



**Age-Related Hearing Loss:
Research → Clinical Practice**

Ishara Ramkissoon, Ph.D., CCC-A
Speech and Hearing Association of
Alabama Convention
February 22, 2018



DISCLOSURE STATEMENT

 **Financial Disclosure:** The authors do not have financial relationships relevant to the content of the session.

 **Non-financial Disclosure:** The authors do not have non-financial relationships relevant to the content of the session.

LEARNER OBJECTIVES

- 1) Define Age-Related Hearing Loss (ARHL)
- 2) Identify 5 medical risk factors for ARHL; describe the supporting research per risk factor
- 3) Identify 3 lifestyle risk factors for ARHL; describe the supporting research per risk factor
- 4) Describe 4 strategies to promote hearing health
- 5) Produce and modify case history form with new information learned.
- 6) Design 3 ways to modify your clinical practice.

OUTLINE OF PRESENTATION

- 1) Age-Related Hearing Loss (ARHL)
 - Definition, Prevalence, Rationale for Services
- 2) Federal and professional mandates/guidelines - elder care
- 3) Risk Factors for ARHL
 - Discuss risk factors individually – research findings
 - Clinical implications - assessment & management of HL
- 4) Framework for promoting hearing health
- 5) Clinical strategies in audiologic clinical service
 - Include risk factor analysis

AGING & AGE-RELATED HEARING LOSS

Aging is a natural, biologic process that results in global changes within a species as time advances

- "Older adult" = persons over 65 years of age

Not disease, which is:

- process including abnormal changes and pathology
- significant decrements in functional skills

Aging is universal, predictable, and follows a natural evolution and maturation

Senescence

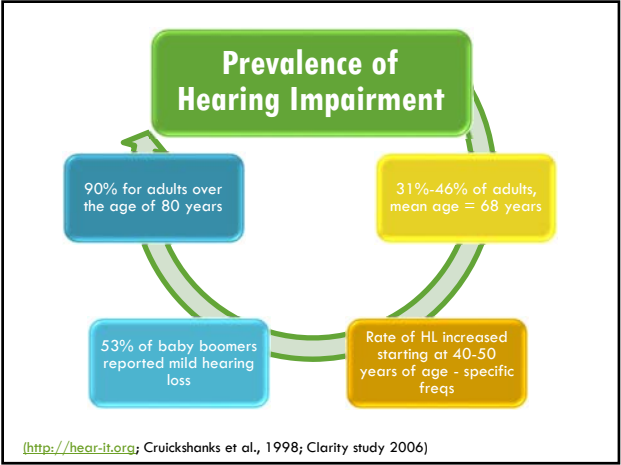
ARHL = broad and modern term

- Hearing loss associated with growing older
- Includes cochlear degeneration

Influenced by intrinsic and extrinsic factors, e.g.,

- cardiovascular disease
- diabetes
- noise exposure
- poverty





WORLD HEALTH ORGANIZATION (WHO) ESTIMATES OF DISABLING HEARING LOSS, 2012

360 million people have disabling hearing loss (DHL)

- 91% are adults
- Males- 56%
- Females- 44%

The prevalence of DHL is greatest in adults over 65 years:

- And is highest in South Asia, Asia Pacific, and Sub-Saharan Africa

HEALTHY PEOPLE 2020: OBJECTIVES FOR OLDER ADULTS

HP - US federal initiative implemented with goals for a 10-year period

- to better serve the overall health of the population by preventing disease and promoting health

OA-2 states:

"Increase the proportion of older adults who are up to date on a core set of clinical preventive services"

OA-4 and OA-6

"Increase proportion of adults with reduced physical or cognitive function who engage in leisure time physical activities"

ARHL is more than just hereditary factors

{ Comorbidities
 Chronic conditions }

INTRINSIC RISK FOR ARHL

CARDIOVASCULAR DISEASE (CVD)

Compromises blood supply to cochlea

Relation of HL & 5 Risk Factors for CVD:

- Blood pressure & hypertension
- Serum total cholesterol, triglyceride, & lipoprotein levels
- Diabetes mellitus
- Smoking
- Overweight: BMI > 25 is risk factor for CVD

Friedland et al., (2009): found a significant association between:

- LF HL and CVD risk factors
- LF presbycusis and intracranial vascular pathology
- Peripheral vascular disease, coronary artery disease, history myocardial infarction

Patients with LF HL are at greater risk for cardiovascular events and should be informed.

DIABETES MELLITUS

Prevalence:	Diabetic	Non-Diabetic
of hearing loss (HL) overall	16%	4%
of mild or greater HL in poorer ear (low/mid freq)	21.3%	9.4%
of mild or greater HL in poorer ear (high freq)	54.1%	32%

Bainbridge et al., 2008

DIABETES

Progression of HL:
70% in diabetics
 vs.
48% in non-diabetics

(Mitchell et al, 2009)

(NHANES 1999-2002 data)

- > Increased odds of hearing loss: OR=2.0
- > Worse thresholds at
 - > 500-1000 Hz and 3-8 kHz
 - > No age effect

Association between cardiovascular risk factors and frequency-specific hearing level, NHANES 1999-2002

Agrawal et al. (2009)

HYPERTENSION & VISION IMPAIRMENT

Hypertension

- Patients with hypertension have greater increase in hearing threshold versus those without hypertension
- Hearing loss **prevalence** increased with more severe HPT: 40% in Grade 2 and 54% in Grade 3 patients with HPT.

Blood Pressure	Grade 1	Grade 2	Grade 3
SBP (mm Hg)	140-159	160-179	≥ 180
DBP (mm Hg)	90-99	100-109	≥ 110

(Agrawal et al, 2013)

Vision Impairment

- Blindness in one eye: 18% of adults > 70 years
- Dual sensory impairments (hearing & vision): 8.6%
- 16.6% in adults >80 yrs
- Greater difficulty with ambulating, preparing meals, and going outside
- Decreased socialization:
 - 63% vs. 74% in those without sensory loss
- One consequence: higher mortality in women

(Crews & Campbell, 2004; Lee, 2007)

COGNITIVE STATUS/ABILITY

The poorer the score on test of mental status, the greater was likelihood of HL in older adults.

- [Helzner et al, 2005]

Age was moderately correlated with cognitive functions in German older adults

- Cognitive Tests included functions related to:
 - memory, speed of processing, reasoning, knowledge
- [Lindenberger & Baltes, 1994]

DEMENTIA

Senile Dementia (SD)

- Syndrome that describes the pattern of symptoms that can result from different brain diseases
- SD is commonly caused by Alzheimer's
- The incidence is 15% in 65+ and 50% in 80 yr

HL & Dementia explored - BLS:

- Baseline: no dementia; n=639
- after 12 yrs: N=58 had dementia; 37 due to AD
- Pts with HL - greater risk for dementia
- Risk of **Incident Dementia** by baseline hearing >25 dB HL increased with more severe hearing loss
- Corroborates previous research:
 - Patients with dementia had more significant HL

(Lin et al, 2011)

TINNITUS

In study of older adults,
Incidence of Tinnitus:

- 5.7% at year 5
- > in men than women
- 12% at year 10
- 37% at baseline had tinnitus (self report)
- incidence decreased with age - only 18% at year 5 testing
- (Gopinath et al, 2010)

Fig. 2. The 5-yr incidence of tinnitus by age and sex in the Blue Mountains Hearing Study. $P_{trend} = 0.005$.

EXTRINSIC RISK FACTORS FOR ARHL

- Lifestyle Choices
- Medications
- Other Factors

SMOKING

Relation between HL and smoking

60-69 years
Nonsmokers: 36%
Current Smokers: 56%

70-79 years
Nonsmokers: 60%
Current Smokers: 71%

80-92 years
Nonsmokers: 89%
Current Smokers: 92%

(Namura et al., 2005; Cruickshanks et al., 1998)

Conclusions

Positive association between HL and smoking.

Secondhand Smoke
Those living with a smoker are more likely to have HL

Agrawal et al., 2009

- ▶ Heavy smokers
- ▶ >1 pack/ day
- ▶ increased odds of hearing loss (OR=1.5)
- ▶ 4-5 dB poorer hearing level than nonsmokers at 4000-8000 Hz

Ramkissoon & Cole, 2011; Ramkissoon, 2012

- ▶ Self reported (SR) hearing difficulty was greater in
- ▶ baby boomer smokers (37.5%) and young smokers (18%) vs. nonsmokers
- ▶ Specificity of SR
- ▶ poorer/lower in BBS (67%) vs. BBNS (92%)

SMOKING – EVOKED POTENTIAL FINDINGS

- ▶ The Auditory Middle Latency Response (AMLR) and acute smoking effects
- ▶ Higher AMLR amplitude after smoking a cigarette: (acute condition) vs. nonsmokers

Ramkissoon & Chambers (2008)

ALCOHOL ALONE + ALCOHOL AND SMOKING

Moderate alcohol intake

- ▶ inversely correlated w/ hearing loss

Successful aging predictors

- ▶ Absence of HL based on self-reported hearing as:
 - ▶ good, fair, poor, deaf
- ▶ Moderate alcohol consumption, i.e. 4-30 oz (120-900 ml) per month versus never or greater amounts
- ▶ Increased odds of successful aging

Fransen et al, 2008; (Strawbridge et al, 1996)

Combined Alcohol & Smoking

- Nonsmokers with moderate alcohol use less likely to have hearing loss ($p = 0.03$)
- Those with <2 drinks/day had reduced likelihood for severe HL
- Interaction between smoking and moderate alcohol use on hearing loss
 - not significant ($p = 0.73$)
 - Additive effects of smoking and alcohol on HL prevalence
- Drinkers (smokers & nonsmokers)
 - more likely to have hearing loss than non-drinkers

(Gopinath et al., 2010)

EXERCISE & FITNESS

- Exercise impacts cognitive abilities in people 55+ years
- Increased physical activity benefits women, esp. on HRT > men
- Interaction of fitness with age
- Declines in the brain gray and white matter with age
 - reduced in adults with cardiovascular fitness

Link between fitness (exercise) and cognitive health impacts ARHL
 (Kramer et al., 2003; Colcombe et al., 2003)

MEDICATIONS

Vitamins/Nutrition	Ototoxicity
<p>Aldosterone- hormone (Robert D. Frisina)</p> <ul style="list-style-type: none"> • Levels decrease with age • Influences potassium levels in inner ear <ul style="list-style-type: none"> • inner ear is especially sensitive to any disruption in potassium levels <p>Folic Acid- B vitamin (Durga et al., 2007)</p> <ul style="list-style-type: none"> • Supplement slowed the decline in hearing of the speech frequencies in older adults 	<ul style="list-style-type: none"> • Partial list of ototoxic medications <ul style="list-style-type: none"> • salicylates, NSAIDs, antibiotics, loop diuretics, quinine, chemo meds, cardiac and hypertensive meds • Ototoxic medication accelerates ARHL (Ison, et al., 2010) • Loop diuretics – tinnitus • Quinine and Aspirin in large quantities <ul style="list-style-type: none"> • Temporary SNHL • Progesterin in HRT – poorer auditory function in women

NIHL & INTERACTION WITH OTHER FACTORS

Noise interacts with age, ethnicity, gender, smoking, and education level to impact incidence of ARHL

- Black males had significantly better HF hearing vs. white males, but significantly poorer LF hearing
- Age was the most important influence on hearing thresholds for both groups
- Race was significant in determining susceptibility to NIHL and ARHL

Strauss et al, 2013

ACTIVITY #1

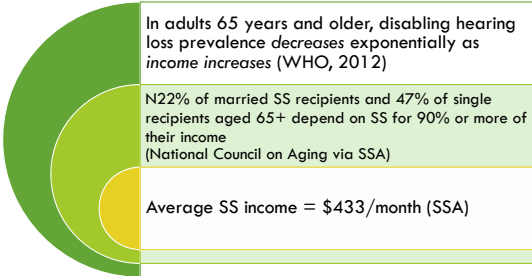
The color paper in front of you corresponds to the Medical Comorbidity and Lifestyle Choice listed below.

Create 5 potential questions about this comorbidity and 5 questions about this lifestyle choice that could be included on a questionnaire targeted for older adults.

- Cardiovascular disease; Smoking
- Diabetes Mellitus; Exercise
- High Diastolic Pressure (Hypertension); Noise Exposure
- Cognitive dysfunction; Vitamins and Nutrition
- Vision Impairment; Ototoxicity
- Tinnitus; Alcohol Consumption

OTHER EXTRINSIC CONSIDERATIONS

Economic status



In adults 65 years and older, disabling hearing loss prevalence decreases exponentially as income increases (WHO, 2012)

N22% of married SS recipients and 47% of single recipients aged 65+ depend on SS for 90% or more of their income (National Council on Aging via SSA)

Average SS income = \$433/month (SSA)

OTHER EXTRINSIC CONSIDERATIONS

Health literacy and access to healthcare

- Findings of National Assessment of Adult Literacy (NAAL) survey in 2003: (cited in Riggs et al., 2016)
- 36% of adults had only basic or below basic health literacy (BHL)
 - "skills necessary to perform simple and everyday literacy activities."
- Adults 65 and older - lower average health literacy vs. younger adults
- Adults aged 60 years and older:
 - 71% have difficulty using print materials,
 - 80% have difficulty using documents such as forms or charts,
 - 68% have difficulty interpreting numbers and performing calculations.
- Estimates suggest 2/3 older adults are not able to understand information received about their prescription medications

OTHER EXTRINSIC CONSIDERATIONS

Federal and State Policies

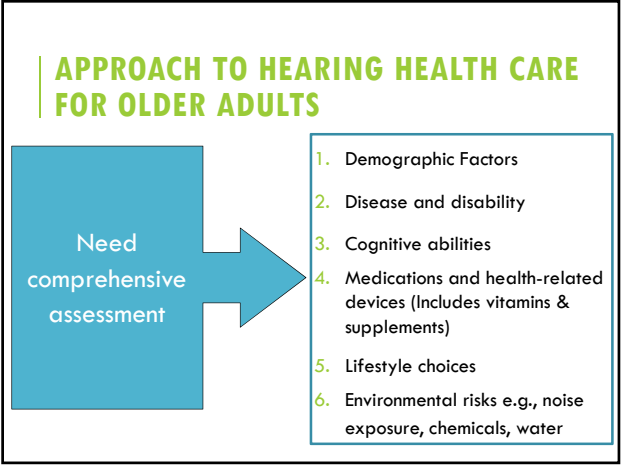
- One objective of Healthy People 2020 is to increase the access to health care services
- 3 barriers for lack of access to healthcare:
 1. Lack of availability
 2. Cost
 3. Lack of insurance coverage



HEARING HEALTH PROMOTION

- Framework
- Clinical Strategies

APPROACH TO HEARING HEALTH CARE FOR OLDER ADULTS



Need comprehensive assessment

1. Demographic Factors
2. Disease and disability
3. Cognitive abilities
4. Medications and health-related devices (Includes vitamins & supplements)
5. Lifestyle choices
6. Environmental risks e.g., noise exposure, chemicals, water

APPROACH TO HEARING HEALTH CARE FOR OLDER ADULTS

Characteristics & Conditions related to hearing loss

1. Age
2. Race
3. Medical history
4. Ototoxic medications
5. Lifestyle factors
6. Gender (Pearson et al, 1995)
 - HL develops faster in men - early as 30 years
 - 3-4 kHz showed the largest gender difference

HOW CAN HEARING HEALTH PROMOTION BE ACHIEVED?

Combine Activities from Categories	Role of audiologists
Education Organization <ul style="list-style-type: none">• Various levels Environmental Economic <ul style="list-style-type: none">• Access to healthcare	<ul style="list-style-type: none">• Develop and implement professional activities<ul style="list-style-type: none">• based on categories• Address specific factors linked to hearing loss• Target specific areas....

HEALTH PROMOTION STRATEGIES: EDUCATION

Goal

- to increase general knowledge in the community so that progression of hearing loss is slowed, prevented, or managed to best available current standards

Current patients and the local community at-large should:

- receive educational information about hearing function and how it interacts with chronic conditions, medications,
- lifestyle choices impacting general health and hearing

**HEALTH PROMOTION STRATEGIES:
EDUCATION**

Lectures/workshops

- local community venues
- Senior centers/retirement villages
- Local businesses/chambers of commerce

Flyers/pamphlets

- info about hearing health
- Meds, lifestyle choices, noise exposure, etc.
- Develop your own or use AAA/ASHA

“Lunch and Learn”

- Raffle off hearing aids
- ask local HA manufacturer representatives

**HEALTH PROMOTION STRATEGIES:
EDUCATION**

Continuing Education Lectures

- local physicians
- nurse practitioners
- geriatric specialists

**NOT the
Whisper Test**

Self Report Measures

- HHIE or other questionnaire

Welch Allyn, Inc.

- Audioscope 3

Interdisciplinary Medical Outreach Events

- Hearing Screening Day

**HEALTH PROMOTION STRATEGIES:
ORGANIZATIONS**

Hearing loss organizations that promote hearing health for the aging population

- **Local/Public e.g.,**
- Rotary Club, Lions Club, Senior Centers
- We can provide info on effective comm., leave handouts, give presentations, demonstrate hearing instrument care
- **State**
- ALAA
- Dept. of Rehab. Services

HEALTH PROMOTION STRATEGIES: ORGANIZATIONS

National/Professional

- HLAA
- ASHA
- AAA
 - Provides useful and quick information on preventing and managing hearing loss

International

- WHO
 - Helps assist in developing hearing care programs integrated into the primary healthcare system
 - provides international statistics on hearing loss

HEALTH PROMOTION STRATEGIES: ENVIRONMENTAL

Excessive noise exposure

- Distribute hearing protection at presentations and local businesses
- OSHA/NIOSH recommendation handouts

Noise ordinances

- States, counties, and cities - own policies
- Advocate for legislation in your area

Smoking/Second-hand smoke exposure

- Environmental considerations
- Ordinances
- Community awareness

HEALTH PROMOTION STRATEGIES: ECONOMIC

- **Free Screenings**
 - Baseline information
- **Multidisciplinary "Student Run Free Clinic" with a local college/university**
- **Group Audiologic Rehabilitation services**
 - Teach how to cope with their HL even if they can't afford amplification devices
 - Communication strategies
 - Group Discussions

**HEALTH PROMOTION STRATEGIES:
ECONOMIC**

- Consider each patient's social standing, economic background and current status, education level with
 - a community's access to healthcare professionals in order to
 - improve a country's commitment to addressing ARHL nationally
- Lions Club
 - "Affordable Hearing Aid Project"
 - <http://www.lcif.org/>
- Starkey's Hear Now program
 - Application-based program that provides help to low-income Americans
 - <https://www.starkeyhearingfoundation.org/Hear-Now>

ACTIVITY #2

Specific to your own community, develop/write down one Hearing Health event or strategy corresponding to each health promotion category below:

- 1. Education**
- 2. Organizations**
- 3. Environmental**
- 4. Economic**



Questions?

References

- Agarwal, S., Mishra, A., Jagade, M., Kasbekar, V., & Nagle, S. (2013). Effects of Hypertension on Hearing. *Indian Journal Of Otolaryngology & Head & Neck Surgery*, (65) 614-618.
- Agrawal, Y., Platz, E. A., & Niparko, J. K. (2009). Risk factors for hearing loss in US adults: data from the National Health and Nutrition Examination Survey, 1999 to 2002. *Otology & Neurotology: Official Publication Of The American Otological Society, American Neurotology Society [And] European Academy Of Otology And Neurotology*, 30(2), 139-145.
- Agrawal, Y., Platz, E. A., & Niparko, J. K. (2008). Prevalence of hearing loss and differences by demographic characteristics among US adults: data from the National Health and Nutrition Examination Survey, 1999-2004. *Archives of Internal Medicine*, 168(14), 1522-1530.
- American Psychological Association (n.d.). *Older Adults' Health and Age-Related Changes*. Retrieved from <http://www.apa.org/pi/aging/resources/guides/older.aspx>.
- Bainbridge, K. E., Hoffman, H. J., & Cowie, C. C. (2008). Diabetes and Hearing Impairment in the United States: Audiometric Evidence from the National Health and Nutrition Examination Survey, 1999 to 2004. *Annals Of Internal Medicine*, 149(1), 1-10.
- Bentur, N., Valinsky, V., Lemberger, J., Ben Moshe, Y., & Heymann, A. D. (2012). Primary care intervention programme to improve early detection of hearing loss in the elderly. *Journal of Laryngology & Otology*, 126, 574-579.
- Blazer, D., Domnitz, S., & Liverman, C. (2016). *Hearing Health Care of Adults: Priorities for Improving Access and Affordability*. Washington, D.C.: National Academies Press.
- Brant, L., & Fozard, J. (1990). Age changes in pure-tone hearing thresholds in a longitudinal study of normal human aging. *Journal of the Acoustical Society of America*, 88: 813-820.
- Chien, W., & Lin, F. R. (2012). Prevalence of hearing aid use among older adults in the United States. *Archives of internal medicine*, 172(3), 292-293.
- Clarity (2006). *Baby Boomer Hearing Loss Study*. [PDF document]. Retrieved from http://www.southalabama.edu/alliedhealth/speechandhearing/ramkissoon/teaching/643/Clarity_Boomer_2006.pdf.
- Cohen-Mansfield, J., & Taylor, J. W. (2004). Hearing aid use in nursing homes, Part I: Prevalence rates of hearing impairment and hearing aid use. *Journal of the American Medical Directors Association*, 5(5), 283-288.
- Colcombe, S. J., Erickson, K. I., Raz, N., Webb, A. G., Cohen, N. J., McAuley, E., & Kramer, A. F. (2003). Aerobic fitness reduces brain tissue loss in aging humans. *The Journals Of Gerontology. Series A, Biological Sciences And Medical Sciences*, 58(2), 176-180.
- Colcombe S. and Kramer A.F. (2003). Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychol Sci* 14: 125-130.
- Crews, J., & Campbell, V. (2004). Vision impairment and hearing loss among community-dwelling older Americans: implications for health functioning. *American Journal Of Public Health*, 94(5), 823-829.
- Cruickshanks, K. (2010). Age-related hearing loss: Demographics and Risk factors. Presented at the ARC meeting in San Diego, CA, April 14. http://www.audiologynow.org/pdf/Aging/2010_ARC_Cruickshanks.pdf.
- Cruickshanks, K. J., Klein, R., Klein, B. E., Wiley, T. L., Nondahl, D. M., & Tweed, T. S. (1998a). Cigarette smoking and hearing loss: the epidemiology of hearing loss study. *JAMA*, 279(21), 1715-1719.
- Cruickshanks, K.J., Wiley, T. L., Tweed, T. S., Klein, B.E.K., Klein, R., Mares-Perlman, J.A., & Nondahl, D.M.. (1998b). Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin: the Epidemiology of Hearing Loss Study. *American Journal Of Epidemiology*, 148(9), 879-886.
- Curhan, S.G., Eavey, R., Wang, M., Stampfer, M.J., & Curhan, G.C. (2013). Body Mass Index, Waist Circumference, Physical Activity, and Risk of Hearing Loss in Women. *The American Journal of Medicine*, 126 (12), 1142.e1-1142.e8.
- Dawes, P., Emsley, R., Cruickshanks, K. J., Moore, D. R., Fortnum, H., Edmondson-Jones, M., & Munro, K. J. (2015). Hearing loss and cognition: the role of hearing AIDS, social isolation and depression. *PLoS One*, 10(3), e0119616.
- Durga, J., Verhoef, P., Anteunis, L. C., Schouten, E., & Kok, F. J. (2007). Effects of Folic Acid Supplementation on Hearing in Older Adults. *Annals Of Internal Medicine*, 146(1), 1-W2.
- Eggermont, J. J., & Roberts, L. E. (2004). The neuroscience of tinnitus. *Trends in neurosciences*, 27(11), 676-682.
- Fransen, E., Topsakal, V., Hendrickx, J., et al. (2008). Occupational noise, smoking, and a high body mass index are risk factors for age-related hearing impairment and moderate alcohol consumption is protective: a European population based multicenter study. *Journal Of The Association For Research In Otolaryngology: JARO*, 9(3), 264-276.

- Friedland, D. R., Cederberg, C. and Tarima, S. (2009), Audiometric pattern as a predictor of cardiovascular status: Development of a model for assessment of risk. *The Laryngoscope*, 119: 473–486.
- Frisina, R. D. (2012). Hormones and Hearing: Too Much or Too Little of a Good Thing Can Be Ototoxic. *Seminars In Hearing*, (3), 231-241.
- Gates, G.A., Cooper, J.C. J., Kannel, W.B., & Miller, N.J. (1990) Hearing in the Elderly: The Framingham Cohort, 1983-1985. Part I. Basic Audiometric Test Results. *Ear and Hearing*, 11 (4), 247-256.
- Gopinath, B., McMahon, C. M., Rochtchina, E., Karpa, M. J., & Mitchell, P. (2010). Incidence, persistence, and progression of tinnitus symptoms in older adults: the Blue Mountains Hearing Study. *Ear & Hearing*, 31(3), 407-412.
- Gopinath, B., Flood, V., McMahon, C., Burlutsky, G., Smith, W., & Mitchell, P. (2010). The effects of smoking and alcohol consumption on age-related hearing loss: the Blue Mountains Hearing Study. *Ear & Hearing*, 31(2), 277-282.
- Healthwise Staff (2012). *Aldosterone in Blood*. Retrieved from <http://www.webmd.com/a-to-z-guides/aldosterone?page=4>.
- Helzner, E., Cauley, J., Pratt, S., et al. (2005). Race and sex differences in age-related hearing loss: the health, aging and body composition study. *Journal Of The American Geriatrics Society*, 53(12), 2119-2127.
- Hearing Loss Association of America. (n.d.). *Hearing Health Care for Adults: Priorities for Improving Access and Affordability*. Retrieved from <http://www.hearingloss.org/content/hlaa-supports-newreport-change-hearing-health-care>.
- Hear-it. (n.d.). *Baby Boomer Facts*. Retrieved from <http://www.hear-it.org/baby-boomer-facts>.
- Ison, D. G., Tremblay, K., & Allen, P. (2010). Closing the gap between neurobiology and human presbycusis: Behavioral and evoked potential studies of age-related hearing loss in animal models and in humans. *The Aging Auditory System* (pp. 75-110) Springer-Verlag: New York.
- Jackson, A., & Mbiza, S. (2016). Exercise prescription for the older adult. The Deep South CME Network, UAB Division of CME, Geriatric-Focused CME Courses. <http://www.alabamacme.uab.edu/geriatrics.aspx>.
- Kujawa, S. G., & Liberman, M. C. (2006). Acceleration of age-related hearing loss by early noise exposure: Evidence of a misspent youth. *Journal Of Neuroscience*, 26(7), 2115-2123.
- Lee, D. J., Gómez-Marín, O., Lam, B. L., et al. (2007). Severity of concurrent visual and hearing impairment and mortality: the 1986-1994 National Health Interview Survey. *Journal Of Aging And Health*, 19(3), 382-396.
- Lin, F. R., Metter, E. J., O'Brien, R. J., Resnick, S. M., Zonderman, A. B., & Ferrucci, L. (2011). Hearing loss and incident dementia. *Archives Of Neurology*, 68(2), 214-220.
- Lin, F. R., Niparko, J.K., & Ferrucci, L. (2011). Hearing Loss Prevalence in the United States. *Archives of Internal Medicine*, 171(20), 1851-1853.
- Lindenberger, U., & Baltes, P. B. (1994). Sensory functioning and intelligence in old age: A strong connection. *Psychology And Aging*, 9(3), 339-355.
- Lions Club International. (n.d.). *Hearing*. Retrieved from <http://www.lcif.org/EN/our-work/humanitarian-efforts/hearing.php>.
- Liu, X. Z., & Yan, D. (2007). Ageing and hearing loss. *The Journal Of Pathology*, 211(2), 188-197.
- Matthews, S. (2013). *How the Aging Population Is Changing the Healthcare System*. Retrieved from <http://www.everydayhealth.com/senior-health/aging-and-health/pressures-on-healthcare-from-booming-senior-population.aspx>.
- McKinley, K., & Green, R. (2016). *Financial Challenges Facing Low-Wealth Older Adults*. The Deep South CME Network, UAB Division of CME, Geriatric-Focused CME Courses, <http://www.alabamacme.uab.edu/geriatrics.aspx>.
- Mitchell, P., Gopinath, B., McMahon, C. M., et al. (2009). Relationship of Type 2 diabetes to the prevalence, incidence and progression of age-related hearing loss. *Diabetic Medicine*, 26(5), 483-488.
- Munnell, A. H. (2015). The Average Retirement Age--an Update. *Pension Benefits*, 24(5), 8-10. Retrieved from <http://www.oecd.org/els/emp/average-effective-age-of-retirement.htm>.
- National Academies of Sciences, Engineering, and Medicine. (2016). *Hearing Health Care for Adults: Priorities for Improving Access and Affordability*. Washington, DC: The National Academies Press.
- National Center for Education Statistics. (n.d.). *National Assessment of Adult Literacy*. Retrieved from <https://nces.ed.gov/naal/>.
- National Center for Health Statistics (n.d.). National Health Interview Survey. Retrieved from <https://www.cdc.gov/nchs/nhis/ad292tbl.html>.
- National Council on Aging (n.d.). *Economic Security for Seniors Facts*. Retrieved from <https://www.ncoa.org/news/resources-for-reporters/get-the-facts/economic-security-facts/>.

- Nomura, K., Nakao, M., & Morimoto, T. (2005). Effect of smoking on hearing loss: Quality assessment and meta-analysis. *Preventive Medicine: An International Journal Devoted To Practice And Theory*, 40(2), 138-144.
- Office of Disease Prevention and Health Promotion. (n.d.). *Healthy People 2020*. Retrieved from <https://www.healthypeople.gov/2020/topics-objectives/topic/older-adults/objectives>.
- Olusanya, B. O., Neumann, K. J., & Saunders, J. E. (2014). The global burden of disabling hearing impairment: a call to action. *Bulletin Of The World Health Organization*, 92(5), 367-373.
- Pearson, J. D., Morrell, C. H., Gordon-Salant, S., et al. (1995). Gender differences in a longitudinal study of age-associated hearing loss. *Journal of The Acoustical Society of America*, 97(2), 1196-1205.
- Ramkissoon, I., (2012). Cigarette smoking impacts protocols for hearing testing in baby boomers and young adults. *Aging and Society: An Interdisciplinary Journal*. 1 (1), 75-86.
- Ramkissoon, I. & Buchanan, K. (2017). Developing Health Promotion Strategies to Enhance Clinical Practice with consideration of Risk Factors for Age-Related Hearing Loss. *Communication Disorders Quarterly*.
- Ramkissoon, I., & Chambers, R. D. (2008). Effects of chronic and acute smoking on AMLRs in older and younger listeners. *International Journal of Audiology*, 47(12), 715-723.
- Ramkissoon, I., & Cole, M. (2011). Self-reported hearing difficulty versus audiometric screening in younger and older smokers and nonsmokers. *Journal Of Clinical Medicine Research*, 3(4), 183-190.
- Ramkissoon, I., Hodges, M.S., & Gaines, C.T. (2016). *Comprehensive Geriatric Assessment: An Interdisciplinary Approach*. The Deep South CME Network, UAB Division of CME, Geriatric-Focused CME Courses, Retrieved from <http://www.alabamacme.uab.edu/geriatrics.aspx>.
- Riggs, J.S., McGilvray, S., McBride, M., & Carithers, T. (2016). *Assessing Health Literacy in Older Adults*. The Deep South CME Network, UAB Division of CME, Geriatric-Focused CME Courses. <http://www.alabamacme.uab.edu/geriatrics.aspx>.
- Rogalski, Y., & Rominger, A. (2015). The Impact of Subjective and Objective Hearing Loss on Cognition and Memory in Older Adults. *SIG 15 Perspectives on Gerontology*, 20(2), 49-57.
- Schow, R.L., & Nerbonne, M.A. (1980). Hearing levels among Elderly nursing home residents. *Journal of Speech and Hearing Disorders*, 45(1), 124-132.
- Starkey. (n.d.). *Hear Now*. Retrieved from <https://www.starkeyhearingfoundation.org/Hear-Now>.
- Strauss, S., Swanepoel, D. W., Becker, P., Eloff, Z., & Hall, J. I. (2013). Noise and age-related hearing loss: A study of 40 123 gold miners in South Africa. *International Journal of Audiology*, 53(Suppl. 2), S66-S75.
- Strawbridge, W. J., Cohen, R. D., Shema, S. J., & Kaplan, G. A. (1996). Successful aging: predictors and associated activities. *American Journal Of Epidemiology*, 144(2), 135-141.
- Tynan, M.A., Holmes, C.B., Promoff, G., Hallett, C., Hopkins, M., Frick, B. State and Local Comprehensive Smoke-Free Laws for Worksites, Restaurants, and Bars — United States, 2015. *MMWR Morb Mortal Wkly Rep* 2016; 65:623–626.
- United States Department of Labor. (n.d.). *Occupational Noise Exposure*. Retrieved from <https://www.osha.gov/SLTC/noisehearingconservation/>.
- University of South Alabama. (n.d.). *Community Service and Learning Opportunities*. Retrieved from <http://www.usahealthsystem.com/student-run-clinic>.
- University of South Alabama. (n.d.). *Graduate Gerontology Certificate*. Retrieved from <http://www.southalabama.edu/bulletin/current/degreesprograms/gerontology/gerontology-certificate/index.html>.
- U.S. Preventive Services Task Force. (2012). *Hearing Loss in Older Adults: Screening*. Retrieved from https://www.uspreventiveservicestaskforce.org/Page/Document/Update_SummaryFinal/hearing-loss-in-older-adults-screening.
- Wallhagen, M. I., & Strawbridge, W. J. (1997). An Increasing Prevalence of Hearing Impairment and Associated Risk Factors over Three Decades of the Alameda County Study. *American Journal Of Public Health*, 87(3), 440-442.
- Weinstein, B., (2013). *Geriatric Audiology* (2nd ed.). New York: Thieme Medical Publishers, Inc.
- Weinstein, B., (2000). *Geriatric Audiology*. New York: Thieme Medical Publishers, Inc.
- World Health Organization. (2012). *Mortality and Burden of Diseases and Prevention of Blindness and Deafness* [PDF document]. Retrieved from http://www.who.int/pbd/deafness/WHO_GE_HL.pdf.
- World Health Organization. (n.d.). *Deafness and Hearing Loss*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs300/en/>.