EFFECT OF AGE ON HEARING: OUTCOMES

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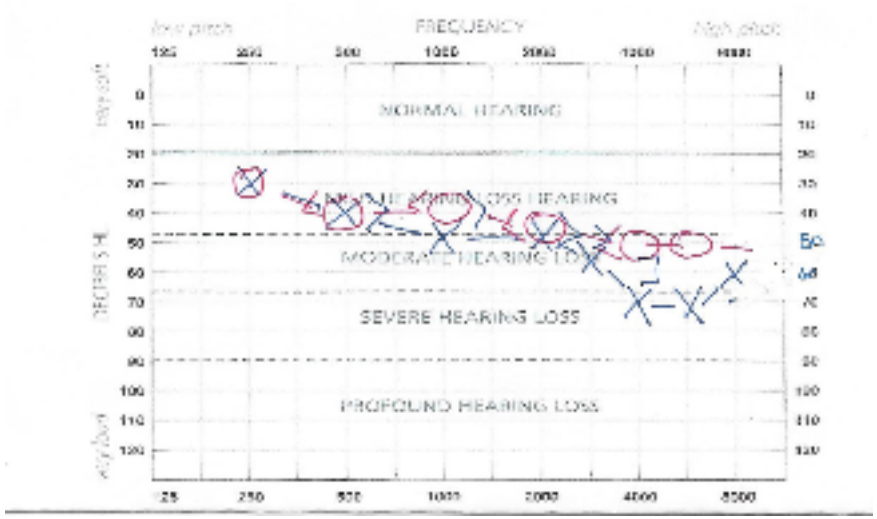
22nd Annual Appalachian Spring Conference

DISCLOSURE STATEMENT

Financial: Salary paid by Graduate Center, CUNY, the institute at which Dr. Weinstein is on faculty. Non-financial: Barbara Weinstein has a number of publications directly related to the content of this course.

GOALS

- SO WHAT?
- SO WHAT IF?
- SO WHAT NOW?



* Hearing loss influences the trajectories of people's lives

* Hearing loss associated with real world outcomes

* Can outcomes help make the case for greater investment in hearing interventions

* Is there a potential for hearing health care interventions to moderate the association between hearing loss and documented negative health outcomes

PROXIMAL CONSEQUENCES

- Communication
- Listening Effort
- Speech Understanding in Noise
- Audibility
- Hearing Related Quality of Life

PATIENT-PROVIDER COMMUNICATION

COMMUNICATION

- The ability to be understood and to understand others - a cornerstone of healthy aging
  - an important predictor of how people perceive quality of care

- American Academy of Communication in Health Care (AACH) -communication represents a key foundation of positive patient experiences
- integral to relationship centered healthcare - a guiding principle for care of older adults

PHYSICIAN PATIENT COMMUNICATION

*Effective communication – necessary to patient-centered care

*An important predictor of how people perceive quality of care

*Good communication - improves health outcomes (Steward, 1995)

positive correlations between patient–physician communication and outcomes such as emotional health, symptom resolution, pain control, functional status, and blood pressure and glucose control

HEARING LOSS AND P-P COMMUNICATION (MICK, ET AL, 2014)

- Medical Expenditure Panel Survey Household Component (MEPS-HC), a nationally representative survey of the U.S. civilian noninstitutionalized population from 2002 to 2011
- HL - based on self-report and summarized as a binary variable (no hearing loss vs any hearing loss (excluding deafness)
- Physician Patient Communication - Consumer Assessment of Healthcare Providers and Systems (CAHPS) composite measure developed for the Agency for Healthcare Research and Quality

MICK, ET AL (2014)

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- Physician Patient Communication - Consumer Assessment of Healthcare Providers and Systems (CAHPS) composite measure developed for the Agency for Healthcare Research and Quality(rate overall care from 0 (worst possible) to 10 (best possible)
- .

How Well Providers (or Doctors) Communicate with Patients

The survey asked patients how often their providers explained things clearly, listened carefully, showed respect, provided easy to understand instructions, knew their medical history, and spent enough time with the patient.

Q14	Provider explained things in a way that was easy to understand	**Response Options** • Never • Sometimes • Usually • Always
Q15	Provider listened carefully to patient	
Q17	Provider gave easy to understand information about health questions or concerns	
Q18	Provider knew important information about patient's medical history	
Q19	Provider showed respect for what patient had to say	
Q20	Provider spent enough time with patient	

RESULTS

- Individuals with HL had significantly lower odds than those with normal hearing of rating quality of patient–physician communication negatively (sex, age, hearing aid use, and self-reported visual impairment did not significantly modify these associations)
- Individuals with HL had significantly lower odds than those with normal hearing of having favorable ratings of their healthcare experiences

DOWNSTREAM OUTCOMES

- The most pronounced effects of hearing loss are psychological, not the more readily evident communicative gaps or “mishearings” experienced in everyday interactions

Cognitive Status

Physical Activity Levels

Functional Limitations

Falls, Gait Speed, FOF

Self Rated Health

Depression

Social and Emotional Loneliness

DOWNSTREAM HEALTH OUTCOMES: PHYSICAL

- Changes in brain volume
- Dementia
- Cognitive decline
- Falls
- Physical activity levels
- Self rated health
- Disease burden
- Driving risk
- Mortality
- Gait Speed
- Fear of Falling

DOWNSTREAM HEALTH OUTCOMES: PSYCHOSOCIAL

- Social Isolation
- Depression
- Caregiver burden
- Functional declines
- Quality of life
- Increased reliance on formal and informal support
- Increased risk of incident disability (Betz, et al., 2015)*
- Increased risk of needing nursing home care (Betz, et al., 2015)*

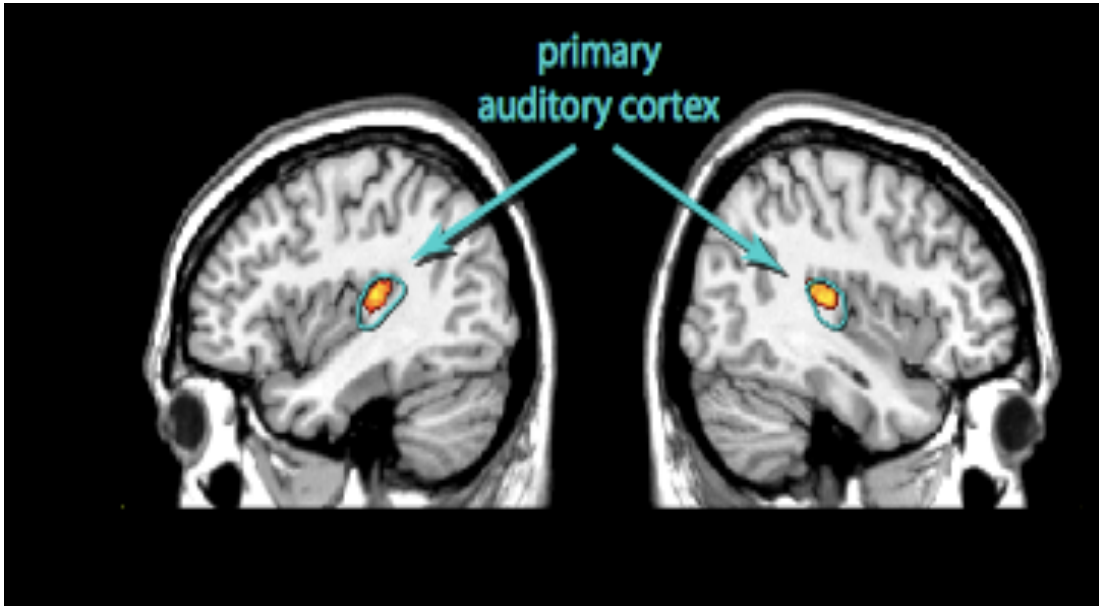
*Dose dependent effect

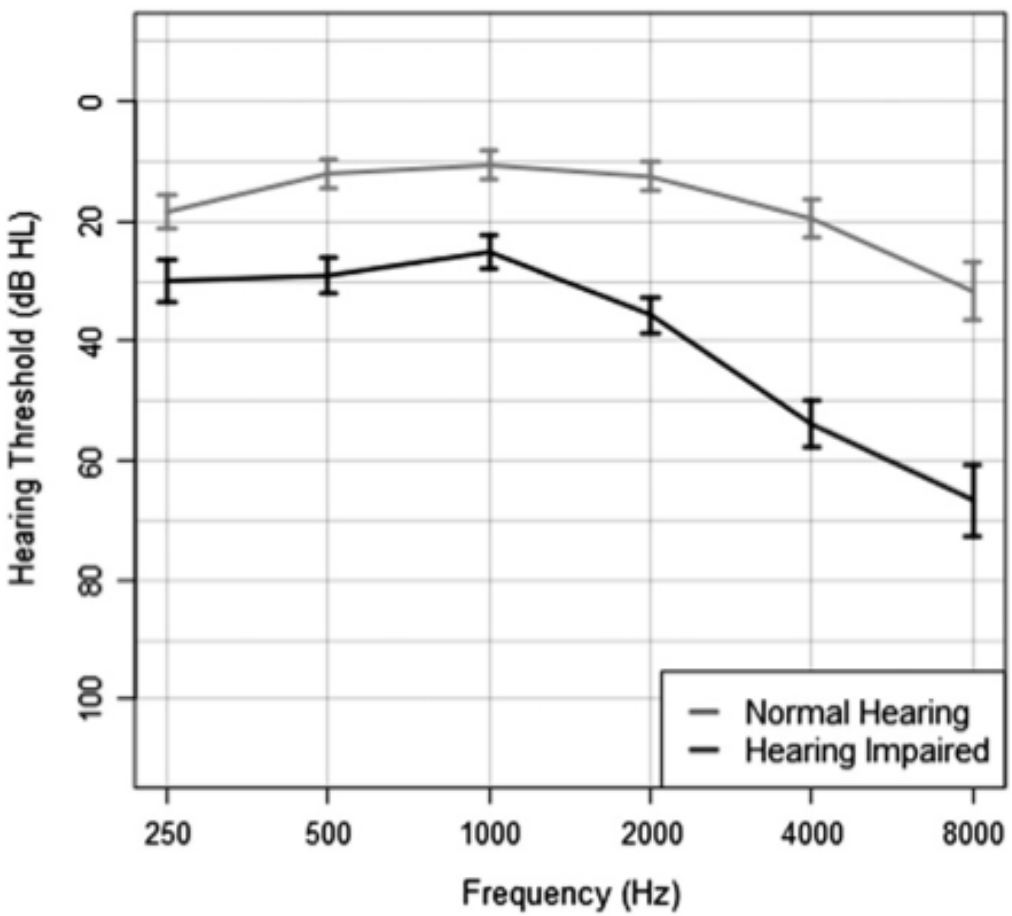
DOWNSTREAM HEALTH OUTCOMES: ECONOMIC

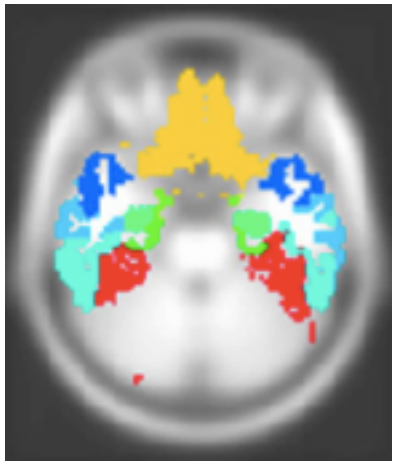
BRAIN VOLUME

- NEUROIMAGING STUDIES

  Association between peripheral hearing impairment, temporal lobe and whole brain atrophy (Peelle, 2011; Lin, Ferrucci, et al., 2014)







Baltimore Longitudinal Study on Aging (N- 126) compared structural changes in the brain over time in adults with normal hearing and hearing impairment

At baseline no differences between groups in terms of brain volume – 6 year fu

AUDITORY CORTEX CHANGES (LIN, FERRUCCI, ET AL., 2014)

- **Significant rates of atrophy over time were observed across all brain regions for individuals with normal hearing and hearing impairment**
- **Persons with hearing impairment had accelerated rates of atrophy in whole brain and temporal lobe gray matter volume as compared to normals**
- **HI had significantly more shrinkage (volume decline) in the superior, middle temporal gyri, and parahippocampal gyrus of the right temporal lobe**

- Hearing impairment in older adults - independently associated with accelerated rates of decline in regional brain volumes in the right temporal lobe critical to spoken language processing as well as whole brain volume
- Older adults with impaired hearing may have a faster rate of brain shrinkage as they age

COGNITION

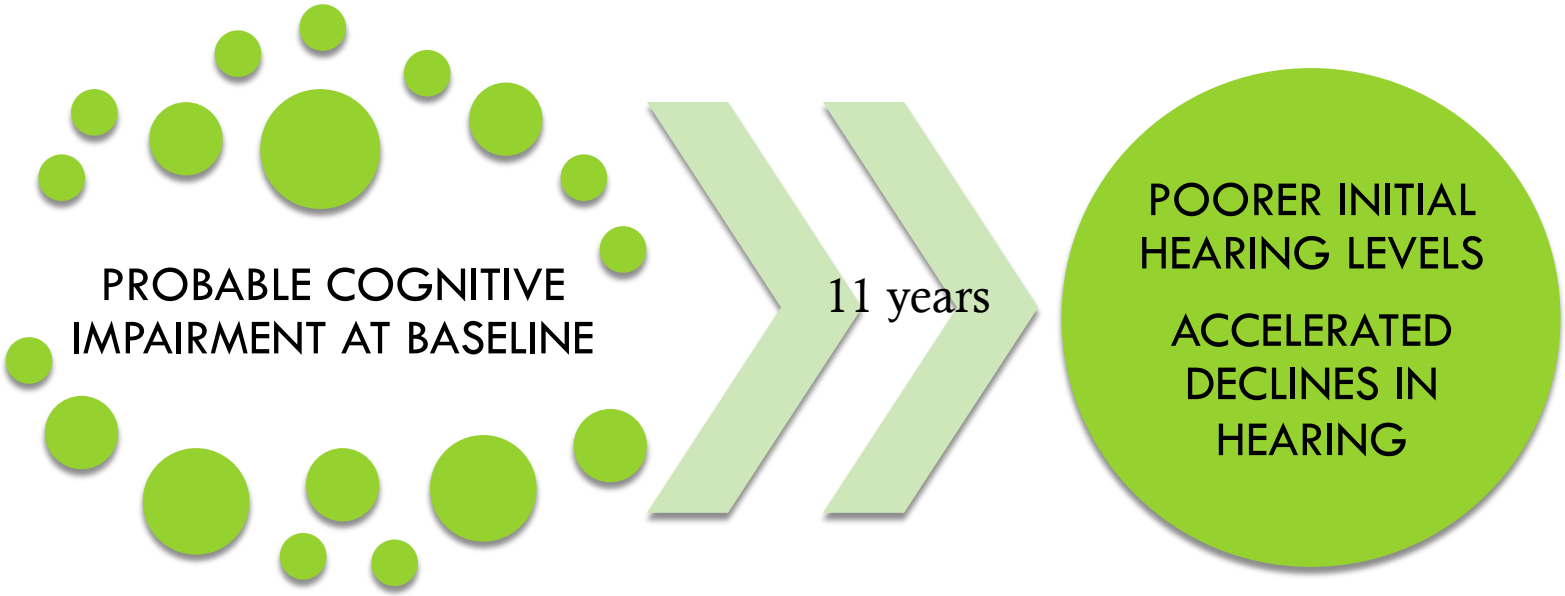
- The ability to learn, to think and to remember
- The basis for how we reason, judge, concentrate, plan and organize
- Good cognitive health critical to healthy and active aging
- Decrements in memory and executive function decline before dementia sets in

LIN, ET AL., 2011

- Greater hearing loss associated with:
  - Lower scores on MMSE
  - Memory – free recall
  - Executive function

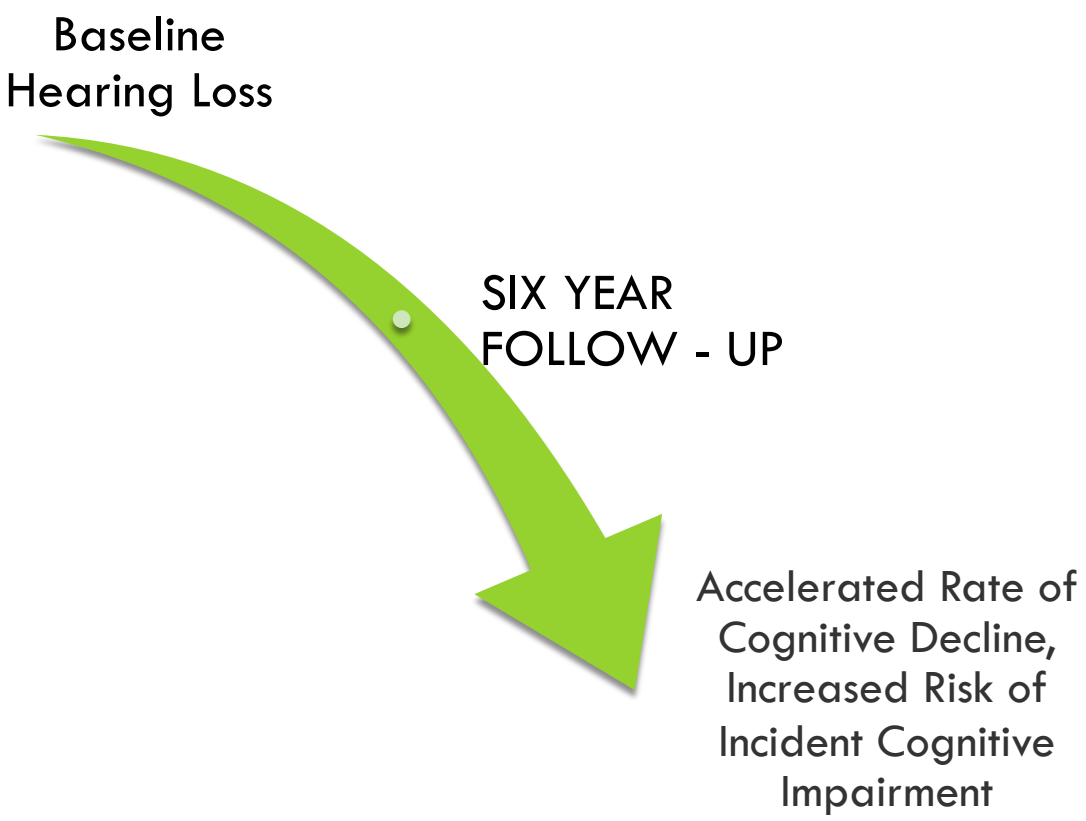
N=347, cross-sectional

Predictor of Rate of Change in Hearing (KIELY, ET AL, 2012)



HEARING LOSS AND INCIDENT COGNITIVE IMPAIRMENT

(LIN, YAFFEE, XIA, XUE, HARRIS, ET AL., 2013)



ATHEROSCLEROSIS RISK IN COMMUNITIES NEUROCOGNITIVE STUDY
DEAL, ET AL., 2015

Moderate/severe HI measured in late life associated with poorer performance on memory tasks and with a faster rate of decline in both memory and global cognitive function as compared to normal hearers

CONCLUSIONS

- Hearing loss - a late life risk factor for cognitive decline
- Hearing loss – independently associated with cognitive decline and incident cognitive impairment (6 years)
- Cognitive Impairment associated with accelerated declines in peripheral hearing ability
- Incidence of cognitive impairment associated with poorer hearing

- Hearing loss is selectively associated with cognitive measures and domains known to decline prior to dementia onset
- Hearing loss associated with decline in function on verbal and non verbal cognitive tests

DEMENTIA

- Prevalence projected to double every twenty years
- By 2050 over 100 million people or nearly 1 in 85 persons will be affected worldwide
- Risk factors - low involvement in leisure activities and social interactions, sedentary state, diabetes, and hypertension
- Interventions that could delay onset by one year could lead to a more than 10% decrease in the global prevalence in 2050

- Hearing loss and SD– two of the most common bugaboos of aging
  - 360 million people worldwide have hearing loss (WHO)
  - Nearly 45 million have Alzheimer's Disease or another form of dementia – Prevalence expected to double every 20 years

HEARING LOSS VERSUS SENILE DEMENTIA

	HEARING LOSS	SENILE DEMENTIA
Occurs More Frequently in Individuals Over 65 Years	◆	◆
Social Engagement Compromised	◆	◆
Difficulty Remembering New Information	◆	◆
Physical Activity Levels are Compromised	◆	◆
Poses a Challenge to Successful Aging	◆	◆
Increases in Prevalence with Advancing Age	◆	◆
Increases Mortality Risk	◆	◆
Associated with Social Isolation	◆	◆

LIN, ET AL., (2011)

*Attributable risk of dementia associated with hearing impairment is 36%.

*37 cases of AD were diagnosed

*Hearing loss INDEPENDENTLY associated with incident, all cause dementia

*Risk of dementia increased with severity of hearing loss – risk increased for all levels of hearing loss (individuals with mild to severe hearing loss had a 2- to 5-fold increased risk of developing dementia) as compared to those with normal hearing

LIN, ET AL. (2011)

Risk Increased
With HL Severity
(11 year fu)

(BLSA, N=639)

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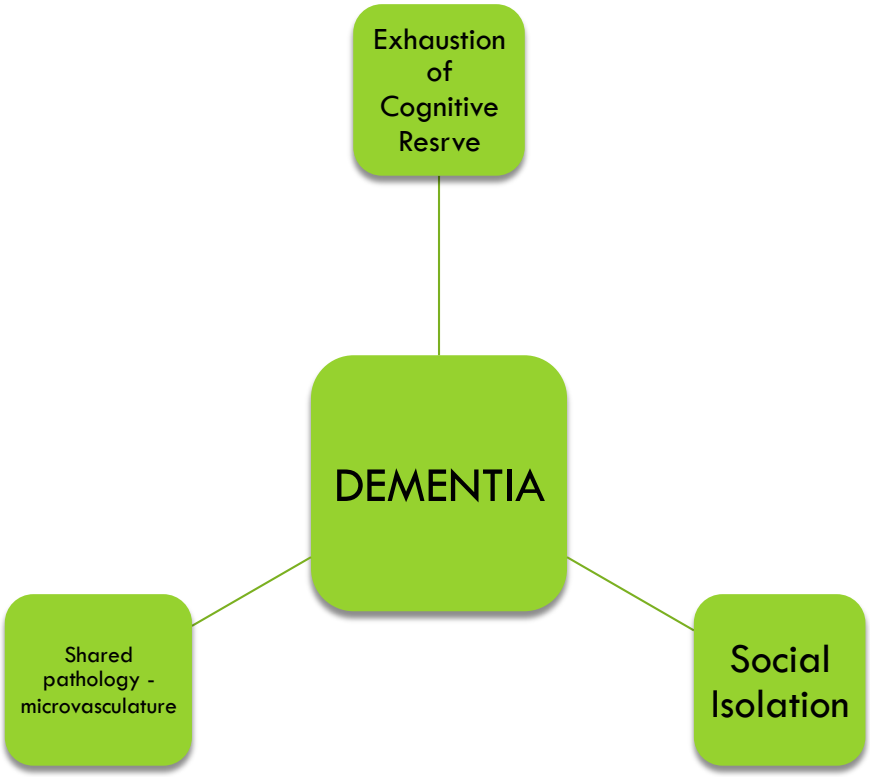
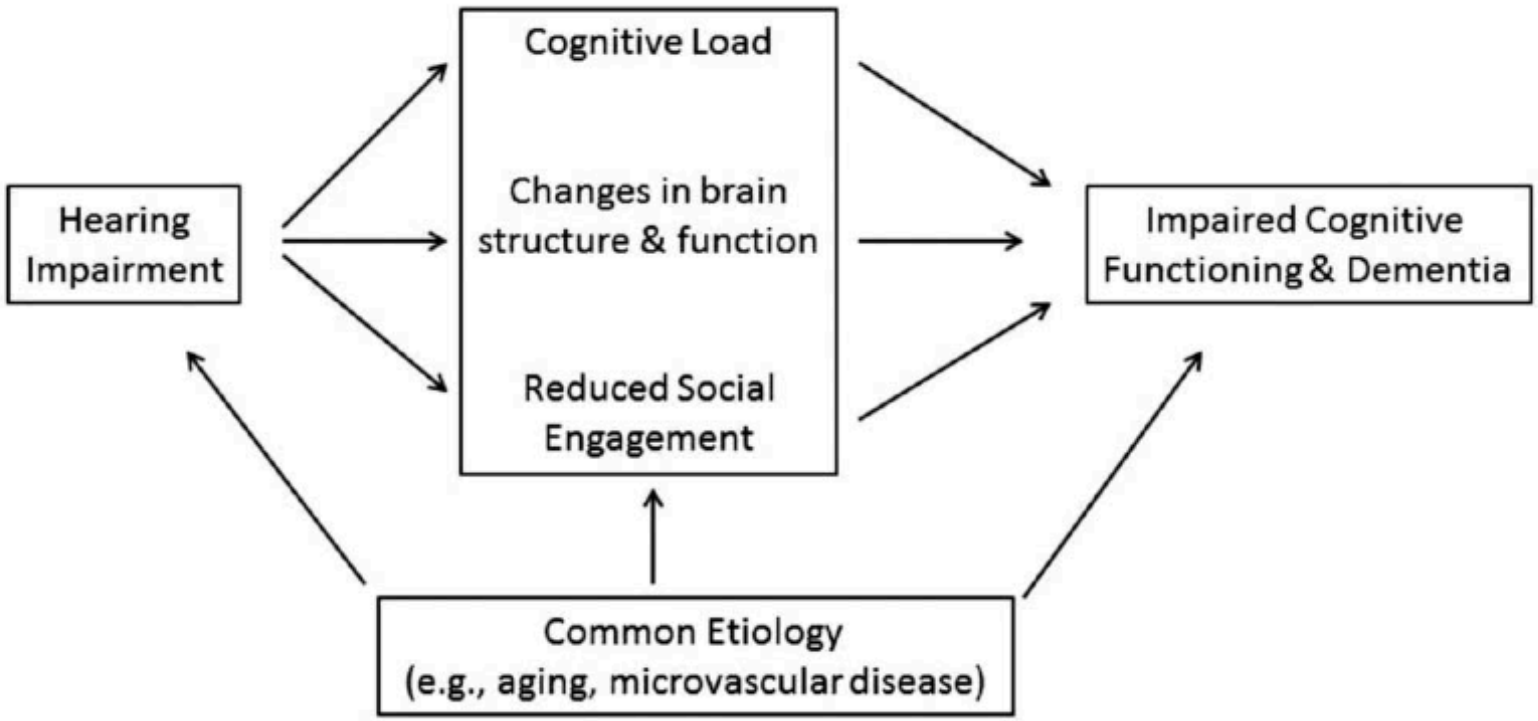

Exhaustion of Cognitive Resrve
DEMENTIA
Shared pathology - microvasculature
Social Isolation

CONCEPTUAL MODEL OF THE ASSOCIATION OF HEARING IMPAIRMENT WITH COGNITIVE FUNCTIONING AND DEMENTIA (LIN & ALBERT, 2014)



FALLS, GAIT SPEED, FOF

COST

- More than 2.4 million older adults were treated in ER for falls
- 35% of persons > 65 years fall each year
- An increase of 50% over the last decade
- NIA – $30 million study on falls prevention
- RISK FACTOR FOR FALLS RARELY INCLUDES HEARING LOSS

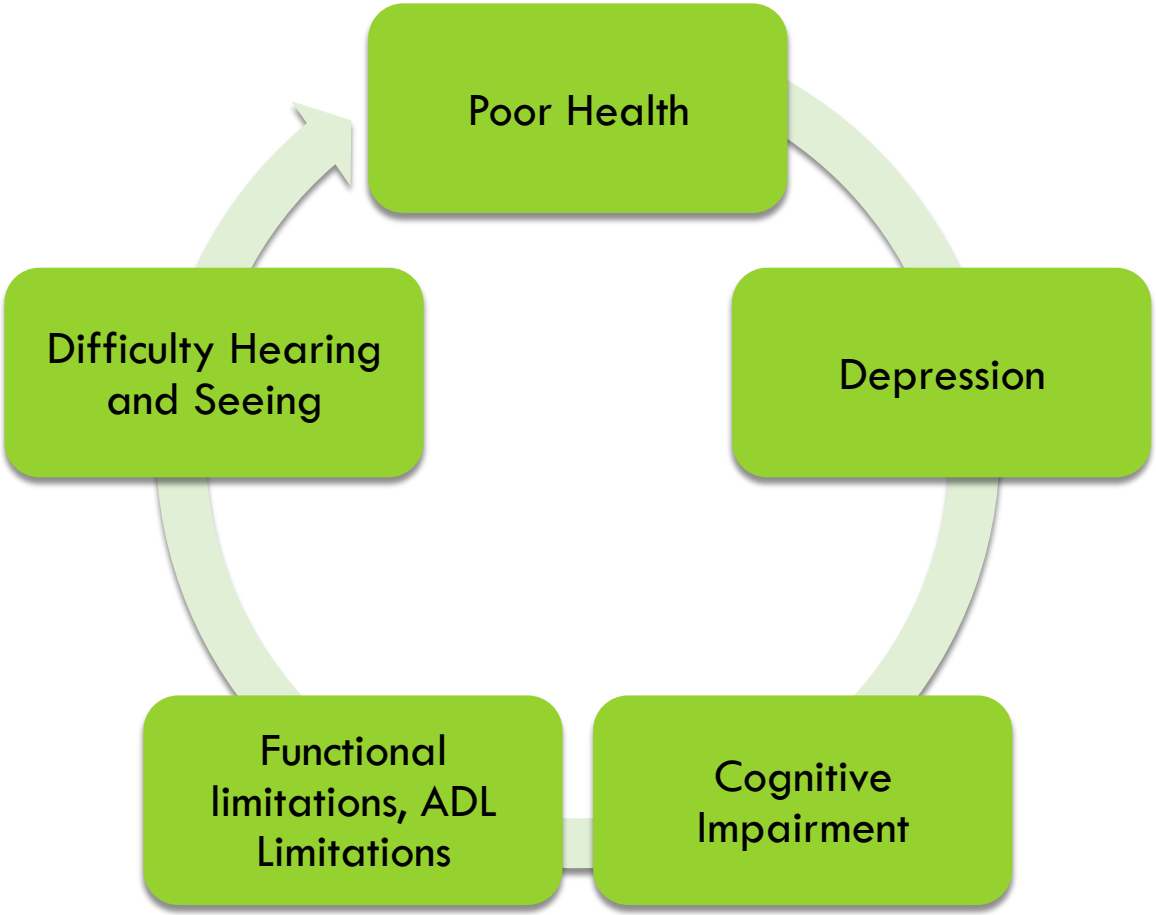
LEADING CAUSE OF INJURY, MORTALTIY

FALLS

LEADING CAUSE OF LOSS OF INDEPENDENCE

NUMBER ONE CAUSE OF HOSPITAL ADMISSIONS

RISK FACTORS FOR FALLS

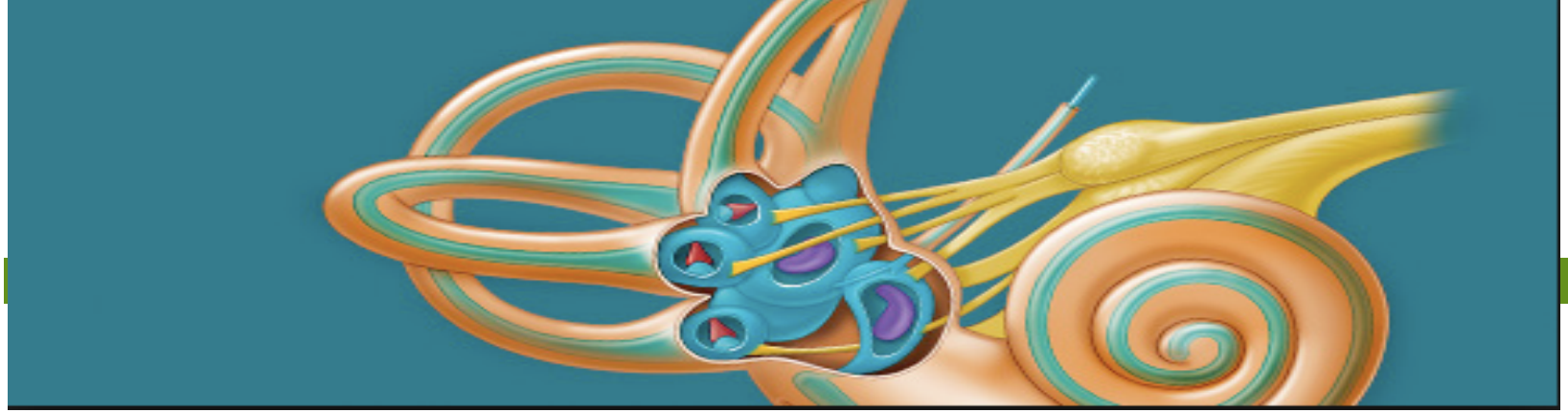


Stevens, Ballesteros, Mack, et al., 2012) N= 12,013, MCBS respondents
*strongest risk factors for falling

STEVENS, ET AL., (2012)

CONDITION	PROPORTION REPORTING FALLS
Poor Self Rated Health	45%
Limitations in 2+ ADLS Depressed Difficulty Hearing	43% 38% 32%

MCBS,
N=12013



- HIGH FREQUENCY HEARING LOSS ASSOCIATED WITH SACCULE DYSFUNCTION (Zuniga, Dinkes, Davalos-Bikara, et al., 2012)

- HEARING LOSS SIGNIFICANTLY ASSOCIATED WITH ODDS OF REPORTING FALLS

- FOR EVERY 10dB INCREASE IN HEARING LOSS – 1.4 FOLD INCREASED ODDS OF INDIVIDUAL REPORTING A FALL (Lin & Ferrucci, 2012)

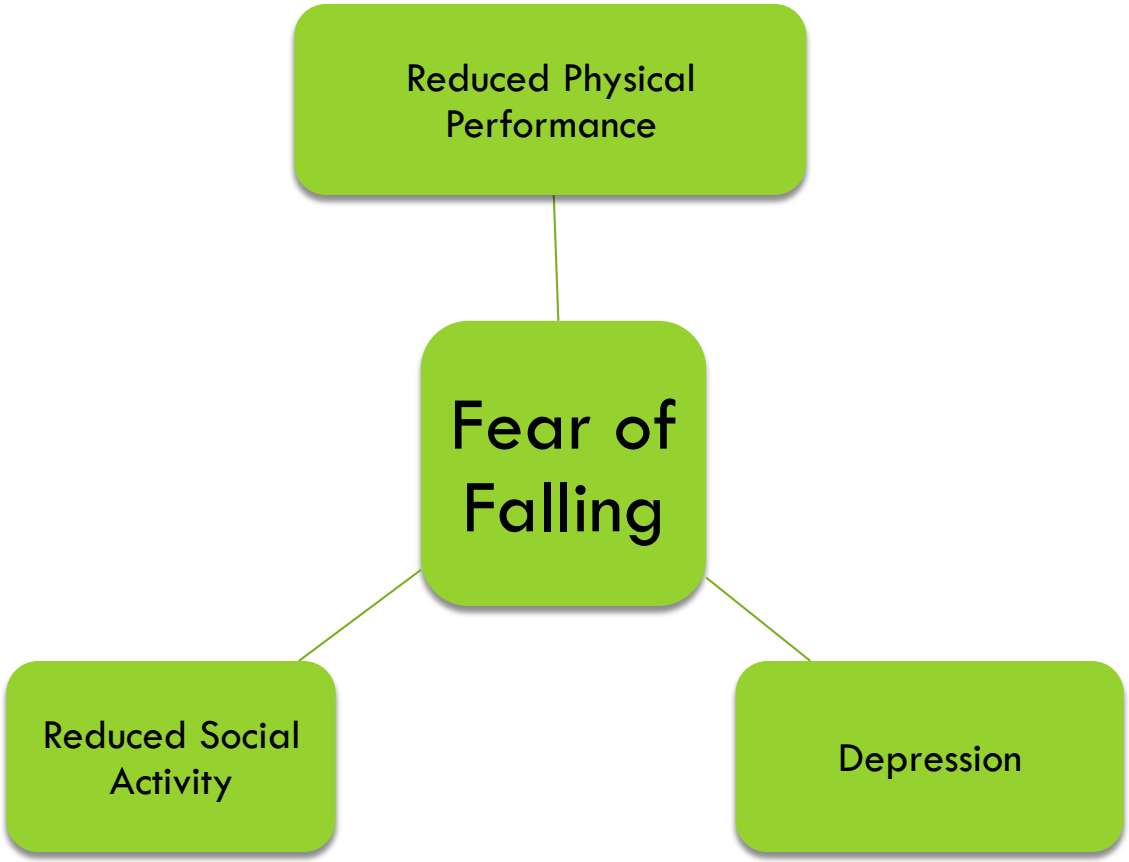
- WOMAN WITH POORER HEARING HAVE POORER POSTURAL CONTROL AND ARE AT A HIGHER RISK FOR FALLS (Viljanen, Kaprio, Pykko, et al., 2009)

FEAR OF FALLING (FOF)

(VILJANEN, ET AL., 2009)

- FOF: a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing

QUALITY OF LIFE AND FOF VILJANEN, KULMALA (RANTAKOKKO, 2013)



HEARING LOSS, WALKING DIFFICULTY AND FALLS

(VILJANEN, ET AL., 2009)

- Impaired hearing correlated with greater risk of falls, poor mobility, lower walking endurance
- HL preceded mobility decline in older woman (N=434, 419) (Vilianen, Kaprio, Prykko, et al., 2009)

FEAR OF FALLING (FOF)

HEARING DIFFICULTY ASSOCIATED WITH FEAR OF FALLING and MOBILITY DECLINE (Viljanen, Kulmala, Rantakokko, et al, 2012)

HIP FRACTURES (GRUE, KIRKEVOLD & RANHOFF, 2008)

- Patients with hip fractures have a high prevalence of sensory impairments
  - 50% had visual impairment
  - 66% had hearing impairment
  - 30% had combined vi and hi
  - **HL and HIP FRACTURES MOST COMMON AMONG OLDEST OLD**

MORTALITY

GENTHER, ET AL., (2015)

- HEALTH ABC STUDY (N=1958; normal on MMSE, no difficulty walking a quarter of a mile, climbing 10 steps without resting, or performing activities of daily living)

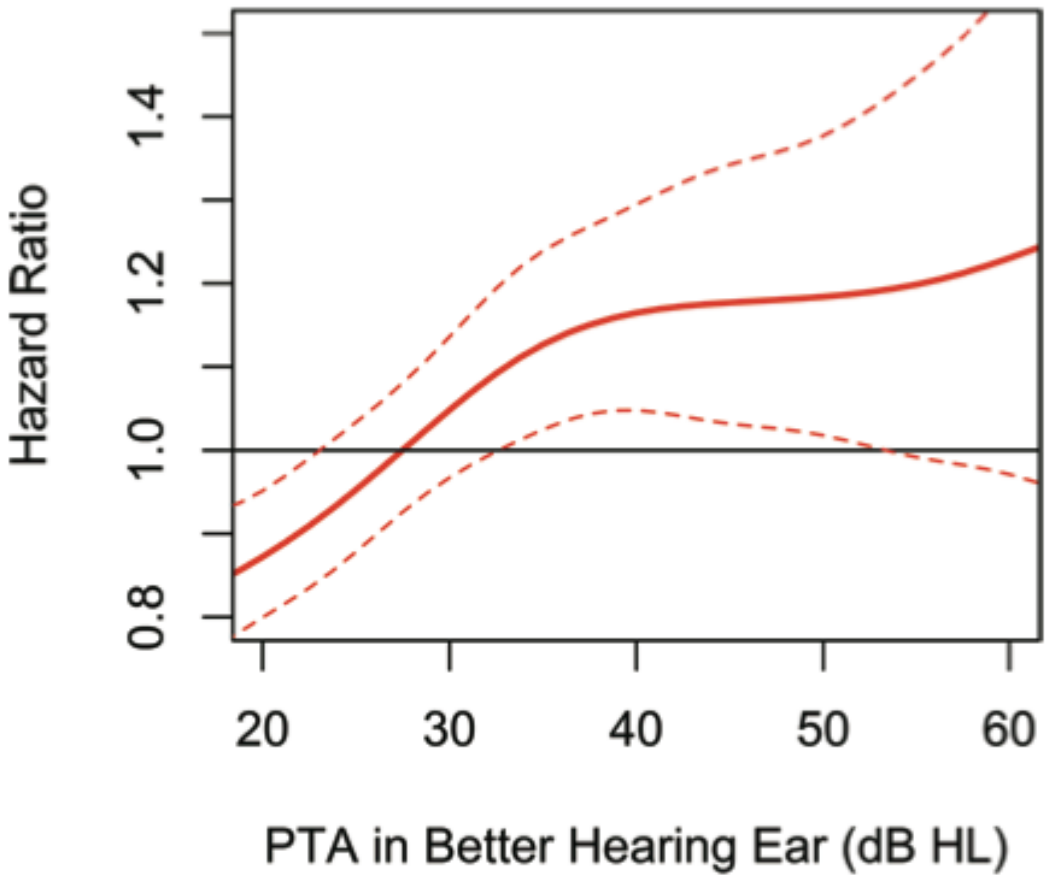
	NORMAL HEARING (18dBHL)	*HEARING IMPAIRED (59%) (38dBHL)
STATUS AFTER FIVE YEARS		
DECEASED	31%	43%

*HI associated with a 20% increased risk of mortality compared with normal hearing after adjusting for confounding variables;

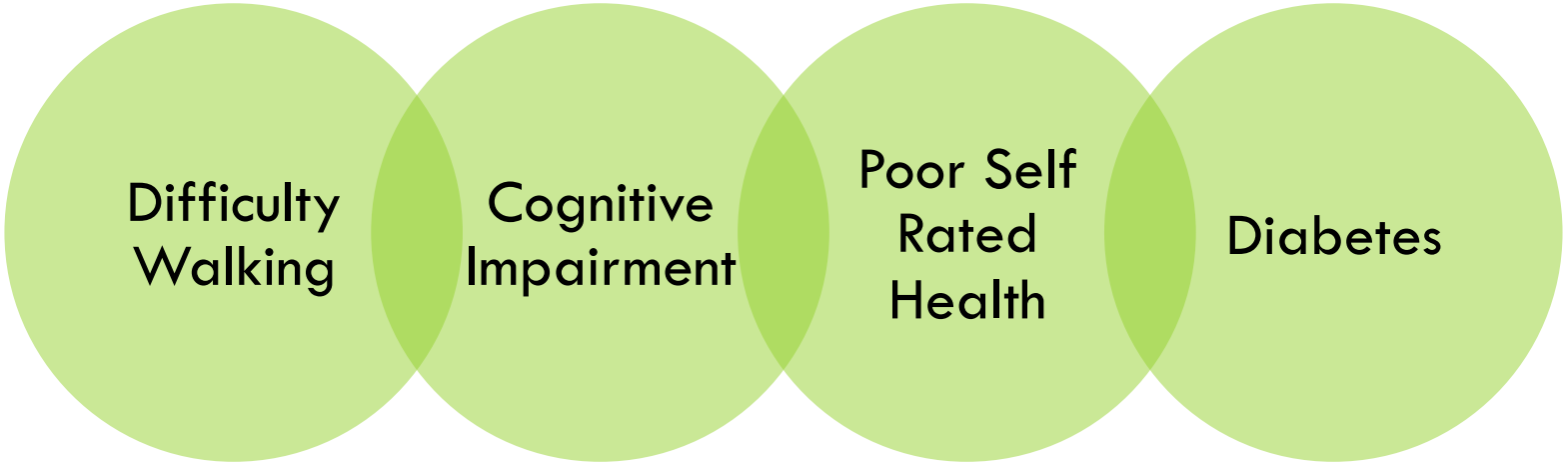
Association with mortality was slightly attenuated by adjusting for gait speed and cognition

HA use not significantly associated with lower risk of mortality

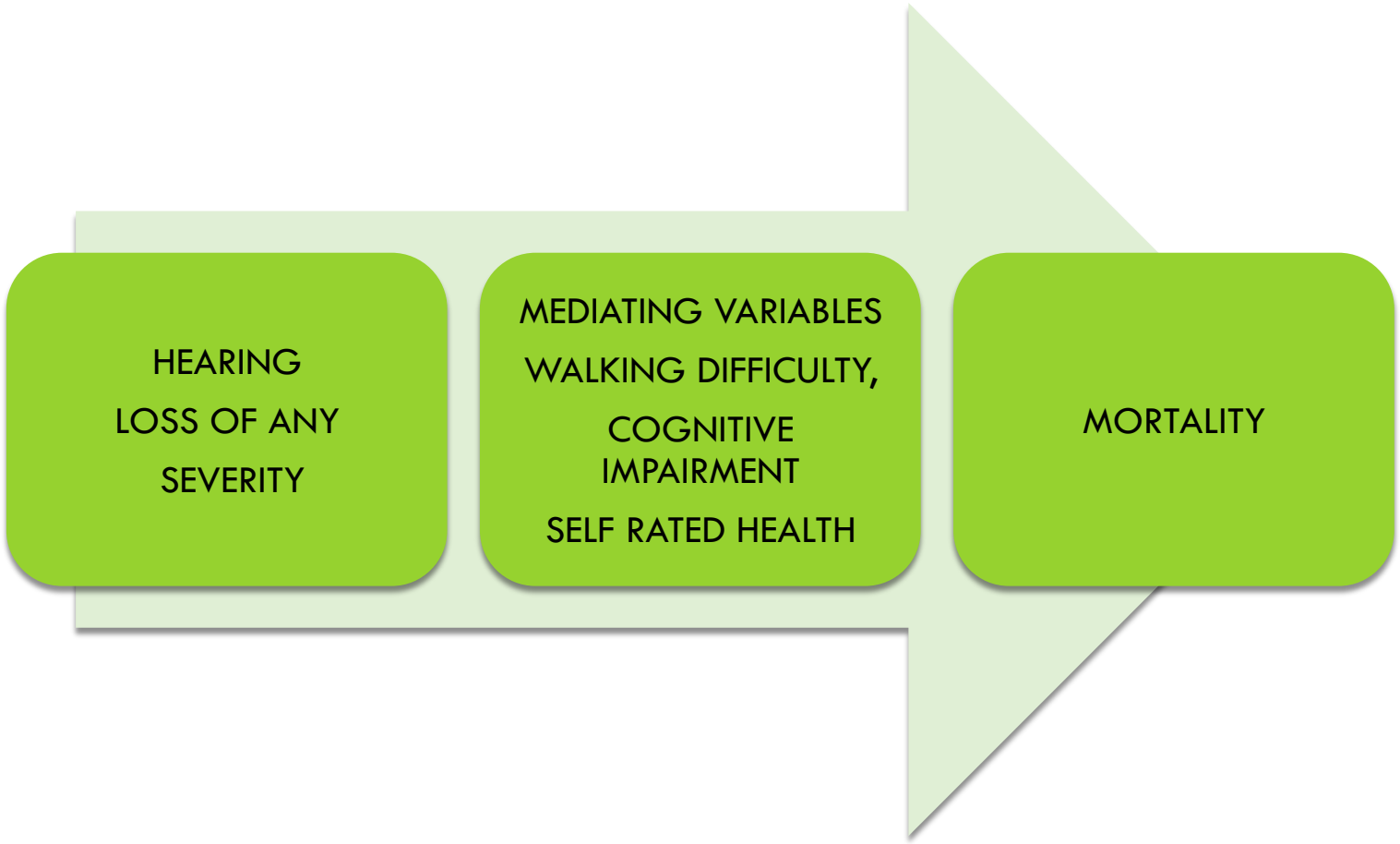
HA USE DID NOT LOWER RISK OF MORTALITY



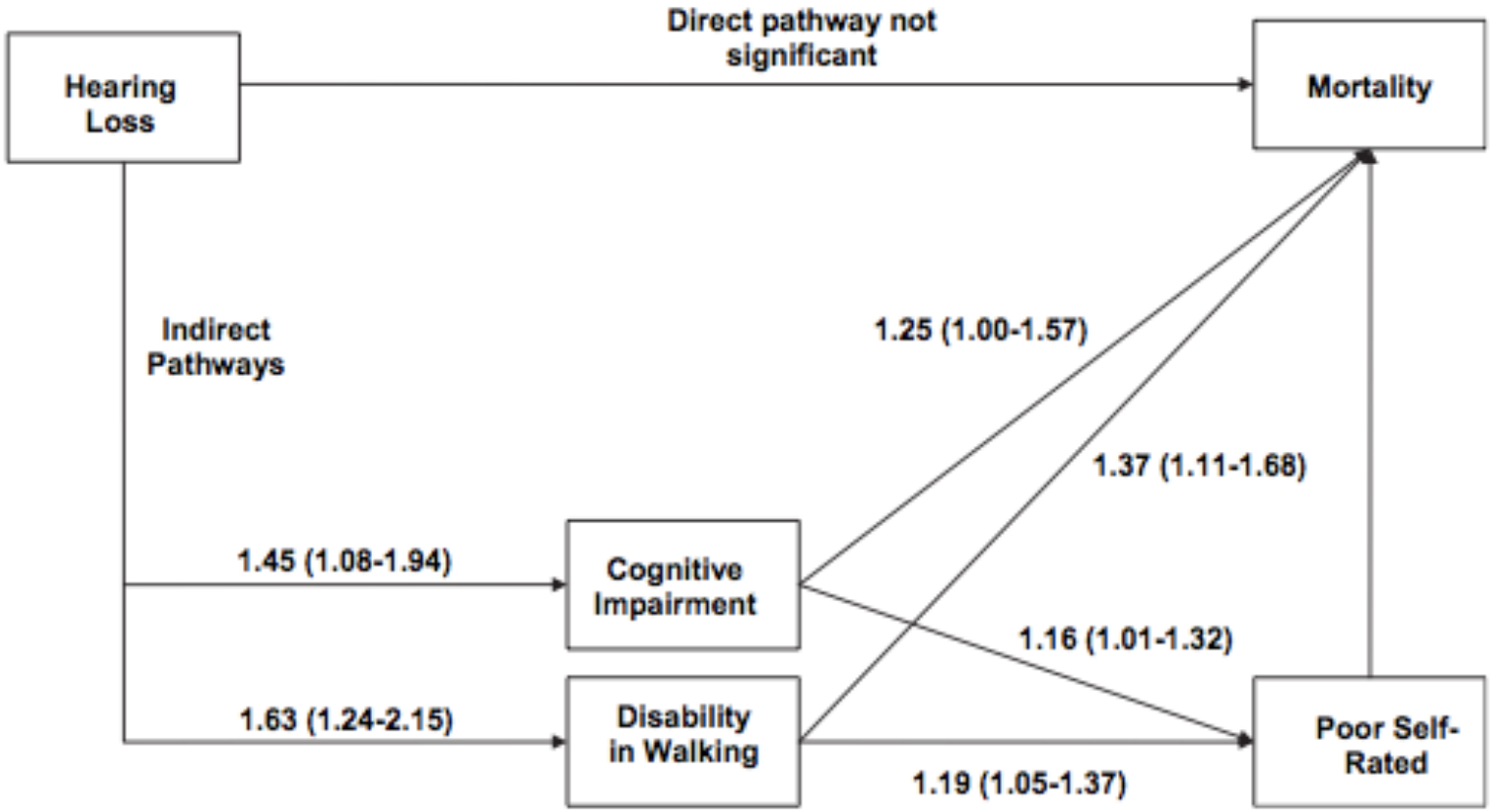
HEARING LOSS AND MORTALITY RISK (KARPA, GOPINATH, BEATH, ET AL., 2010)



N=2815, 33% HL


HEARING
LOSS OF ANY
SEVERITY
MEDIATING VARIABLES
WALKING DIFFICULTY,
COGNITIVE IMPAIRMENT
SELF RATED HEALTH
MORTALITY

MORTALITY (KARPA, ET AL., 2010)

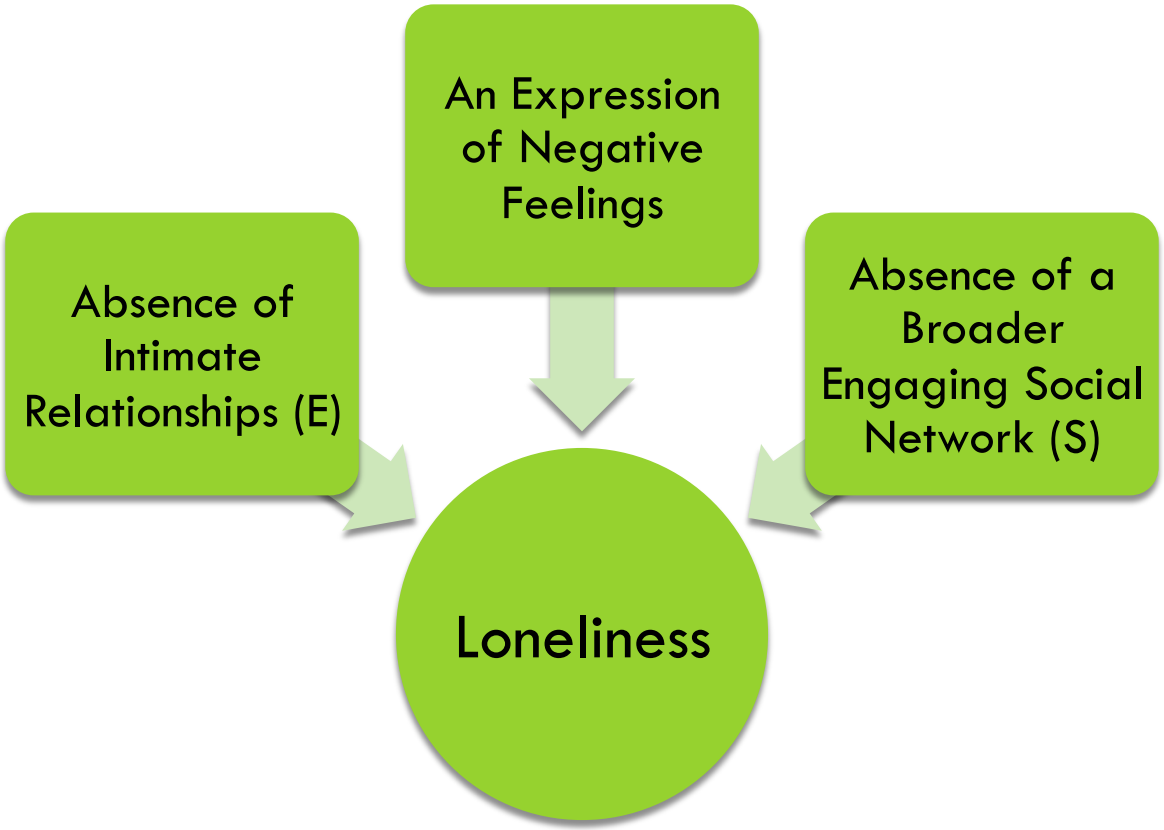


NO ASSOCIATION DIRECTION, NO CAUSALITY

SOCIAL ISOLATION

SOCIAL ISOLATION

An objective and quantifiable reflection of reduced social network size and paucity of social contact.



EMOTIONAL ND SOCIAL LONELINESS (Peplau & Perlman, 1982)

HI AND SOCIAL ISOLATION (WEINSTEIN, 1980)

- Isolates versus Non Isolates
  - Greater self perceived hearing handicap, auditory processing difficulties and poorer hearing
- Stronger Correlation with Subjective than Objective Social Isolation
  - Self perceived hearing handicap, auditory processing

SOCIAL ISOLATION

- South Australian Health Omnibus Survey (N=3015)
  (Hawthorne, 2008)
  - Likelihood of self perceived social isolation increased with number of chronic conditions
  - Individuals with 5+ chronic condition were 19 times more likely to feel social isolation than persons with 0-1 chronic health conditions
  - Depression had the strongest association with social isolation, followed by self reported hearing difficulties

HEARING LOSS AND PERCEIVED SOCIAL ISOLATION/LONELINESS

- Significant relationship between baseline hearing status (Speech-in-noise, self-reported hearing disability) and loneliness (DeJong Gierveld Loneliness scale)
  - Higher baseline hearing status scores were associated with greater social loneliness scores at 4 year follow-up in males, in those with chronic diseases, and in non-hearing aid user
  - Hearing aids may serve as a buffer against loneliness as only individuals (adverse effect was absent for hearing-aid users)

(Pronk, Deeg, and Kramer, 2013)

DEPRESSION

DEPRESSION

- Not a normal part of aging – 26% prevalence
- Under-recognized
- Under-treated
- Among top causes of worldwide disability; largest contributor to the burden of disease in high-income countries
- Health care costs for older adults with depression -50 percent higher than for those without depression

DEPRESSION

- Significant association with bilateral hearing loss (Gopinath, et al., 2009)
- Independent association between hearing handicap and presence of depressive symptoms (Gopinath, Hickson, et al., 2012) (N= 811)
  - After adjusting for age, sex, walking disability, receipt of pension payment, use of community support services, living alone, cognitive impairment, and history of arthritis and/or stroke

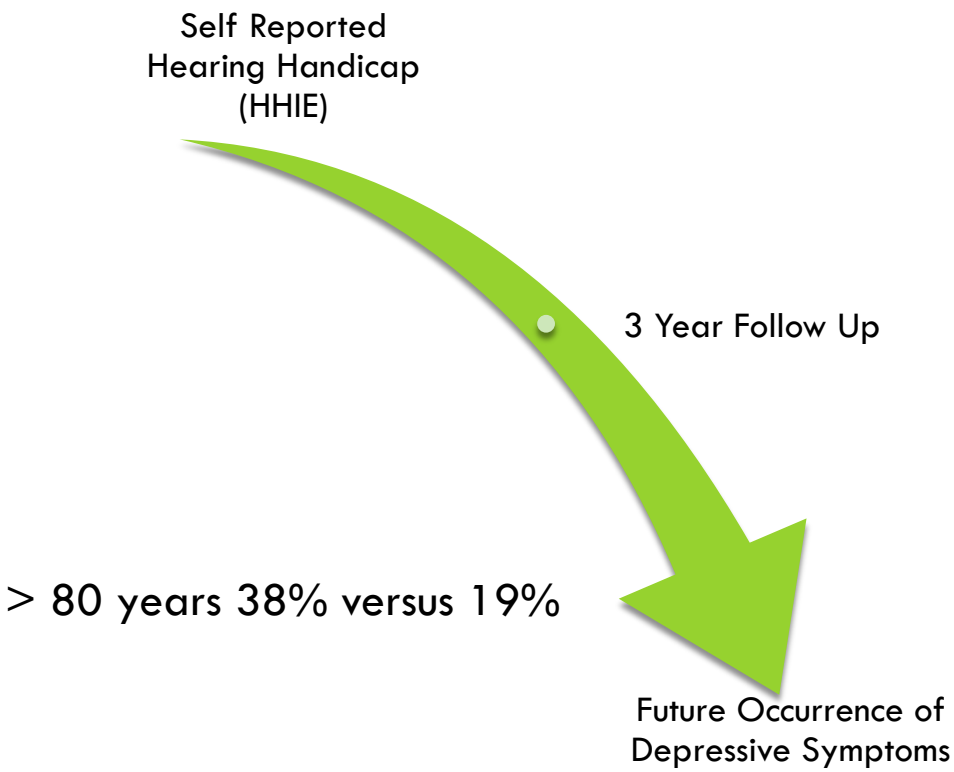
RISK FACTOR FOR DEVELOPMENT OF DEPRESSION

- *Self reported hearing handicap accounted for 26% of variance in depression score (CES-D) (hearing levels -10%)
- *Incidence of depression higher among older adults with self reported hearing handicap (20% versus 8%) – Japan
  - Odds of developing depressive symptoms were high as compared to those without HH - after adjusting for age, co-exiting medical conditions, vision impairment
  - HH independent predictor of depressive symptoms, HI was not

*MacDonald (2011) (N=45)
**Saito, Nishiwaki, Michikawa, Kikuchi,Mizutari, et al., (2010); (N=548) (Long)

HH AND FUTURE OCCURRENCE OF DEPRESSION

(SAITO, NISHWAKI, MICHIKAWA, ET AL., (2010)



DEPRESSION AND HEARING HANDICAP (HHIE-S> 10)

	No Hearing Handicap (N=80%)	Hearing Handicap (20%)
Incidence of Depressive Symptoms	8%	20%
*Hearing impaired	10%	54%
Hearing Aid Use	2%	20%

*Not associated with depressive symptoms

HHIE-S

- Impaired ADLs
- Impaired Q of L

Q of L

- Depression

ADL

- Depression

DO HEARING AIDS MAKE A DIFFERENCE?

- Loneliness
- Depression
- Cognitive Decline
- Caregiver Burden

LONELINESS AND HEARING AID USE

- Sample Social Loneliness Items (5)*
  - "There are plenty of people that I can lean on in case of trouble"
  - "There are many people that I can count on completely"
  - "There are enough people that I feel close to"

- Sample Emotional Loneliness Items (6)*
  - "I experience a general sense of emptiness"
  - "I miss having people around"
  - "Often, I feel rejected"

*DEJONG GIERVELD LONELINESS SCALE

CHARACTERISTICS OF THE PARTICIPANTS

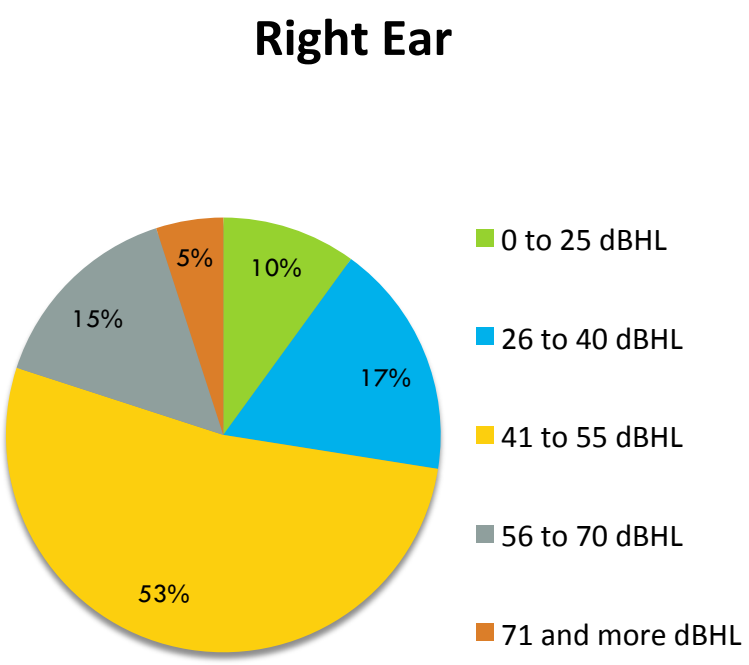
Sex (N=40)	Female: n=26 (65.0%) Male: n=14 (35.5%)
Age (N=40)	Mean: 80.4 years Standard Deviation: 7.2 years Range: 63 - 92 years

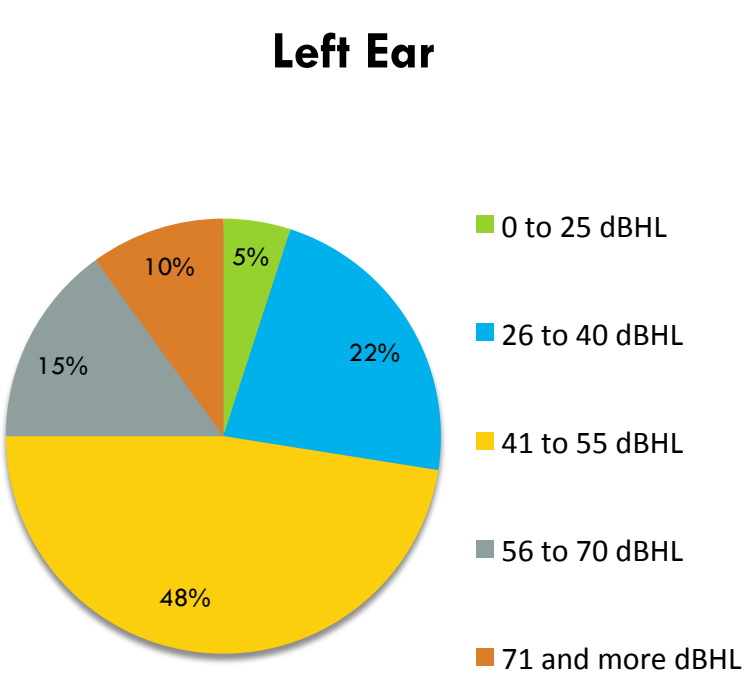
HEARING LEVELS OF PARTICIPANTS

	Mean	S.D.	Range
Hearing Left Ear (dBHL)*	49.3	18.6	17.5 – 100
Hearing Right Ear (dBHL)*	46.4	14.6	20.0 - 97.5
Reading Span Score (%)	36.9	12.5	4.0 - 66.0
QSIN+ aided	5.0	3.1	0.5 - 12.0
QSIN+ unaided	14.8	5.6	5.5 - 25.5
QSIN+ difference	9.8	4.2	3.0 - 20.0

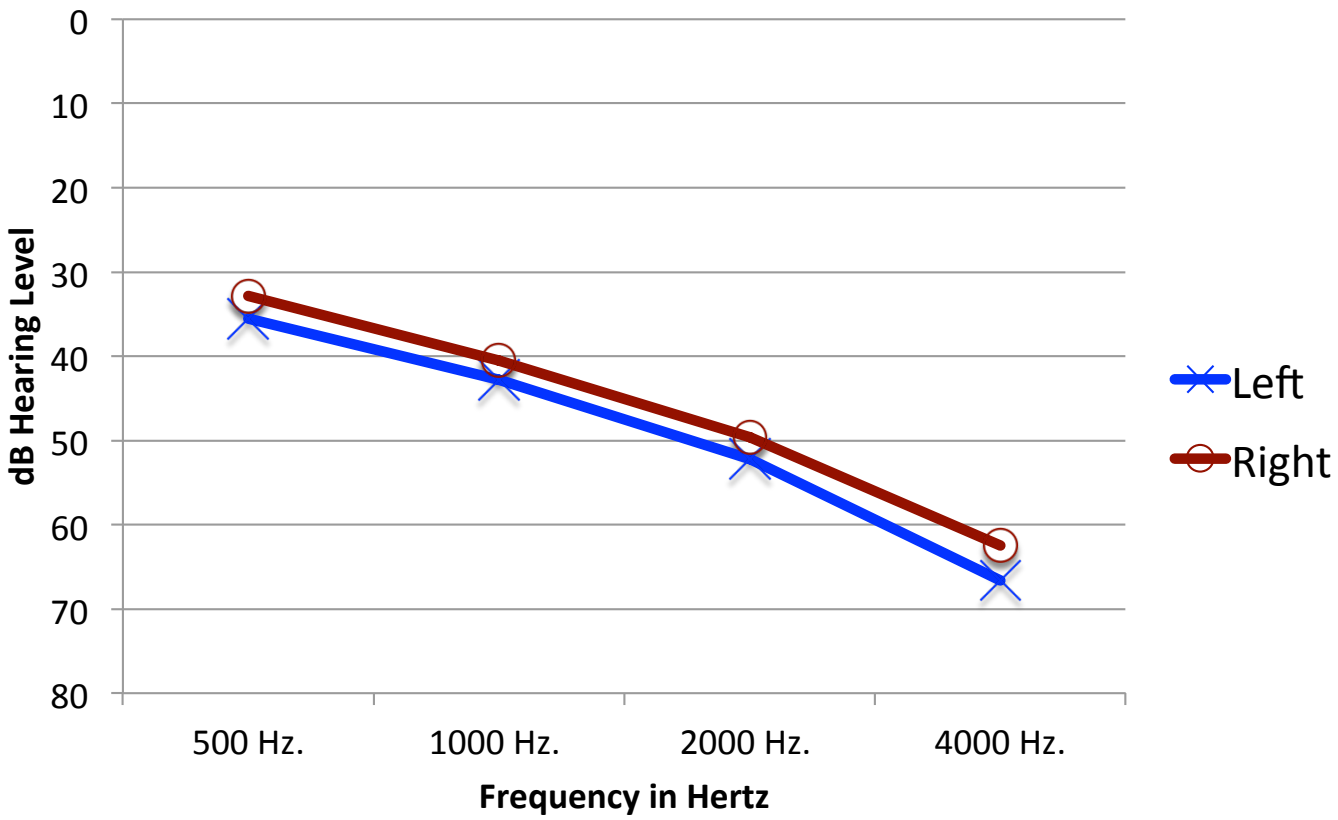
* Mean 4 frequency pure tone average
+ Performance on Speech-in-Noise Tests

HEARING LOSS SEVERITY

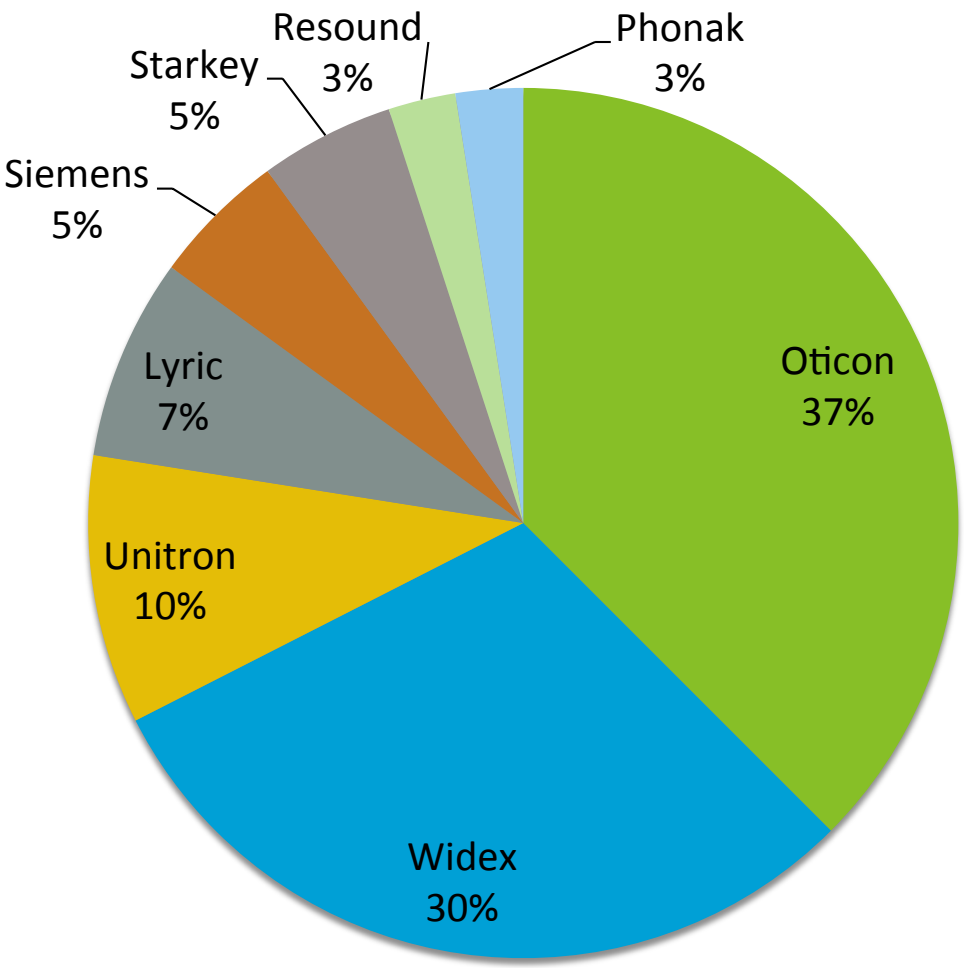




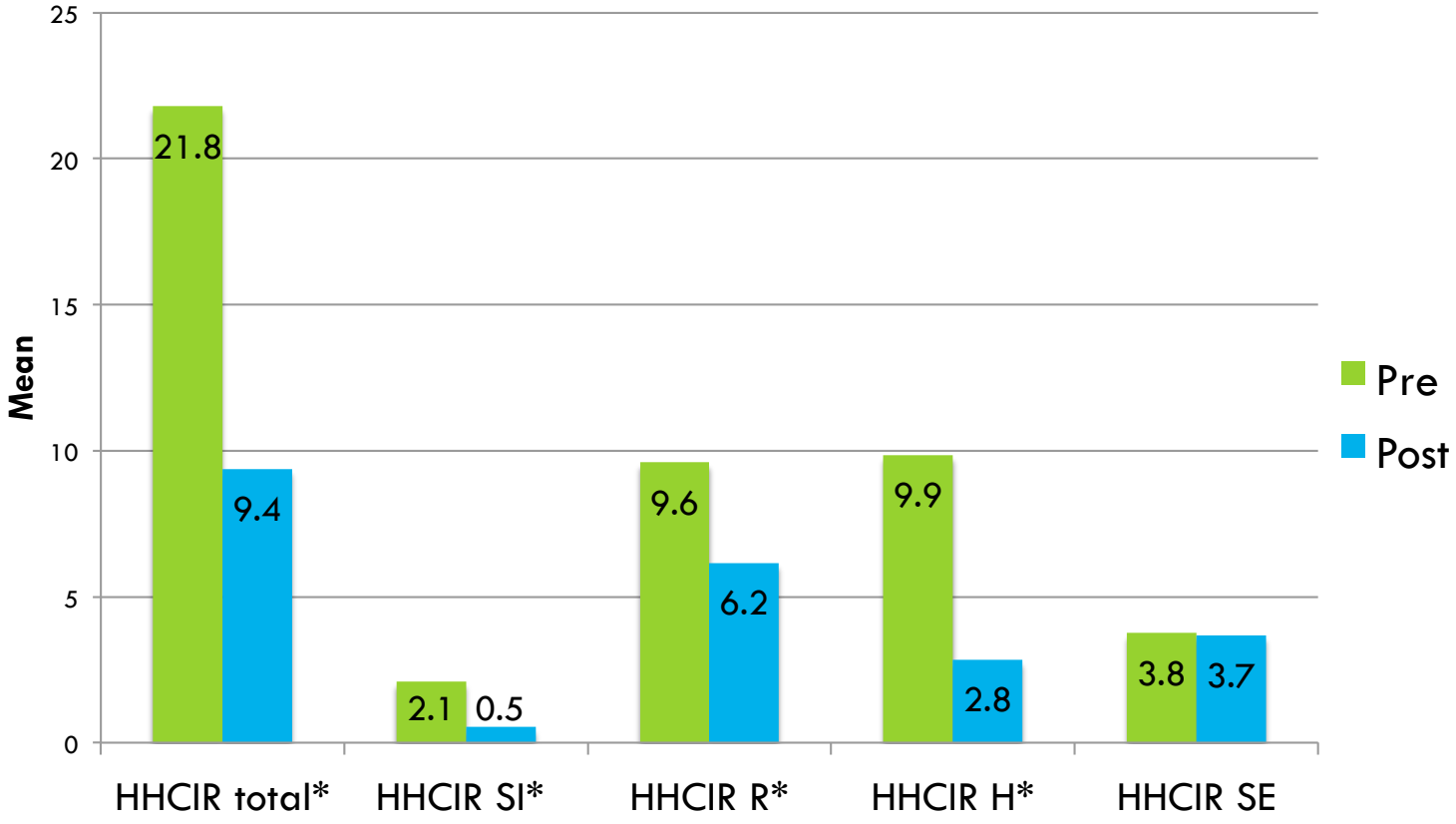
MEAN THRESHOLDS ACROSS FREQUENCIES



BRANDS OF HEARING AIDS

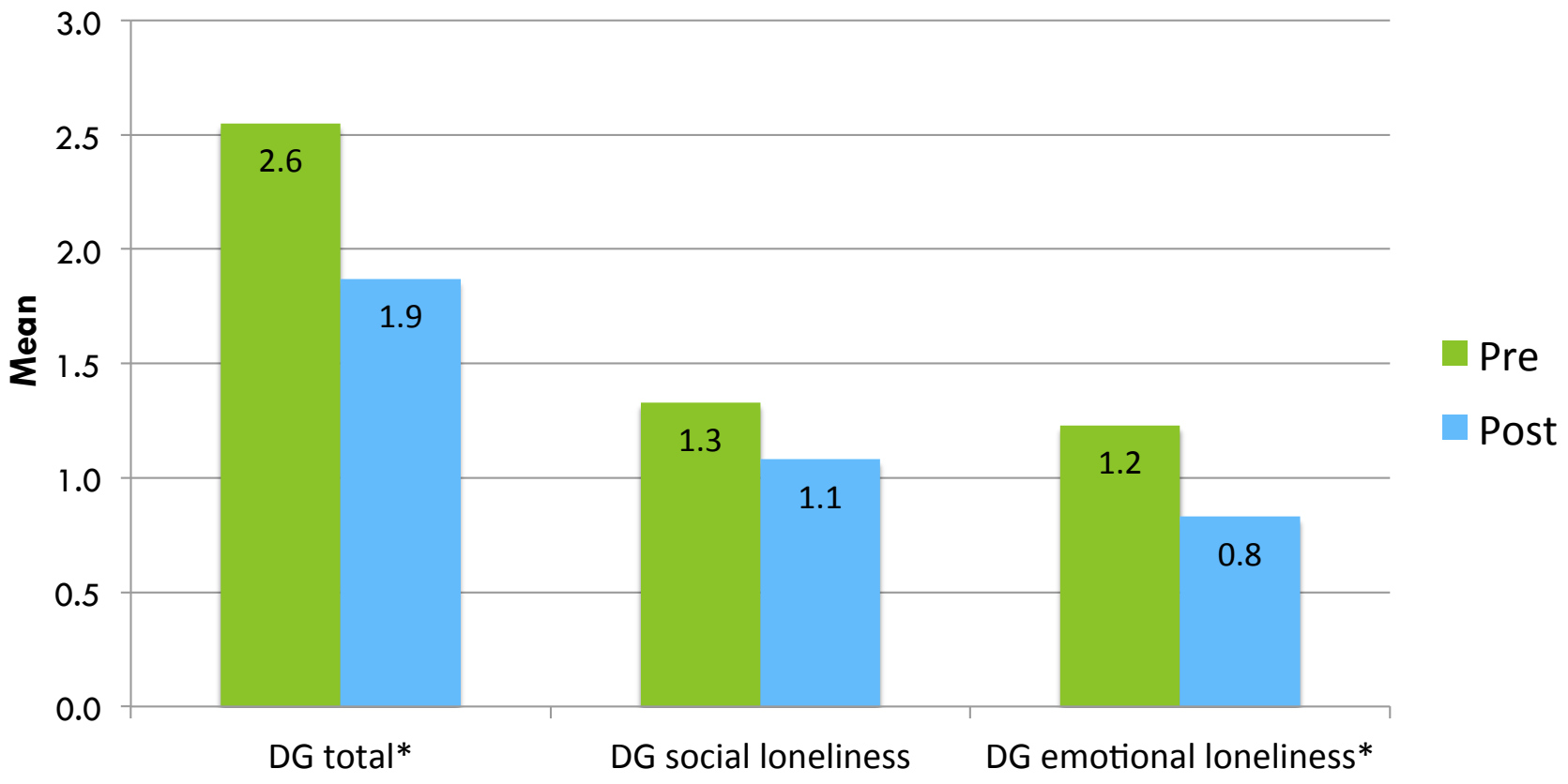


OUTCOMES ON HHCIR SCALE



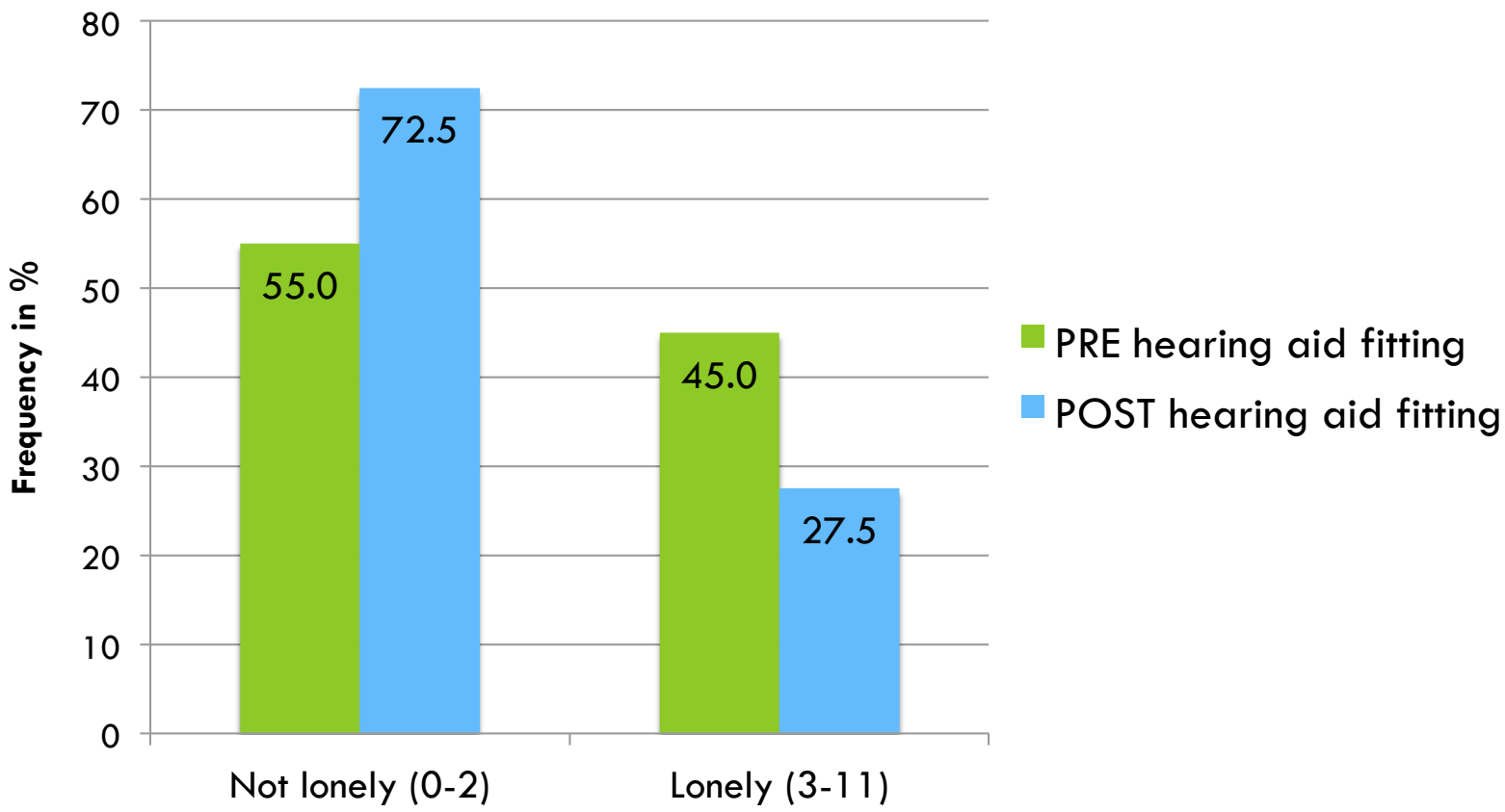
* significant p<0,05 (two tailed)

OUTCOMES ON DG LONELINESS SCALE (N=40)



* significant p<0,05 (two tailed)

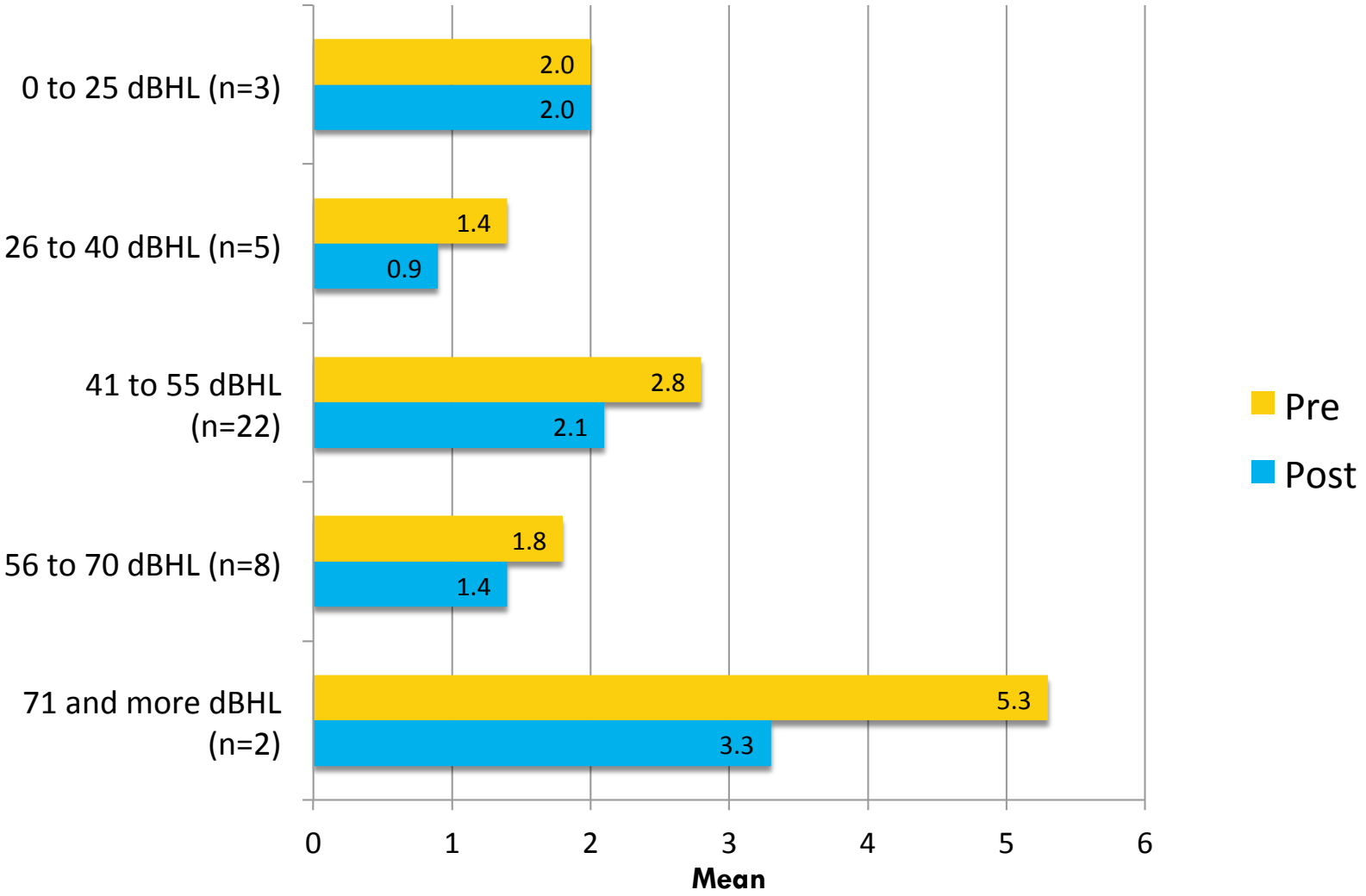
CHANGE IN SOCIAL/EMOTIONAL LONELINESS



Chi square=18.54
Fisher's exact test: df=1; p (two tailed) 0.000 → significant p<0,05

It is possible for an individual to feel lonely even when they are socially engaged

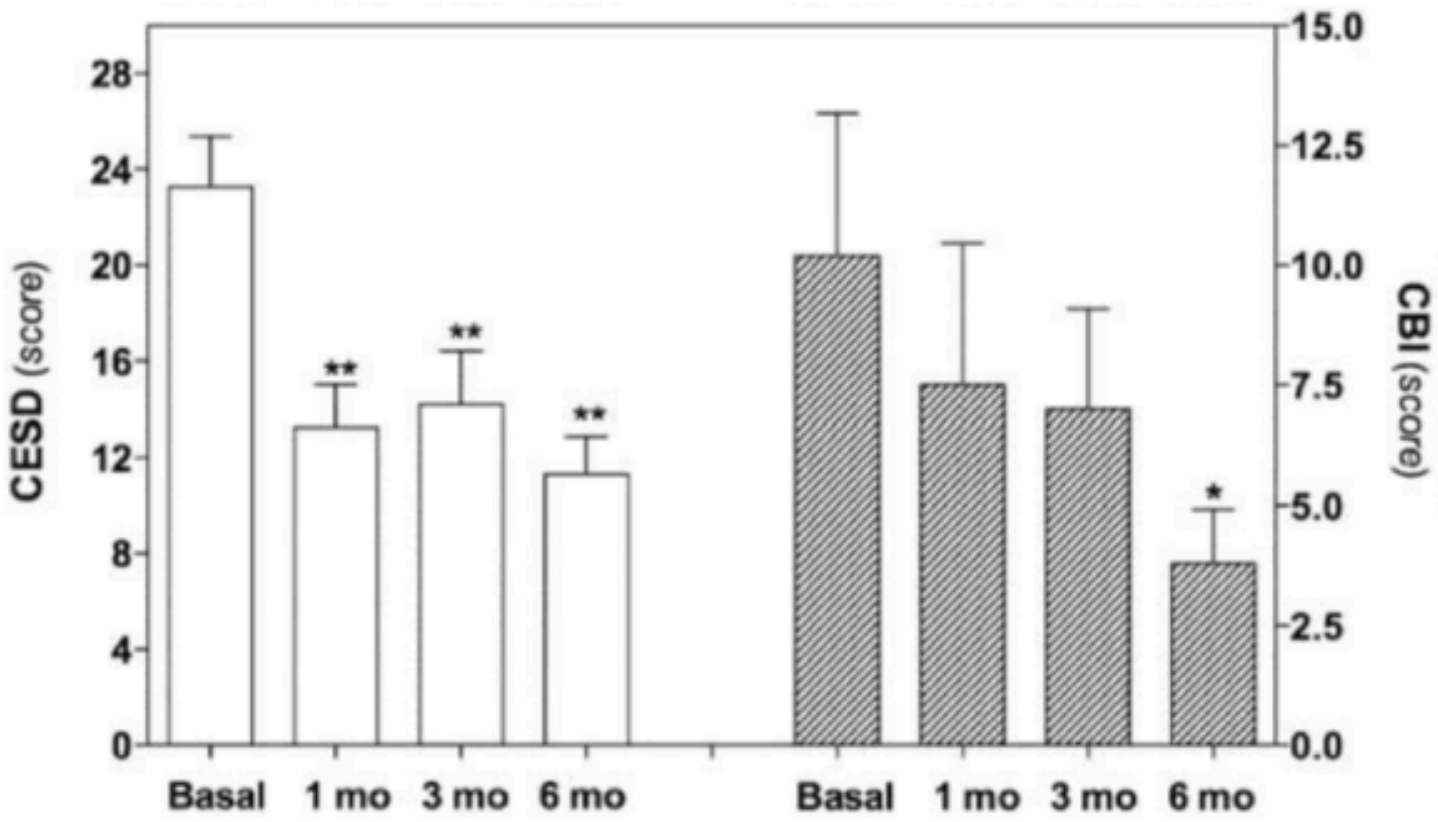
SEVERITY OF HEARING LOSS AND SOCIAL/ EMOTIONAL LONELINESS



DEPRESSION (BOI, ET AL., 2012)

N=15	Baseline	One Month	Three Months	Six Months
Depression Scores (CES – D)	23.27	13.27	14.2	11.3
Caregiver Burden	10	7	7	3.8
SF-36 (social functioning, social emotional, mental health scales)	387			523

93%-moder to severe; 7% severe
Binaural, digital
Wore units six to 12 hours/day
Normal on MMSE and on ADLs


CESD (score)
28
24
20
16
12
8
4
0
**
**
**
Basal
1 mo
3 mo
6 mo
15.0
12.5
10.0
7.5
5.0
2.5
0.0
*
CBI (score)
Basal
1 mo
3 mo
6 mo

DEPRESSION (Mener, Betz, Genther, Chin, & Lin, 2013)

- NHANES (1,029) (70-79 years)
- Mild hearing loss -36%; Moderate-22%; Normal – 42%; Severe – 1%
- Hearing aid users – used hearing aids for one year prior to study – 5 hours/week (12% of sample)
- 3.9% MDD, 7.4% and depressive symptom
- Patient Health Questionnaire (PHQ-9)
  - a self-report depression assessment instrument based on Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, symptoms and signs of MD

*Hearing aid use - lower odds of MDD (OR = 0.35, 95% C = 0.14–0.90) and any depressive symptoms (one year)

*Reductions in depressive symptoms within 3 months of hearing aid use (Acar, et al., 2011; Boi, et al., (2012)

*Hearing aid use was associated with lower odds of having depressive symptoms (Gopinath, 2009)

COGNITIVE STATUS AND HEARING AID USE (DEAL, ET AL., 2015)

- Atherosclerosis Risk in Communities (ARIC) Study (N=253; Mean age 77 years; 37% mild; 34% mod or severe); 51% moderate to severe wore ha
  - Baseline - mean test scores on memory and processing speed tests poorest for participants with moderate/severe HI and best for participants with no HI
  - FU- among participants with moderate/severe HI, not using a hearing aid was associated with poorer cross-sectional performance on memory tasks and global cognitive function; average 20-year changes were greater for hearing aid nonusers than for hearing aid users in memory and global function

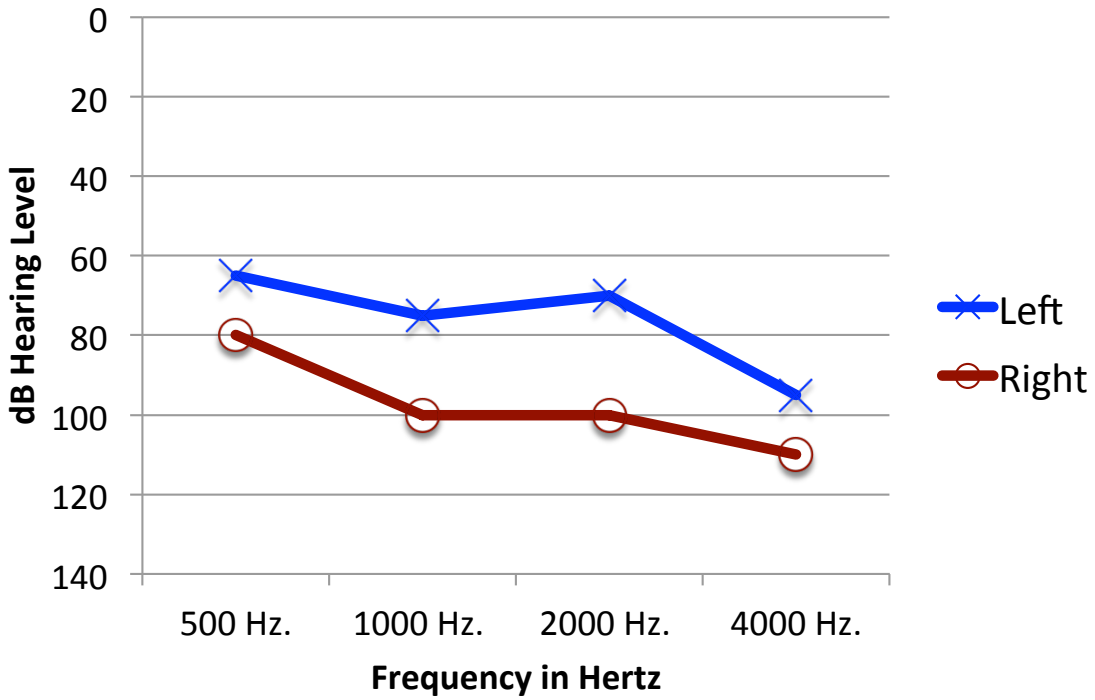
- Frame clinical management decisions within the context of:
  - risks
  - benefits
  - prognosis (e.g., remaining life expectancy, functional status, quality of life)
  - patient reported outcomes

Takes 15 years to innovate, educate, and change culture

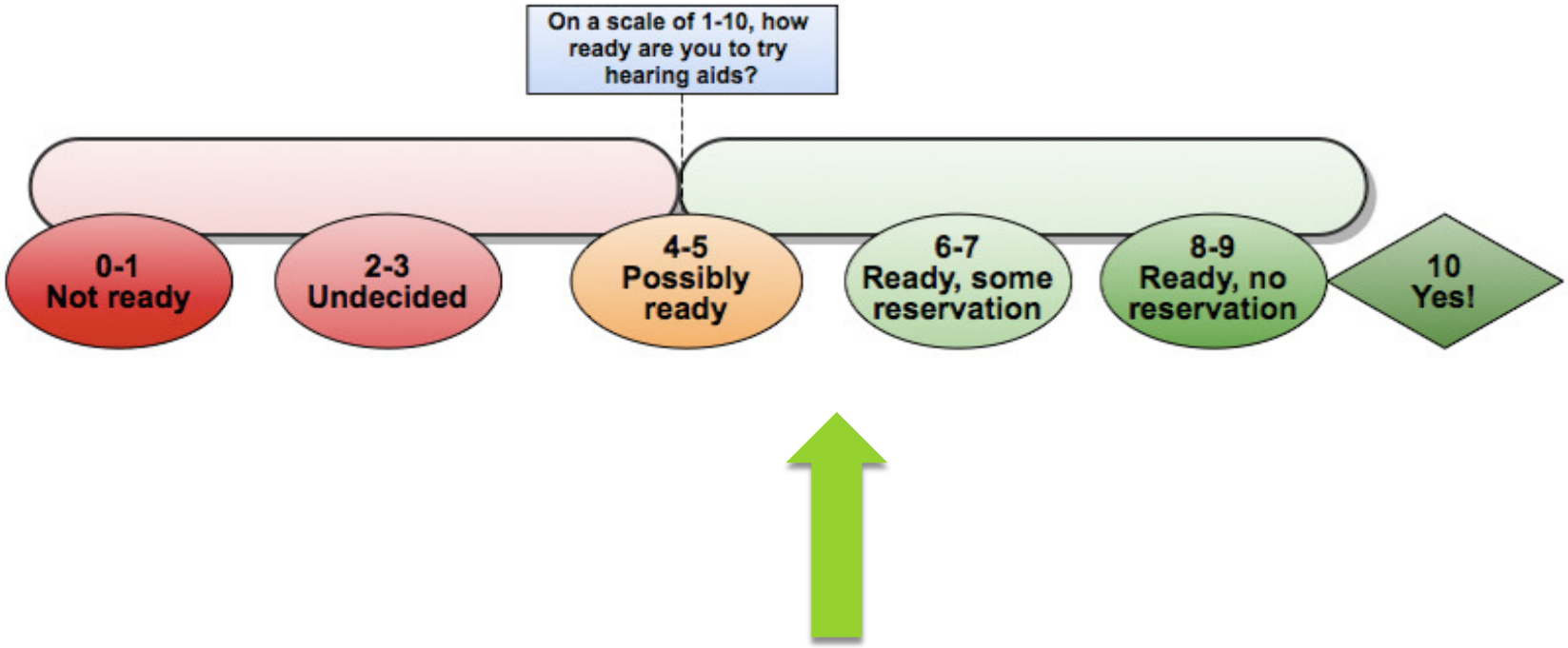
OUTCOME MEASURES

- Cognitive Status
  - MMSE
  - MoCA (Montreal Cogntive Assessment) (http://www.mocatest.org)
- Depression
  - Center for Epidemiological Studies-Depressions scale (CES-D) (Radloff, 1977)
  - PHQ-9
- Self Reported Activity Limitations and Participation Restrictions used PROM that relates to negative outcomes
- Self rated health
- ADLs, IADLs

MR. X (76 YEARS)



	PRE	POST
HHCIR	36.0	22.0
DG Loneliness Scale	6.0	4.0
QSIN aided	5.5	


On a scale of 1-10, how ready are you to try hearing aids?
0-1 Not ready
2-3 Undecided
4-5 Possibly ready
6-7 Ready, some reservation
8-9 Ready, no reservation
10 Yes!

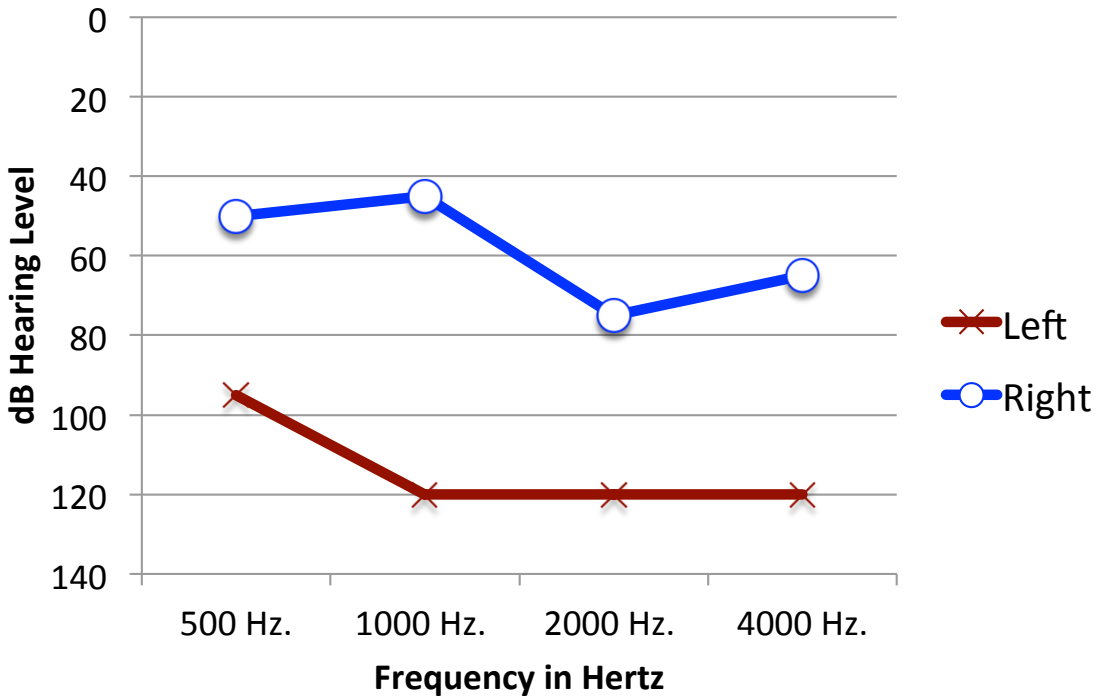
BASELINE

	PRE	
HHCIR	36	
PHQ-9 (Depression)	9	
Loneliness Scale	6	
Network Size	4	
Self Rated Health	Poor	
MMSE - N	22	

OUTCOMES

	PRE	POST
HHCIR	36	22
PHQ	9	5
Loneliness Scale	6	4
Network Size	4	4
Self Rated Health	Poor	Fair
MMSE - N	22	24

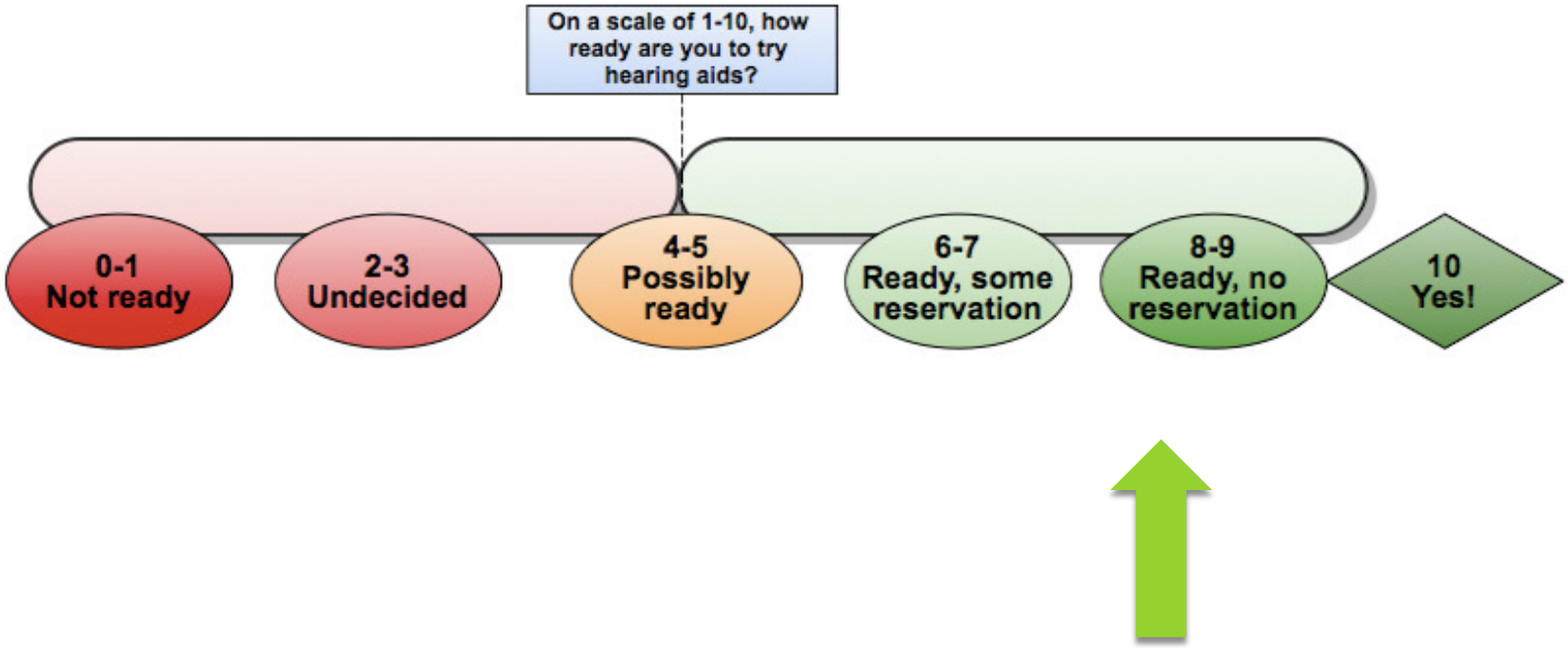
MRS. Z (89 YEARS)



	PRE	POST
HHCIR	34.0	8.0
DG Loneliness Scale	5.0	2.0
QSIN aided	11.5	

HOLISTIC APPROACH NECESSARY

* sensory management to optimize auditory function,
* instruction in the use of technology and control of the listening environment
* perceptual training to improve speech perception and communication, and
* counseling to enhance participation, and deal both emotionally and practically with residual limitations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2-3 Undecided
4-5 Possibly ready
6-7 Ready, some reservation
8-9 Ready, no reservation
10 Yes!

BASELINE

	PRE	
HHCIR	34	
PHQ-9 (Depression)	9	
Loneliness Scale	5	
Network Size	4	
Self Rated Health	Poor	
MMSE - N	22	

OUTCOMES

	PRE	POST
HHCIR	34	8
PHQ	9	5
Loneliness Scale	5	2
Network Size	4	4
Self Rated Health	Poor	Good
MMSE - N	25	26

COMMUNICATING RESULTS

PATIENT ASSETS: Mobile, Large Social Network

FUNCTION: Before hearing aids did not go out much

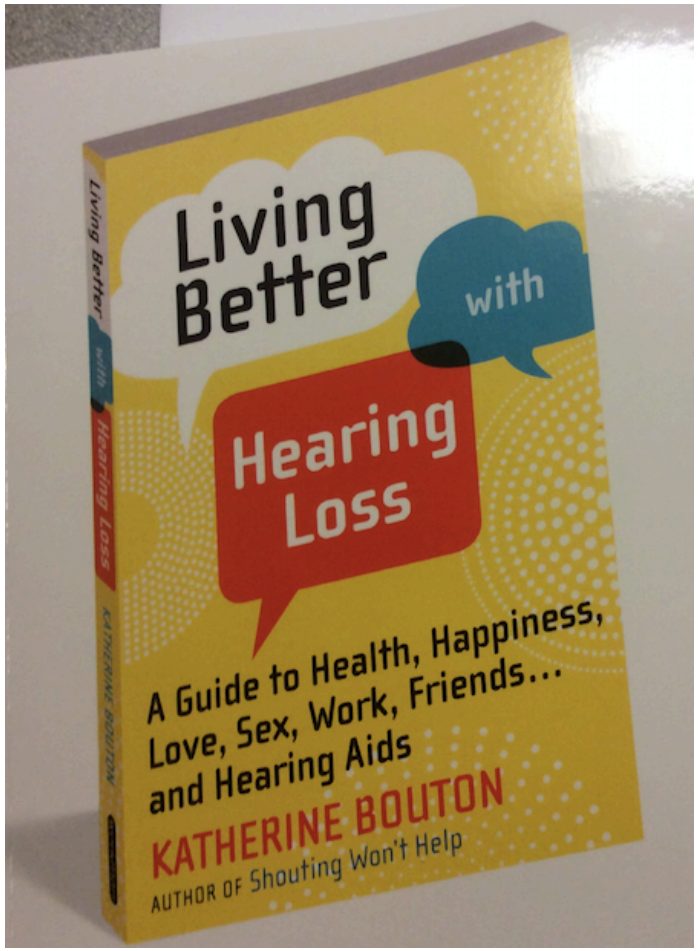
HABITS: Works in family business

HORIZON TO BENEFIT: three to six weeks

- ☐✓ Hearing Loss Severity: Mild to severe - sensorineural
- ☐ ✓Self Reported Hearing Difficulties Baselines:
  - ☐✓ Difficulty hearing and understanding family members
  - ☐ ✓Difficulty communicating with health care professionals
  - ☐ Difficulty understanding over telephone
  - ☐ ✓Difficulty understanding in Small Groups and In Noise
  - ☐ ✓Home safety concerns
- ☐ Self Reported Hearing Difficulties Post-Fittings: Less lonely,
  - ☐ ✖Difficulty hearing and understanding family members
  - ☐ ✖Difficulty communicating with health care professionals
  - ☐ Difficulty understanding over telephone
  - ☐ Difficulty understanding in Small Groups and In Noise
  - ☐ ✖Home safety concerns

✓Hearing Aids ☐ PSAPS ☐ CI ✓HATS ☐ Home Based

CHANGE THE CONVERSATION



PERSON REPORTED OUTCOMES (PROMs)-HEARING HEALTH CARE PROFESSIONALS

- Focus on what is gained by hearing in terms of social engagement, improved affect, family connections, and self rated health
- Optimize opportunities for improving and preserving health physical, social, and mental wellness; independence; quality of life
- Become part of the team

THANK YOU

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