A. Allen², Helen Henshaw^{3,4}, and Antje Heinrich¹

Trends in Hearing
Volume 21: 1–21
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DOI: 10.1177/2331216517744675
journals.sagepub.com/home/tia


- Nottingham UK
- 25 articles met criteria for analysis
- Articles described cognitive measures
 - ✓ Attention
 - ✓ Memory
 - ✓ Executive function
 - ✓ IQ
 - ✓ Processing speed
- General association between cognitive performance and speech perception in noise

Promoting Healthy Hearing Over the Lifespan: *Recent Review ... Hearing and Dementia*



doi:10.1093/brain/awaa429

BRAIN 2021; 144; 391–401 | 391

BRAIN
A JOURNAL OF NEUROLOGY

UPDATE

Hearing and dementia: from ears to brain

 Jeremy C. S. Johnson,¹ Charles R. Marshall,^{1,2}  Rimona S. Weil,^{1,3,4} Doris-Eva Bamiou,⁵
Chris J. D. Hardy^{1,†} and Jason D. Warren^{1,†}

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RESEARCH ARTICLE

Dual sensory impairment: The association between glaucomatous vision loss and hearing impairment and function

Lucy I. Mudie[☉], Varshini Varadaraj[☉], Prateek Gajwani[☉], Beatriz Munoz[☉], Pradeep Ramulu[☉], Frank R. Lin[☉], Bonnielin K. Swenor[☉], David S. Friedman^{‡*☉}, Nazlee Zebardast^{‡☉}

Johns Hopkins University, Baltimore, MD, United States of America

☉ These authors contributed equally to this work.

‡ These authors are co-senior authors on this work.

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- Dual impairment was associated with significantly more severe driving limitation
- More difficulty with communication compared to those without sensory impairment when adjusted for age, race, gender and number of comorbidities
- Older individuals with glaucoma and hearing loss seem to have generally poorer functioning than those with single sensory loss.



Promoting Healthy Hearing Over the Lifespan: *Considering Hearing Related Comorbid Conditions is Critical*

frontiers in
AGING NEUROSCIENCE

MINI REVIEW ARTICLE

published: 14 May 2014
doi: 10.3389/fnagi.2014.00083



Mental health and dual sensory loss in older adults: a systematic review

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Mental health is a core component of quality of life in old age. Dual Sensory Loss (DSL; combined vision and hearing loss) is prevalent in older adults and has been correlated with decreased levels of well-being. This systematic review aimed to critically review and summarize the evidence from studies that examined the mental health of older adults with DSL. In accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA) statement, specific databases were searched and eight articles were selected for final review. Seven studies investigated the association between DSL and depression or depressive symptoms, whilst one study explored the relationship between DSL and quality of life. No studies investigated the impact of DSL on anxiety. Overall, results of this review suggested that there is a significant relationship between DSL and decreased mental health with those with DSL either displaying depressive symptoms or being at risk for developing depression. Future research should focus on comparative studies of older people with and without sensory loss, as well as targeted studies of older people with dual sensory loss, that incorporate well-defined and valid measures of sensory loss and mental health.

- Dual sensory loss (DSL) is prevalent in older adults
- DSL correlated with decreased levels of well being
- Review of 8 articles confirms relationship between DSL and decreased mental health including depression and risk of developing depression

Promoting Healthy Hearing Over the Lifespan

- **Intersection of Audiology and Public Health**
- **Considering Hearing Related Comorbid Conditions is Critical**
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- **Managing Patients with Comorbid Conditions**
- **Updated Diagnostic Audiology Approach: Case Scenario**
- **Practicing Preventive Audiology: A New Multi-Disciplinary Strategy**

Promoting Healthy Hearing Over the Lifespan

Lifestyle Factors

Healthy Eating Index (HEI)

PROGRAMS - CENTER FOR NUTRITION POLICY AND PROMOTION - RESEARCHER - HEALTHY EATING INDEX (HEI)

Resource Type
Nutrition Education

Related Content
Healthy Eating Index (HEI)
HEI Scores for Americans
How We Use the HEI
How the HEI Is Scored
HEI Resources
HEI Continuing Professional Education



The Healthy Eating Index (HEI) is a measure of diet quality used to assess how well a set of foods aligns with key recommendations of the *Dietary Guidelines for Americans*. The *Dietary Guidelines for Americans* is designed for nutrition and health professionals to help individuals (ages 2 years and older) and families to consume a healthful and nutritionally adequate diet.

Diet



Smoking



Exercise



Noise & Music Exposure

Promoting Healthy Hearing Over the Lifespan

Healthy Eating = Healthy Hearing

EAT LESS CRAP:

- C-Carbonated Drinks
- R-Refined Sugars
- A-Artificial Sweeteners & Colors
- P-Processed Foods

EAT MORE FOOD:

- F-Fruit & Veggies
- O-Organic Lean Protein
- O-Omega 3 Fatty Acids
- D-Drink Water

Promoting Healthy Hearing Over the Lifespan

Healthy Eating = Healthy Hearing

ScienceDaily[®]

Your source for the latest research news

Healthy diet may lower risk of hearing loss in women

Patterns of healthy eating may lower risk of hearing loss by 30 percent

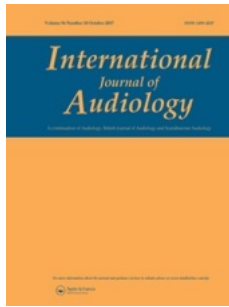
Date: May 11, 2018

Source: Brigham and Women's Hospital

Summary: In a new study, researchers examined the relation between three different diets and risk of developing hearing loss, and found that eating a healthy diet is associated with a lower risk of acquired hearing loss in women.

Promoting Healthy Hearing Over the Lifespan

Healthy Eating = Healthy Hearing



International Journal of Audiology



ISSN: 1499-2027 (Print) 1708-8186 (Online) Journal homepage: <http://www.tandfonline.com/loi/ijja20>

Relationship between dietary quality, tinnitus and hearing level: data from the national health and nutrition examination survey, 1999–2002

Christopher Spankovich, Charles Bishop, Mary Frances Johnson, Alex Elkins, Dan Su, Edward Lobarinas & Colleen G. Le Prell

- Examined relationship between Healthy Eating Index (HEI), a measure of dietary quality, and report of tinnitus
- N = 8143 adults 20 to 69 years
- Controlled for
 - Gender
 - Race/ethnicity
 - Diabetes
 - Noise exposure
 - Smoking
- Healthier diet associated with lower risk for persistent tinnitus

Promoting Healthy Hearing Over the Lifespan

Healthy Eating = Healthy Hearing



CEO

Clinical and Experimental Otorhinolaryngology Vol. 11, No. 3: 158-165, September 2018

<https://doi.org/10.21053/ceo.2017.01221>

pISSN 1976-8710 eISSN 2005-0720

Original Article

Relationship Between Diet and Tinnitus: Korea National Health and Nutrition Examination Survey

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Seoul National University College of Medicine, Seoul, Korea*

Promoting Healthy Hearing Over the Lifespan

Healthy Eating = Healthy Hearing

OPEN

Relationship Between Diet, Tinnitus, and Hearing Difficulties

Piers Dawes,^{1,2} Karen J. Cruickshanks,³ Antonia Marsden,⁴ David R. Moore,^{1,2,5} and Kevin J. Munro^{1,2}

Objectives: Diet may affect susceptibility of the inner ear to noise and age-related effects that lead to tinnitus and hearing loss. This study used complementary single nutrient and dietary pattern analysis based on statistical grouping of usual dietary intake in a cross-sectional analysis of tinnitus and hearing difficulties in a large population study sample.

Design: The research was conducted using the UK Biobank resource. Tinnitus was based on report of ringing or buzzing in one or both ears that lasts more than five minutes at a time and is currently experienced at least some of the time. Identification of a hearing problem was based on self-reported difficulties with hearing. Usual dietary intake and dietary patterns (involving statistical grouping of intake to account for how foods are combined in real-life diets) were estimated based on between two and five administrations of the Oxford Web-Q 24-hour dietary recall questionnaire over the course of a year for 34,576 UK adult participants aged 40 to 69.

Results: In a multivariate model, higher intake of vitamin B12 was associated with reduced odds of tinnitus, while higher intakes of calcium, iron, and fat were associated with increased odds (B12, odds ratio [OR] 0.85, 95% confidence interval [CI] 0.75 to 0.97; Calcium, OR 1.20, 95% CI 1.08 to 1.34; Iron, OR 1.20, 95% CI 1.05 to 1.37; Fat, OR 1.33, 95% CI 1.09 to 1.62, respectively, for quintile 5 versus quintile 1). A dietary pattern characterised by high protein intake was associated with reduced odds of tinnitus (OR 0.90, 95% CI 0.82 to 0.99 for quintile 5 versus quintile 1). Higher vitamin D intake was associated with reduced odds of hearing difficulties (OR 0.90, 95% CI 0.81 to 1.00 for quintile 5 versus quintile 1), as were dietary patterns high in fruit and vegetables and meat and low in fat (Prudent diet: OR 0.89, 95% CI 0.83 to 0.96; High protein: OR 0.88, 95% CI 0.82 to 0.95; High fat: OR 1.16, 95% CI 1.08 to 1.24, respectively, for quintile 5 versus quintile 1).

Conclusions: There were associations between both single nutrients and dietary patterns with tinnitus and hearing difficulties. Although the size of the associations was small, universal exposure for dietary factors indicates that there may be a substantial impact of diet on levels of tinnitus and hearing difficulties in the population. This study showed that dietary factors might be important for hearing health.

Key words: Diet, Dietary pattern, Hearing difficulties, Nutrients, Presbycusis, Tinnitus.

(Ear & Hearing 2019;XX:00-00)

INTRODUCTION

Tinnitus refers to the perception of sound without an external source. Prevalence of tinnitus among UK adults aged 40 to 69 years was estimated at 16.9% (Dawes et al. 2014). Hearing impairment is common, affecting 36.7% of UK adults aged 61 to 70 years (defined as mean hearing threshold level of >25 dB hearing level over 500 to 4000 Hz in the better ear; Davis 1989). Encouragingly, there is evidence that both hearing loss and tinnitus may be associated with modifiable lifestyle factors including noise exposure, smoking, alcohol consumption, exercise, and diet, offering possibilities for prevention (Hoffman & Reed 2004; Cruickshanks et al. 2010). Diet may impact on susceptibility of the inner ear to noise and age-related effects that lead to hearing loss and tinnitus (Spankovich 2015).

Diet and Tinnitus

The role of diet in tinnitus has been identified as a research priority by both patients and clinicians (Hall et al. 2013). There is anecdotal evidence for certain foods, single nutrients, and dietary supplements exacerbating or reducing tinnitus in individuals; however, there is little or no research evidence for a role of any particular dietary factor in contributing to tinnitus (British Tinnitus Association 2017; Seidman & Babu 2003; Patterson & Balough 2006). Limited research in relation to vitamin B12 and B3 and zinc deficiency and the effects of supplementation and tinnitus is inconsistent (Gersdorff et al. 1987; Hulshof & Vermeij 1987; Paaske et al. 1991; Shemesh et al. 1993; Ochi et al. 1997; Yetiser et al. 2002). Two small controlled studies reported a reduction in tinnitus among people with tinnitus and hyperinsulinemia following a diabetic diet rich in nutrients and low in fat and calories (Basut et al. 2003; Lavinsky et al. 2004). Only three population studies of dietary factors and tinnitus have been conducted to our knowledge (McCormack et al. 2014; Spankovich et al. 2017; Lee & Kim 2018). McCormack et al. (2014) reported inconsistent associations between intake of foods (based

- In a multivariate model, higher intake of vitamin B12 was associated with reduced odds of tinnitus, while higher intakes of calcium, iron, and fat were associated with increased odds.
- A dietary pattern characterized by high protein intake was associated with reduced odds of tinnitus.
- Higher vitamin D intake was associated with reduced odds of hearing difficulties as were dietary patterns high in fruit and vegetables and meat and low in fat.
- This study showed that dietary factors might be important for hearing health.

2019



Promoting Healthy Hearing Over the Lifespan

Healthy Eating = Healthy Hearing

European Journal of Nutrition (2022) 61:231–242
<https://doi.org/10.1007/s00394-021-02644-7>

ORIGINAL CONTRIBUTION

Dietary fat intake and risk of disabling hearing impairment: a prospective population-based cohort study

Humberto Yévenes-Briones¹  · Francisco Félix Caballero¹ · Ellen A. Struijk¹ · Alberto Lana² ·
Fernando Rodríguez-Artalejo^{1,3} · Esther Lopez-Garcia^{1,3}

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Promoting Healthy Hearing Over the Lifespan

Healthy Living = Healthy Hearing

Hearing Loss Joins Long List of Smoking Harms



FROM THE WEBMD ARCHIVES 

By Robert Preidt

HealthDay Reporter

THURSDAY, March 15, 2018 (HealthDay News)

For the study, researchers analyzed eight years of health data on more than 50,000 people in Japan.

After accounting for work-related noise exposure and other [hearing loss](#) risk factors, the investigators found that smokers were 1.2 to 1.6 times more likely to suffer [hearing loss](#) than people who never smoked.

Promoting Healthy Hearing Over the Lifespan

Healthy Living = Healthy Hearing

Open Access

Research

BMJ Open Is smoking a risk factor for tinnitus? A systematic review, meta-analysis and estimation of the population attributable risk in Germany

Annette Veile,¹ Heiko Zimmermann,¹ Eva Lorenz,^{1,2} Heiko Becher^{1,3}

- Germany
- 2017
- > 700 peer reviewed articles
- Data from 35 articles included
- The results of this meta-analysis show a statistically significant association between smoking and tinnitus.
- People suffering from tinnitus should be educated about the potential impact of smoking.
- Especially in noise-exposed populations, education and smoking cessation campaigns are a worthwhile approach.

Promoting Healthy Hearing Over the Lifespan

Healthy Living = Healthy Hearing

Original Article

DOI: 10.7860/JCDR/2013/4968.2730

The Effect of Smoking on the Hearing Status –A Hospital Based Study

Physiology Section

ADESH KUMAR, RAJIV GULATI, SANGEETA SINGHAL, ABRAR HASAN, ASIF KHAN

ABSTRACT

Background: Tobacco smoking has been known to affect the human physiology and among the various damaging effects of tobacco, it has been linked with its effect on the sense of hearing.

Aim and Objective: This study was designed with the aim of finding the relationship between smoking and hearing loss in various age groups.

Materials and Methods: This study included 148 subjects among which 108 were smokers and 40 were age matched

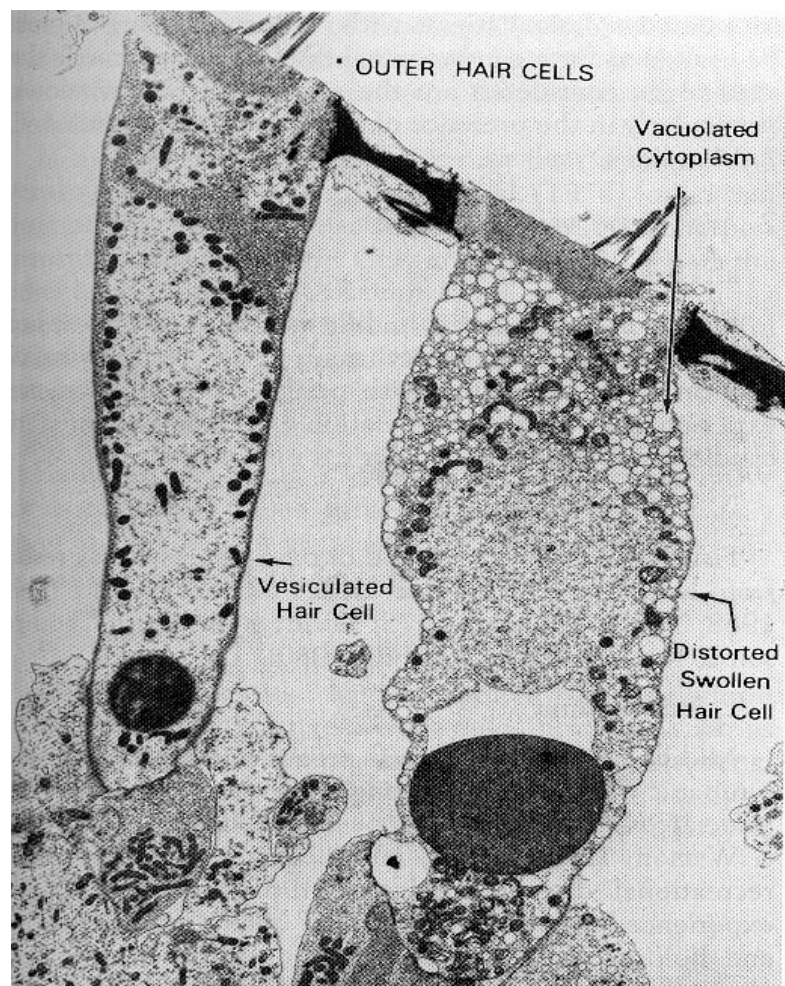
non smokers. The smoking history of all the subjects whose ages ranged from 20 to 60 years was taken in detail and their audiometric thresholds were recorded in a sound proof room by a professional audiometrist. The data was analyzed by using appropriate statistical tests.

Observation and Results: Smoking was found to be significantly associated with hearing loss. Also, the hearing loss was mainly of the sensorineural type, with the mild type (26-40 dB) of hearing loss being the most common among the smokers.



Promoting Healthy Hearing Over the Lifespan

Noise/Music Exposure and Hearing Protection



- **Work-related or recreational noise**
 - **Heavy equipment**
 - **Motors (e.g., lawn mower, motorcycle, ski or snow mobile, race cars, aircraft engines)**
 - **Gunfire**
 - **Amplified live music**
 - **Personal audio players**
- **Assessing risk of hearing damage**
 - **If you need to shout to be heard**
 - **Your ears ring after sound exposure**
 - **Predictably high intensity sound (e.g., shooting a rifle)**
 - **Remember time versus intensity trade off ... 8 hours at 90 dBA vs. < 15 minutes at 115 dBA**

Promoting Healthy Hearing Over the Lifespan

Noise/Music Exposure and Hearing Protection



Foam Roll Ups



Preformed

Generic Earplugs

Promoting Healthy Hearing Over the Lifespan

Noise/Music Exposure and Hearing Protection



Promoting Healthy Hearing Over the Lifespan

Noise/Music Exposure and Hearing Protection



**One-Size-Fits-All
($< \$20$)**



**Custom Musician Earplugs
(~\$200 for earmold, manufacture
and filters of 9, 15, and/or 25 dB)**

Promoting Healthy Hearing Over the Lifespan

- **Intersection of Audiology and Public Health**
- **Considering Hearing Related Comorbid Conditions is Critical**
- **Healthy Living = Healthy Hearing**
- **Diagnostic Hearing Assessment: Enhancing Sensitivity and Specificity in Detection of Auditory Dysfunction**
- **Updated Diagnostic Audiology Approach: Case Scenario**
- **Practicing Preventive Audiology: A New Multi-Disciplinary Strategy**

Promoting Healthy Hearing Over the Lifespan: *Rely on Value Added Tests in Diagnostic Hearing Assessment*

- **Provide information not available from other tests**
- **Shorter test time than alternative test (s)**
- **Pose less risk than alternative test (s)**
- **Lower cost than other test (s)**
- **Findings more reliable than alternative test (s)**
- **Highly sensitive to auditory dysfunction**
- **Site-specific information on auditory dysfunction**
- **Contribute to**
 - **More accurate diagnosis**
 - **More effective management**
 - **Better patient outcome**

Promoting Healthy Hearing Over the Lifespan: *Limitations of Air Conduction Pure Tone Audiometry in Diagnostic Hearing Assessment*


- **Measures a very simple auditory process (detection of sound in quiet) with the simplest of sounds (sinusoids)**
- **Thresholds are estimated for only ≤ 8 frequencies**
 - Normal human ear perceives 20 to 20,000 Hz
 - Audiogram provides very inadequate sample of frequencies in human range (20,000 – 20 = 19,980 or $8/19,980 = 0.0004\%$ of range)
- **Audiogram in quiet doesn't reflect real-world hearing demands**
- **Audiogram has little relation to everyday *listening* problems**
- **People with normal audiogram can have serious communication problems**
- **Test validity affected by patient motivation, cognitive factors, language, and other listener variables**

Promoting Healthy Hearing Over the Lifespan: Limitations of Air Conduction Pure Tone Audiometry in Diagnostic Hearing Assessment

REVIEW ARTICLE



Can adults living with dementia complete pure-tone audiometry? A systematic review

Anthea Bott^{a,b} , Carly Meyer^{a,b}, Louise Hickson^{a,b} and Nancy A. Pachana^c

^aThe HEARing Cooperative Research Centre, Melbourne, Australia; ^bSchool of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Australia; ^cSchool of Psychology, The University of Queensland, Brisbane, Australia

ABSTRACT

Objective: It is estimated that over 60% of adults with dementia will also have a hearing impairment, resulting in a dual sensory-cognitive communication disability. Hearing interventions may lessen the impact of hearing impairment on a communication disability; yet, for audiologists to recommend appropriate hearing interventions, the individual's hearing thresholds must first be accurately established. The gold standard test for establishing hearing thresholds is pure-tone audiometry (PTA). However, the ability of adults with dementia to successfully complete PTA is uncertain. This systematic review examined studies of adults with dementia to better determine the proportion who could complete PTA.

Design: Systematic review.

Study sample: Studies were included that assessed hearing in older adults who were reported as having mild and greater dementia. From a total of 1,237 eligible studies, only three were found to meet all inclusion criteria.

Results: Across these three studies, the proportion of adults with dementia who could successfully complete PTA ranged from 56% to 59%.

Conclusions: Further research is needed in this area, particularly for adults with moderate and severe stages of dementia. Future research should also consider the feasibility of complementary, non-behavioural hearing tests. This systematic review was registered with the PROSPERO database, registration number CRD42017073041.

ARTICLE HISTORY

Received 9 August 2018
Revised 12 November 2018
Accepted 13 November 2018

KEYWORDS

Hearing loss; hearing test; pure-tone audiometry; dementia; geriatric assessment

Promoting Healthy Hearing Over the Lifespan: *Limitations of Bone Conduction Pure Tone Audiometry in Diagnostic Hearing Assessment*

- **Similar limitations of air conduction pure tone audiometry yet only 4 test frequencies**
- **Time consuming (> 5 minutes with masking)**
- **Lacks diagnostic value in patients with**
 - **No history of middle ear disease**
 - **Normal otologic findings**
 - **Normal tympanometry and acoustic reflexes**
 - **Majority of adult patients in otolaryngology clinic have no conductive component to hearing loss (Margolis & Saly, 2008)**



Promoting Healthy Hearing Over the Lifespan: *Limitations of Simple Speech Audiometry in Diagnostic Hearing Assessment ... Speech Reception*

- **Validity of speech reception threshold (SRT) is affected by listener variables (as with pure tone audiometry)**
- **Time consuming (~ 5 minutes)**
- **Limited or no diagnostic value in patients with**
 - **Intact cognitive function**
 - **Normal hearing sensitivity**
 - **Age 20 to 70 years (Roscher & Hall, 2005)**



Promoting Healthy Hearing Over the Lifespan: *Speech Perception in Noise Tests Usually Add Value to Diagnostic Hearing Assessment*

- Results reflect real world communication difficulties (“I can hear well in quiet, but not in noisy places.”)
- Sensitive to auditory processing deficits in patients with neural and central nervous system disorders, e.g.,
 - Vestibular schwannoma
 - Cognitive impairment and dementia
 - Traumatic brain injury (TBI)
 - Cerebrovascular accidents

Joe Frank QuickSIN

Channel 1: 70 dB HL

Channel 2: 0 dB HL

Group 1 SNR Loss Averages: Basic, HFE, HFE-LP (R, B, L)

Group 2 SNR Loss Averages: Basic, HFE, HFE-LP (R, B, L)

PTA AC: 47 BC: SII: 24% Right Reliability: None PTA AC: BC: SII: Left

Test Results Group 1				Test Results Group 1				Test Results Group 1			
Ear	Word List	SNR 50	SNR Loss	Ear	Word List	SNR 50	SNR Loss	Ear	Word List	SNR 50	SNR Loss

QuickSIN - Practice List A (Track 21)

Score
S/N 25 -
S/N 20 -
S/N 15 -
S/N 10 -
S/N 5 -
S/N 0 -
Sum 0

Word Lists Word Nav Aided 5 dB Step 1 Group Research 11:54 AM 9/23/2013

Promoting Healthy Hearing Over the Lifespan: *Objective Tests Add Value to Diagnostic Hearing Assessment*



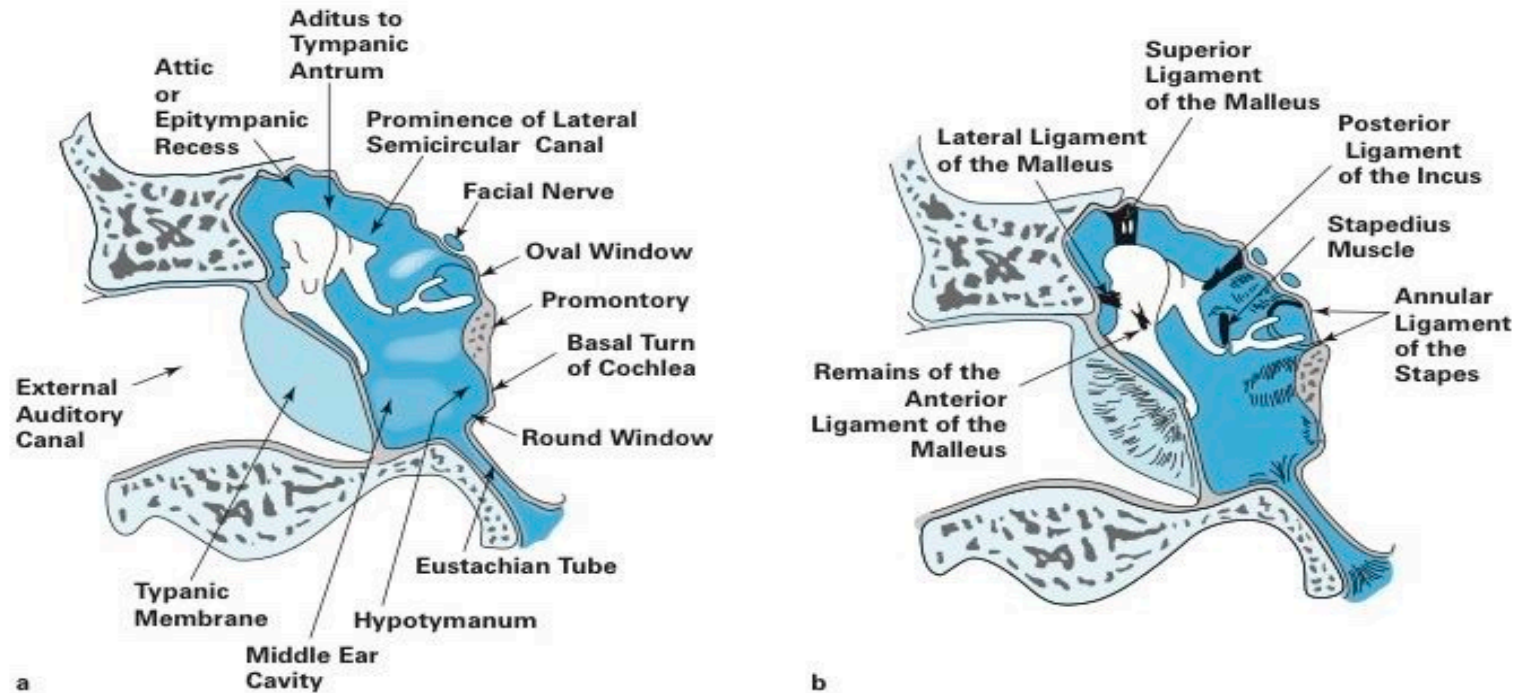
Aural Immittance Measures

- Tympanometry
- Acoustic Reflexes



Otoacoustic Emissions

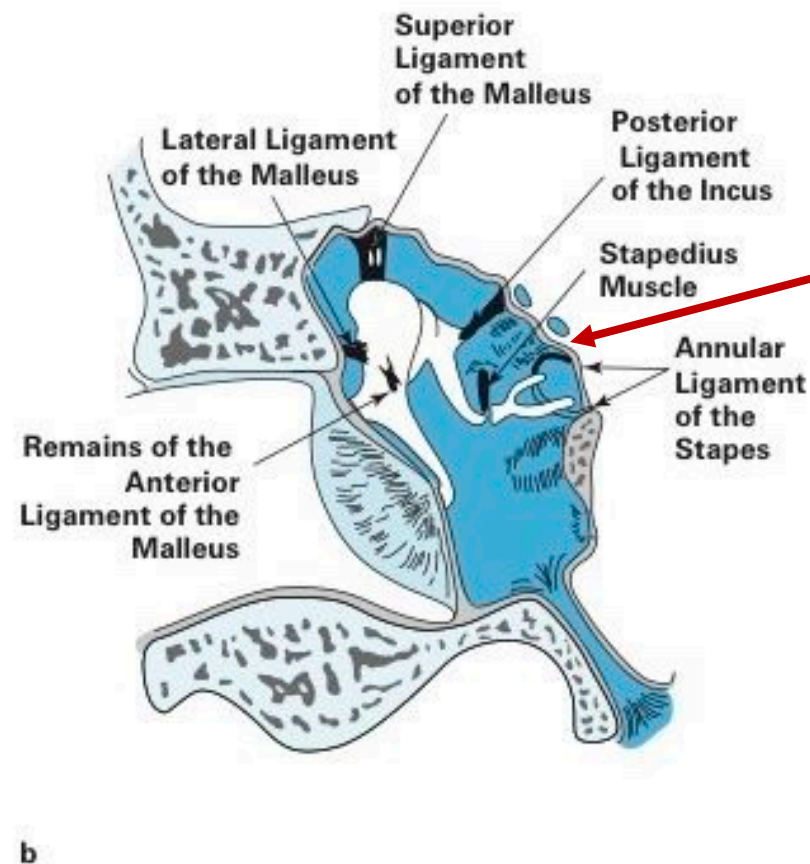
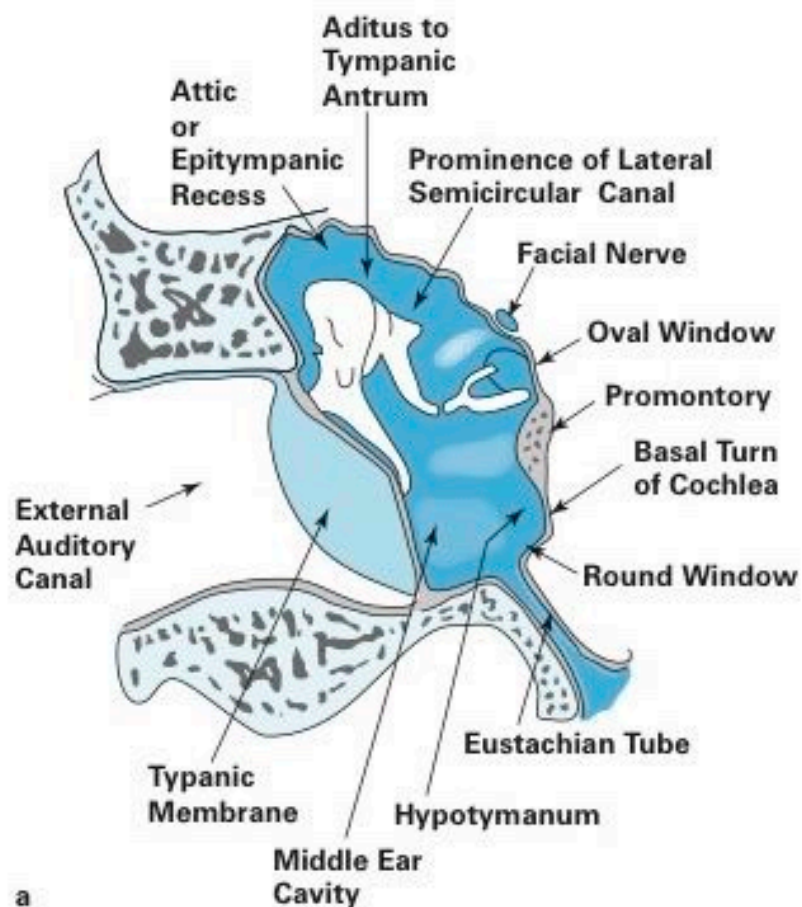
Promoting Healthy Hearing Over the Lifespan: *Objective Tests Add Value to Diagnostic Hearing Assessment*



Tympanometry and Acoustic Reflexes
Most Sensitive Measures of Middle Ear Function

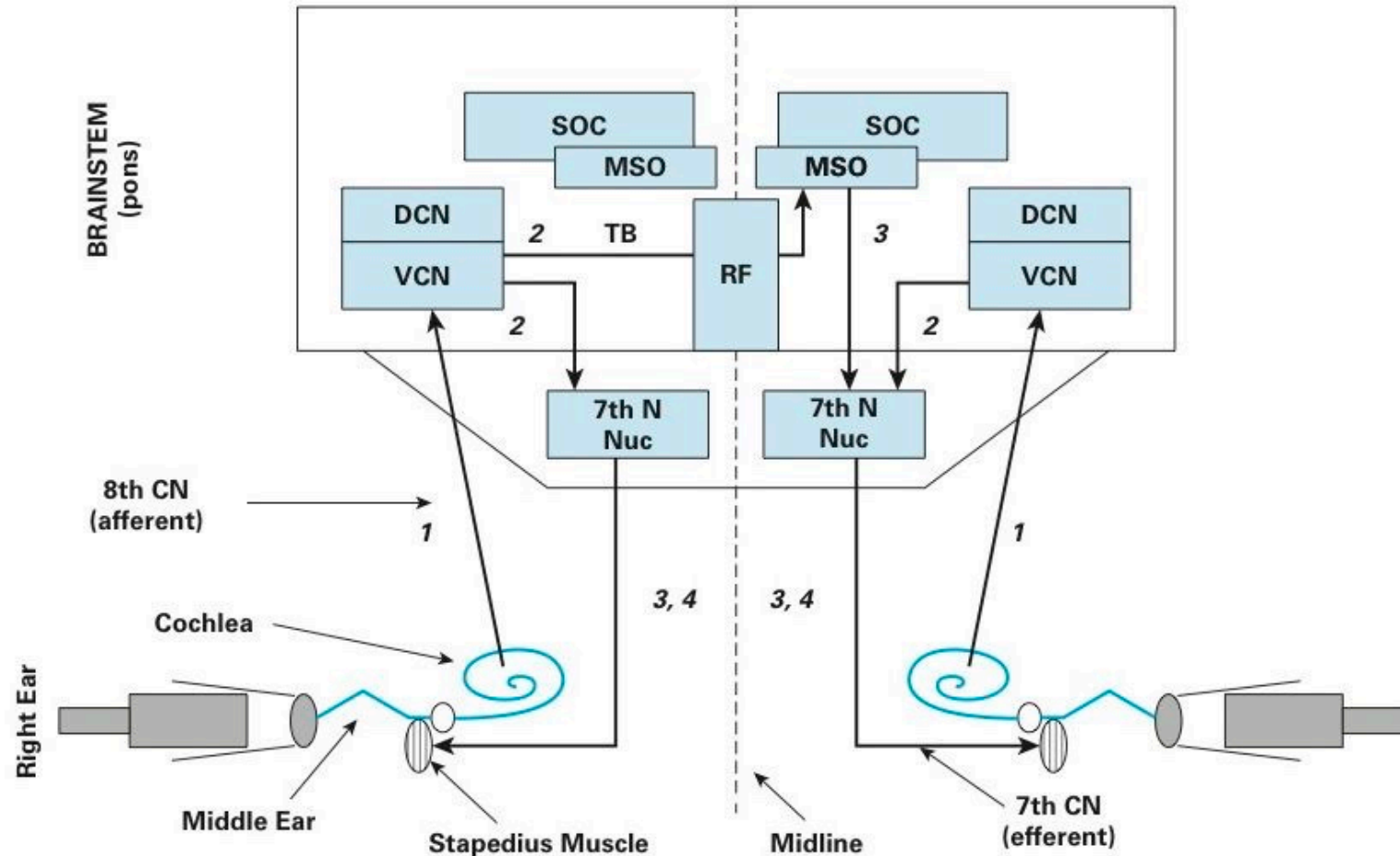
Middle Ear Muscles

(From Hall JW III (2014). *Introduction to Audiology Today*. Boston: Pearson)



Acoustic Stapedial Reflex Pathways According to Erick Borg

(From Hall JW III (2014). *Introduction to Audiology Today*. Boston: Pearson)



Acoustic Reflex Measurement: Diagnostically Powerful yet Clinically Underutilized *A Variety of Response Measurements*

- Acoustic threshold (ART) or minimum response level
- Acoustic reflex amplitude
- Acoustic reflex decay
- Acoustic reflex latency

Clinical Experience With Impedance Audiometry

James Jerger, Ph.D., Houston

Impedance audiometry was performed as part of the routine clinical examination in a consecutive series of more than 400 patients with various types and degrees of hearing impairment. An electroacoustic bridge (Madsen, ZO 70) was used to carry out the measurement of tympanometry, acoustic impedance, and threshold for the acoustic reflex. Results indicate that, while individual components of the total impedance battery lack diagnostic precision, the overall pattern of results yielded by the complete battery can be of great diagnostic value, especially in the evaluation of young children.

THE development of impedance audiometry during the past decade has added new scope and dimension to clinical audiology. Based on the pioneering efforts of Metz,¹ subsequent workers have refined instrumentation, technique, and interpretation to produce an invaluable tool for differential diagnosis.

The development of contemporary instrumentation for impedance audiometry has, in the main, followed two essentially parallel paths. In the United States, Zwislocki and his colleagues²⁻⁶ developed an electromechanical bridge. In Europe, Thomsen, Terkildsen, Møller, and others,⁷⁻¹⁰ pioneered the application of the electroacoustic approach, culminating in the present commercially available electroacoustic bridge.

The present paper reports our clinical experience with the latter instrument based on its routine administration to well over 400 successive patients over a one-year period. Our aim was to assess the efficacy of the electroacoustic approach as a routine clinical

procedure and to evaluate its diagnostic value in a typical audiologic case load.

In general we found that the testing procedure was easily mastered, even by audiologically unsophisticated personnel, that valid and meaningful results could be obtained for almost every patient, and that, with certain reservations, the data of impedance audiometry constitute extremely valuable diagnostic information.

Subsequent sections present statistical information when patients are grouped according to age and type of hearing loss, and individual case reports illustrating the diagnostic value of impedance audiometry.

Method

Apparatus.—Impedance audiometry was carried out by means of an electroacoustic impedance bridge (Madsen, type ZO-70) and an associated pure-tone audiometer (Beltone, type 10D). Figure 1 shows a schematic diagram of the principal components of the impedance bridge.

A probe tip containing three tubes is sealed in the external meatus, forming a closed cavity bounded by the inner surface of the probe tip, the walls of the external meatus, and the tympanic membrane. One tube is used to deliver, into this closed cavity, a probe tone generated by a 220-hertz oscillator driving a miniature receiver. The second tube is connected to a miniature probe microphone which monitors the sound pressure level of the 220-Hz probe tone in the closed cavity and delivers the transduced voltage through an amplifier to a bridge circuit and balance meter. The balance meter is nulled by an SPL of exactly 95 dB in the closed cavity. A potentiometer on the output of the 220-Hz oscillator permits variation of the SPL over a range corresponding to a compliance variation (equivalent volume) of 0.2 to 5.0 cc. The third tube is connected to an airpump which permits variation in air pressure in the closed cavity over a range of ± 400 mm (water). Air pressure is read on an electromanometer.

Accepted for publication June 19, 1970.

From the Department of Otolaryngology, Baylor College of Medicine, and the Audio-Vestibular Laboratory, the Methodist Hospital, Houston.

Reprint requests to 11922 Taylorcrest, Houston 77024.

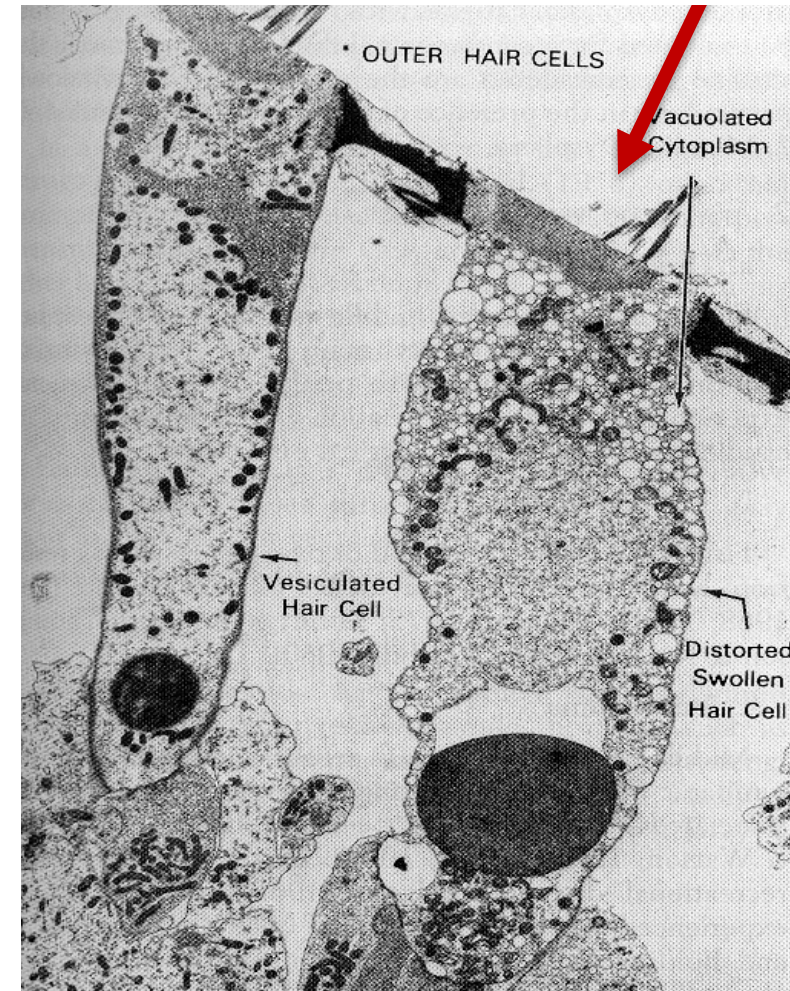
Acoustic Reflex Measurement: Diagnostically Powerful yet Clinically Underutilized *Numerous Valuable Clinical Applications*

- **Detection of even subtle middle ear dysfunction**
- **Normal hearing sensitivity versus sensory hearing loss**
- **Detection of 8th nerve dysfunction**
- **Detection of 7th nerve dysfunction**
- **Detection of brainstem auditory dysfunction**
- **Diagnosis of auditory neuropathy spectrum disorder**



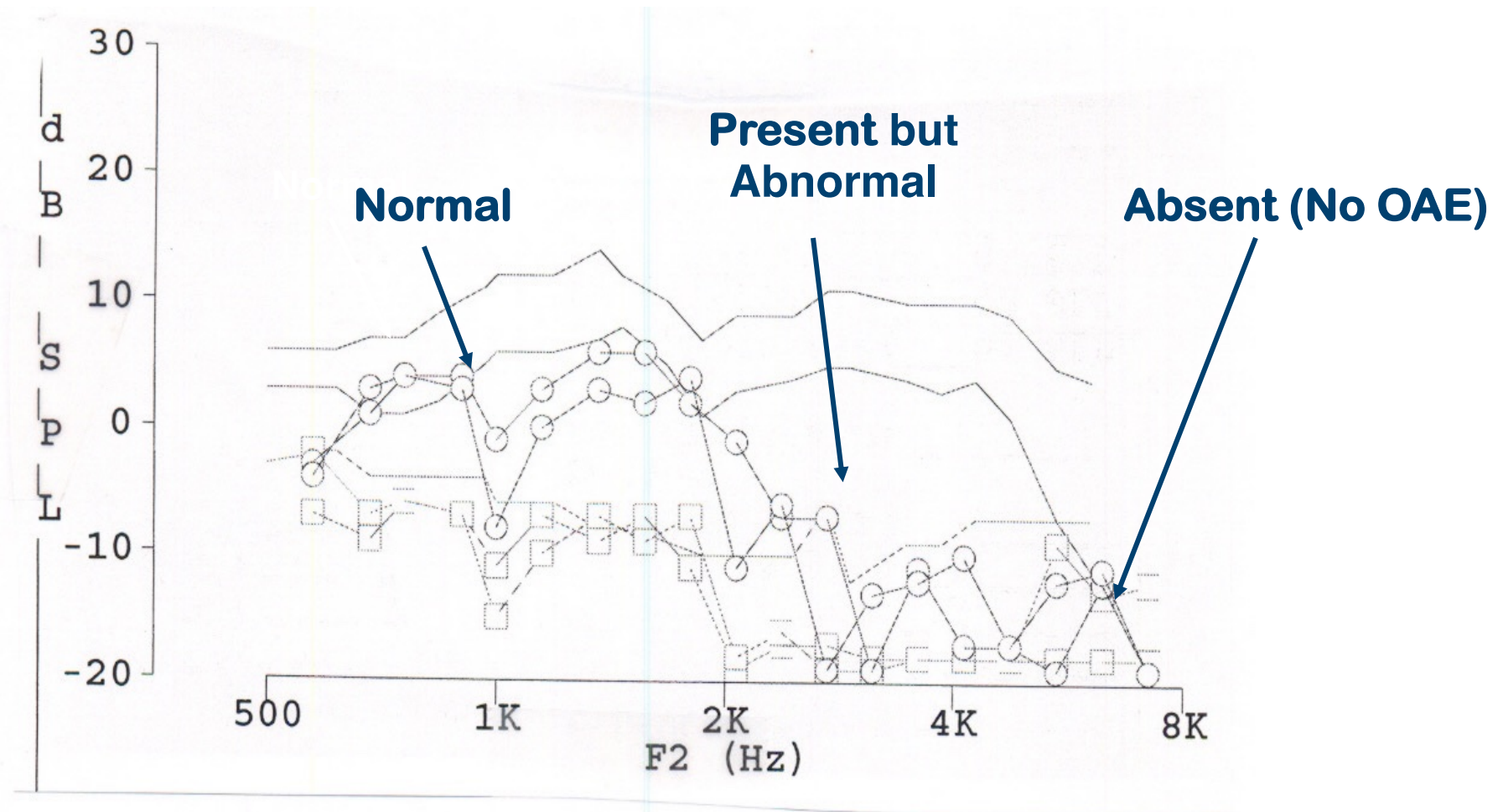
Promoting Healthy Hearing Over the Lifespan: *Objective Tests Add Value to Diagnostic Hearing Assessment*

Otoacoustic Emissions
Most Sensitive Measure of Inner
Ear (Outer Hair Cell) Function



Analysis of Distortion Product Otoacoustic Emissions (DPOAEs)

1. Normal
2. Present but Abnormal
3. Absent (No OAE)



Clinical Guide to OAE Measurement and Analysis: *Relation of OAEs to Audiogram*

OAEs	Audiogram	Possible Interpretation
Normal	Normal	Normal cochlear function
Abnormal	Normal	> Outer hair cell dysfunction > Rule out middle ear dysfunction
Normal	Abnormal	> Technical problems > Inner hair cell dysfunction > Neural auditory dysfunction > False hearing loss

Numerous and Varied Clinical Applications of OAEs in Adults

- Industrial hearing screening
- Risk for noise or music induced auditory dysfunction
- Tinnitus evaluation and counseling
- Ototoxicity monitoring
- False or exaggerated hearing loss
- Differentiating cochlear vs. retrocochlear diagnosis
- Diagnosis of Meniere's disease
- Diagnosis of hidden hearing loss
- Monitoring intracranial pressure in concussion injury



Promoting Healthy Hearing Over the Lifespan

- **Intersection of Audiology and Public Health**
- **Considering Hearing Related Comorbid Conditions is Critical**
- **Healthy Living = Healthy Hearing**
- **Diagnostic Hearing Assessment: Enhancing Sensitivity and Specificity in Detection of Auditory Dysfunction**
- **Updated Diagnostic Audiology Approach: Case Scenario**
- **Practicing Preventive Audiology: A New Multi-Disciplinary Strategy**

Promoting Healthy Hearing Over the Lifespan: Updated Diagnostic and Management Approach

Case Scenario 1

- **55-year-old male**
- **Chief Complaints:**
 - **Bothersome tinnitus**
 - **Difficulty hearing wife, children, and others in noisy listening settings**
- **History**
 - **No middle ear disease**
 - **“Normal hearing” according to family doctor**
 - **Chronic exposure to high levels of recreational noise and music**
 - **Smoker (> 1 pack/day for > 35 years)**
- **At Risk Auditory Disorder (s)**
 - **Sensory hearing loss**
 - **Tinnitus**
 - **Early central auditory nervous system dysfunction**

Promoting Healthy Hearing Over the Lifespan: Updated Diagnostic and Management Approach

Case Scenario 1

■ Traditional diagnostic test battery

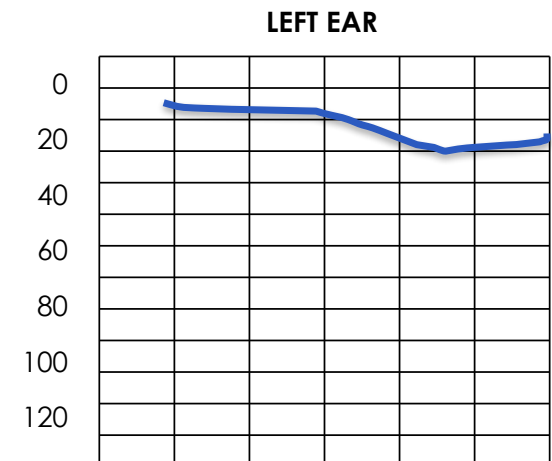
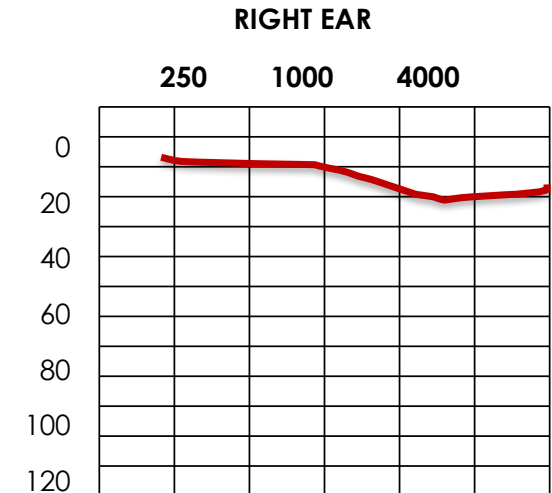
- Normal otoscopy
- Hearing sensitivity within normal limits (< 25 dB HL)
- Normal speech reception thresholds (15 dB HL)
- Good word recognition in quiet (> 90% bilaterally)

■ Impressions

- Generally normal hearing

■ Recommendations

- Possible tinnitus counseling

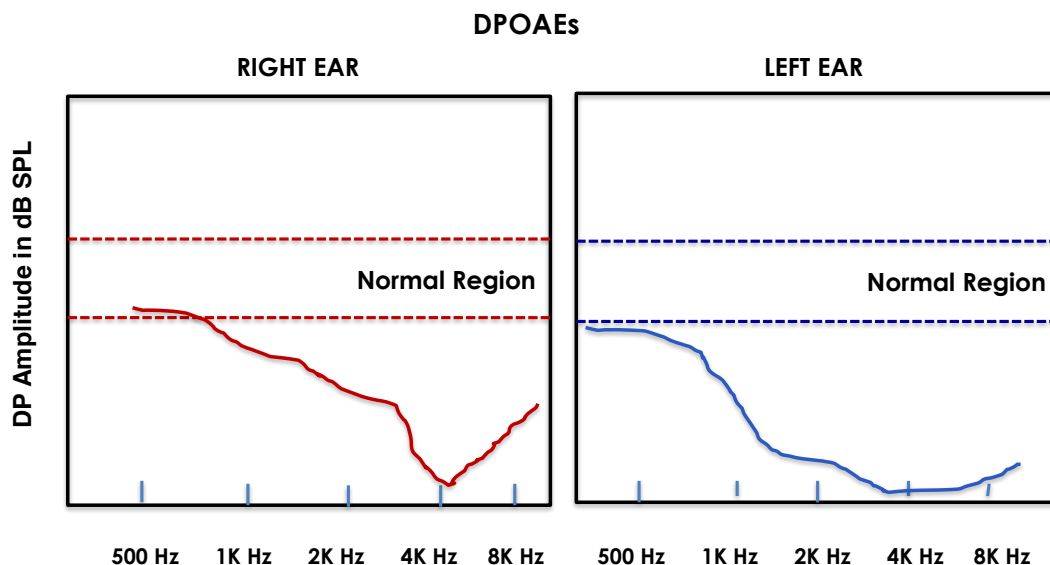


Promoting Healthy Hearing Over the Lifespan: Updated Diagnostic and Management Approach

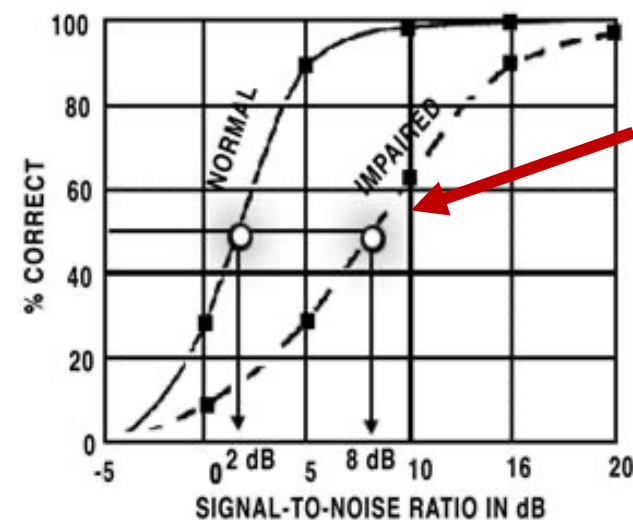
Case Scenario 1

■ Updated diagnostic test battery

- Normal otoscopy
- Normal middle ear function by tympanometry and acoustic reflexes
- **Otoacoustic emissions confirm cochlear dysfunction**
- **Abnormal speech perception in noise**



Quik-SIN (Speech in Noise) Test (Etymotic Research)



Promoting Healthy Hearing Over the Lifespan: Updated Diagnostic and Management Approach *Case Scenario 1*

- **Impressions based on findings of updated diagnostic test battery**
 - **Cochlear dysfunction confirmed with OAEs (despite “normal” audiogram)**
 - **Cochlear origin for persistent tinnitus**
 - **Deficit with speech perception in noise (perhaps CNS dysfunction)**
- **Recommendations based on findings of updated diagnostic test battery**
 - **Detailed and emphatic counseling about hearing protection**
 - **Tinnitus consultation**
 - ✓ **Counseling with recommendations for environmental sound enrichment.**
 - ✓ **Additional tinnitus management as indicated.**
 - **Counseling with suggestions about communication in noisy settings**
 - **Coordination with family physician regarding implementation of lifestyle changes including smoking cessation program**
 - **Follow up assessment in 6 months to monitor hearing status and patient compliance with recommendations**

Promoting Healthy Hearing Over the Lifespan: Updated Diagnostic and Management Approach *Case Scenario 1*

Test Procedure	Diagnostic Test Battery	
	Traditional	Updated
Aural Immittance Tympanometry Acoustic Reflex	---	4.5 mins. \$21.96
DPOAEs	---	5.0 mins. \$33.48
Comprehensive Audio*	\$38.52	---
Pure Tone Audiometry Air	7.5 mins.	7.5 mins. \$32.07
Pure Tone Audiometry Bone	6.0 mins.	---
Speech Reception Threshold	5.0 mins.	---
Speech Recognition in Quiet	5.0 mins.	---
Speech Perception in Noise		10.0 mins. \$37.12
Total Time	23.5 mins.	27.0 mins.
Total Fees (Medicare)	\$38.52	\$124.63

* *Comprehensive audiometry threshold evaluation and speech recognition (92557)*



Promoting Healthy Hearing Over the Lifespan: Updated Diagnostic and Management Approach *Case Scenario 2*

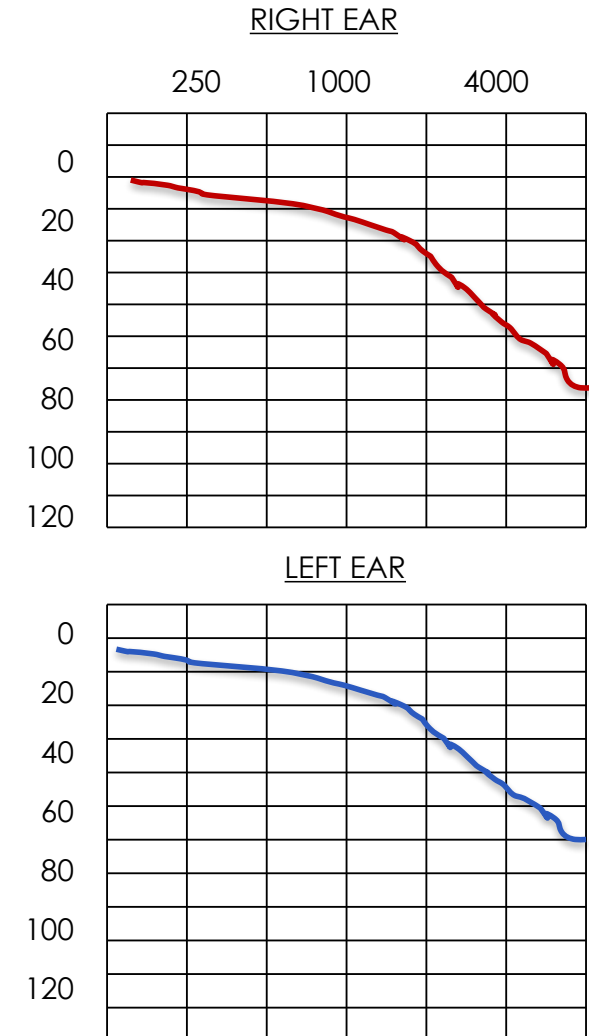
- **75-year-old female**
- **Chief Complaint: Problem communicating in noisy environments**
- **Significant History**
 - **Daughter brought patient to clinic and answered most history questions**
 - **Family concern about mother's (and grandmother's) hearing**
 - **Daughter expressed privately concerns about mom's poor memory and inconsistent attention**
 - **No middle ear disease**
- **At Risk Auditory Disorder (s)**
 - **Sensory hearing loss**
 - **Auditory processing disorder**

Promoting Healthy Hearing Over the Lifespan

Case Scenario 2

Traditional Assessment

- **Normal otoscopy**
- **Pure tone audiometry**
 - **AC: Moderate to severe high frequency hearing loss (PTA = 27 dB)**
 - **BC: ABG < 10 dB**
- **Speech reception threshold: 25 dB HL**
- **Word recognition in quiet: Excellent (92%) bilaterally at 60 dB HL**

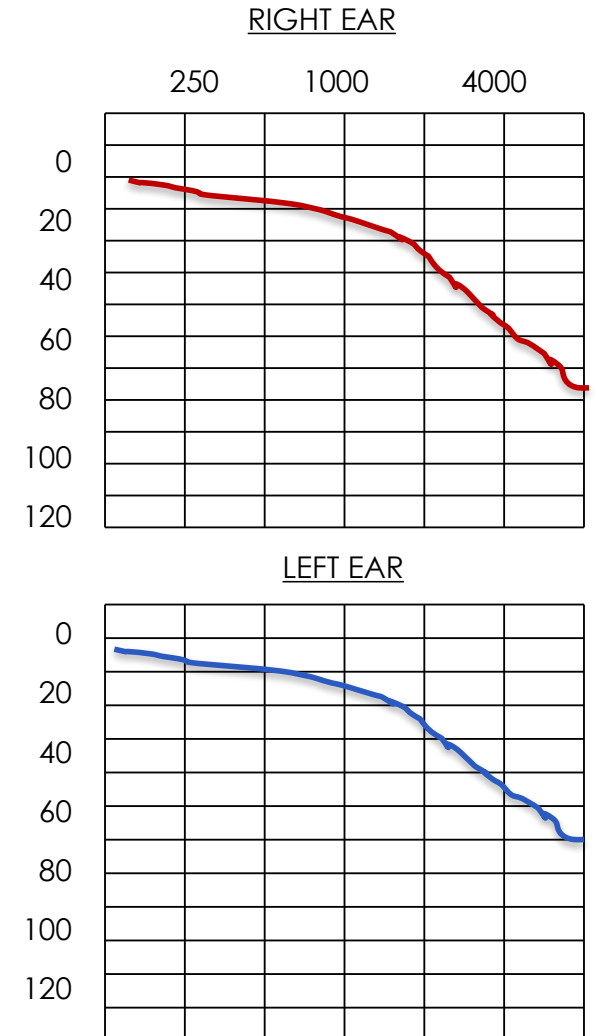


Promoting Healthy Hearing Over the Lifespan

Case Scenario 2

Updated Assessment

- **Normal otoscopy**
- **Aural immittance measurement**
 - Normal tympanograms
 - Acoustic reflexes: Normal ipsilateral but elevated contralateral reflexes
- **Pure tone audiometry: Moderate to severe high frequency hearing loss (see audiogram)**
- **Speech audiometry: Good word recognition in quiet**
- **Synthetic Sentence Identification (SSI)**
 - 90% score at + 10 dB message to competition ratio (MCR)
 - 60% score at 0 dB MCR (typical listening difficulty). Note: Normal performance = $\geq 90\%$



Promoting Healthy Hearing Over the Lifespan

Case Scenario 2

Impressions: Traditional versus Updated (Red) Assessment

■ **Impression**

- **Moderate to severe high frequency sensorineural hearing loss with good word recognition**
- **Confirmation of normal middle ear function by aural immittance**
- **Confirmation of sensory (outer hair cell) loss by DPOAEs**
- **Elevated contralateral versus ipsilateral acoustic reflexes suggest central auditory dysfunction**
- **Poor speech perception in noise with competing meaningful message is evidence of auditory processing disorder**

Promoting Healthy Hearing Over the Lifespan *Case Scenario 2*

Recommendations: Traditional versus Updated (Red) Assessment

- Detailed informational counseling about test findings including ...
- **Possible APD ... Schedule formal APD assessment**
- **Likely benefits from amplification**
 - Pending APD findings schedule hearing aid consultation.
 - **Consider directional microphones and FM technology**
- **Referral to psychology for formal cognitive assessment**
- Annual follow up assessments to monitor hearing status and compliance with recommendations
- Full report to family physician

Promoting Healthy Hearing Over the Lifespan

Case Scenario 2

Recommendations: Traditional versus Updated Assessment

	Test Battery	
	Old	New
Aural Immittance	---	4.5 mins; \$21.96
Tympanometry		
Acoustic reflex		
DPOAEs	---	5.0 mins; \$33.48
Comprehensive Audio	\$38.52	---
Pure Tone Audiometry Air	7.5 mins	7.5 mins; \$32.40
Pure Tone Audiometry Bone	6.0 mins	---
SRT	5.0 mins	---
Speech recognition	5.0 mins	---
SSI Test (92576)	---	10 mins;
\$38.52		
Total Time	23.5 mins	27 mins
Total Fees	\$38.52	\$126.36



Promoting Healthy Hearing Over the Lifespan

- **Intersection of Audiology and Public Health**
- **Considering Hearing Related Comorbid Conditions is Critical**
- **Healthy Living = Healthy Hearing**
- **Diagnostic Hearing Assessment: Enhancing Sensitivity and Specificity in Detection of Auditory Dysfunction**
- **Managing Patients with Comorbid Conditions**
- **Updated Diagnostic Audiology Approach: Case Scenarios**
- **Practicing Preventive Audiology: A New Multi-Disciplinary Strategy**



Promoting Healthy Hearing Over the Lifespan: Practicing Preventive Audiology: A New Multi-Disciplinary Strategy

Hearing Research 369 (2018) 3–14

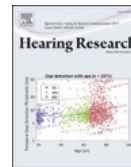


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Review Article

Comorbidities of hearing loss and the implications of multimorbidity for audiological care

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ABSTRACT

With increasing age, the risk of developing chronic health conditions also increases, and many older people suffer from multiple co-existing health conditions, i.e., multimorbidity. One common health condition at older age is hearing loss (HL). The current article reflects on the implications for audiological care, when HL is one of several health conditions in a multimorbidity. An overview of health conditions often co-existing with HL, so called comorbidities, is provided, including indications for the strength of the associations. The overview is based on a literature study examining cohort studies that were published in the years 2010–2018 and examined associations of hearing loss with other health conditions, namely Visual impairment, Mobility restrictions, Cognitive impairment, Psychosocial health problems, Diabetes, Cardiovascular diseases, Stroke, Arthritis, and Cancer. This selection was based on previous publications on common chronic health conditions at older age and comorbidities of hearing loss. For all of these health conditions, it was found that prevalence is larger in people with a HL and several longitudinal studies also found increased incident rates in people with a HL. The examined publications provide little information on how hearing loss should be managed in the clinical care of its comorbidities and vice versa. The current article discusses several options for adaptations of current care. Nonetheless, solutions for an integrated audiology care model targeting HL in a multimorbidity are still lacking and should be subject to future research.

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- Examined associations of hearing loss with other health conditions
 - Visual impairment
 - Mobility restrictions
 - Cognitive impairment
 - Psychosocial health problems
 - Diabetes
 - Cardiovascular diseases
 - Stroke
 - Arthritis
 - Cancer
- Solutions for an integrated audiology care model targeting HL with multimorbidity are lacking.
- Future research should examine potential solutions for an integrated audiology care model targeting HL in multimorbidity and evaluate the benefits to the patient and the healthcare system.

Promoting Healthy Hearing Over the Lifespan: *Practicing Preventive Audiology: A New Multi-Disciplinary Strategy*

The Chronic Care Model and Chronic
Condition Self-Management: An
Introduction for Audiologists

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Gitte Keidser, Ph.D.,^{1,2,3} and Carly Meyer, Ph.D.^{1,3}

ABSTRACT

Hearing health care is biomedically focused, device-centered, and clinician-led. There is emerging evidence that these characteristics—all of which are hallmarks of a health care system designed to address acute, rather than chronic, conditions—may contribute to low rates of help-seeking and hearing rehabilitation uptake among adults with hearing loss. In this review, we introduce audiologists to the Chronic Care Model, an organizational framework that describes best-practice clinical care for chronic conditions, and suggest that it may be a viable model for hearing health care to adopt. We further introduce the concept of chronic condition self-management, a key component of chronic care that refers to the knowledge and skills patients use to manage the effects of a chronic condition on all aspects of daily life. Drawing on the chronic condition evidence base, we demonstrate a link between the provision of effective self-management support and improved clinical outcomes and discuss validated methods with which clinicians can support the acquisition and application of self-management skills in their patients. We examine the extent to which elements of chronic condition self-management have been integrated into clinical practice in audiology and suggest directions for further research in this area.

KEYWORDS: aural rehabilitation, Chronic Care Model, chronic condition, hearing loss, self-management

- **HEARing Cooperative Research Centre (Sydney Australia)**
- **National Acoustic Laboratory (NAL)**
- **Macquarie University (Sydney)**
- **University of Queensland (Brisbane)**

Promoting Healthy Hearing Over the Lifespan: *Combined Audiological and Medical Management*

- **Physicians**
 - Family physicians and internists
 - Gerontologists
 - Pediatricians
 - Otolaryngologists
 - Ophthalmologists
 - Neurologists
 - Psychiatrists
 - Endocrinologists
 - Medical geneticists
- **Non-medical health care professionals**
 - Psychologists and neuropsychologists
 - Optometrist
 - Speech pathologists
 - Physical therapists
 - Professional counselors



Promoting Healthy Hearing Over the Lifespan

Selection of Diagnostic Tests Based on Comorbid Conditions

(+ = Added to Test Battery)

Comorbid Condition	Audiological Procedure			Referral
	Acoustic Reflexes	DPOAEs	Speech In Noise	
Diabetes		+		Internal Medicine; Endocrinology
Cardiovascular Disease		+	+	Internal Medicine; Cardiology
Hyperlipidemia		+		Family Physician; Internal Medicine
Cognitive Decline or Dementia	+	+	+	Psychology; Neurology; Psychiatry
Rheumatoid Arthritis		+		Rheumatologist
Kidney Disease		+		Urologist; Nephrologist



Promoting Healthy Hearing Over the Lifespan: *Conclusions*

- **A multi-disciplinary approach is needed for identification, diagnosis, and management of hearing loss and related disorders in patients with comorbid conditions.**
- **Primary care and other physicians should refer patients with comorbid conditions for audiologic assessment.**
- **Audiologists should verify that patients with comorbid conditions are receiving appropriate medical management.**
- **Audiologists should regularly utilize a diagnostic audiology protocol with high degree sensitivity to peripheral and central auditory dysfunction. *It is medically necessary.***
- **Promoting healthy and normal hearing over the lifespan is evidence based ... age-related hearing loss is not inevitable**

Promoting Healthy Hearing Over the Lifespan

