

Hearing Loss in the Elderly

Hearing loss and Longevity F14

Michael Wolf MD

Department of Otolaryngology, The Sheba Medical Center, and
Sackler Faculty of Medicine, Tel-Aviv University

Israel

Hearing loss:

Top 15 leading causes of burden of disease by 2030

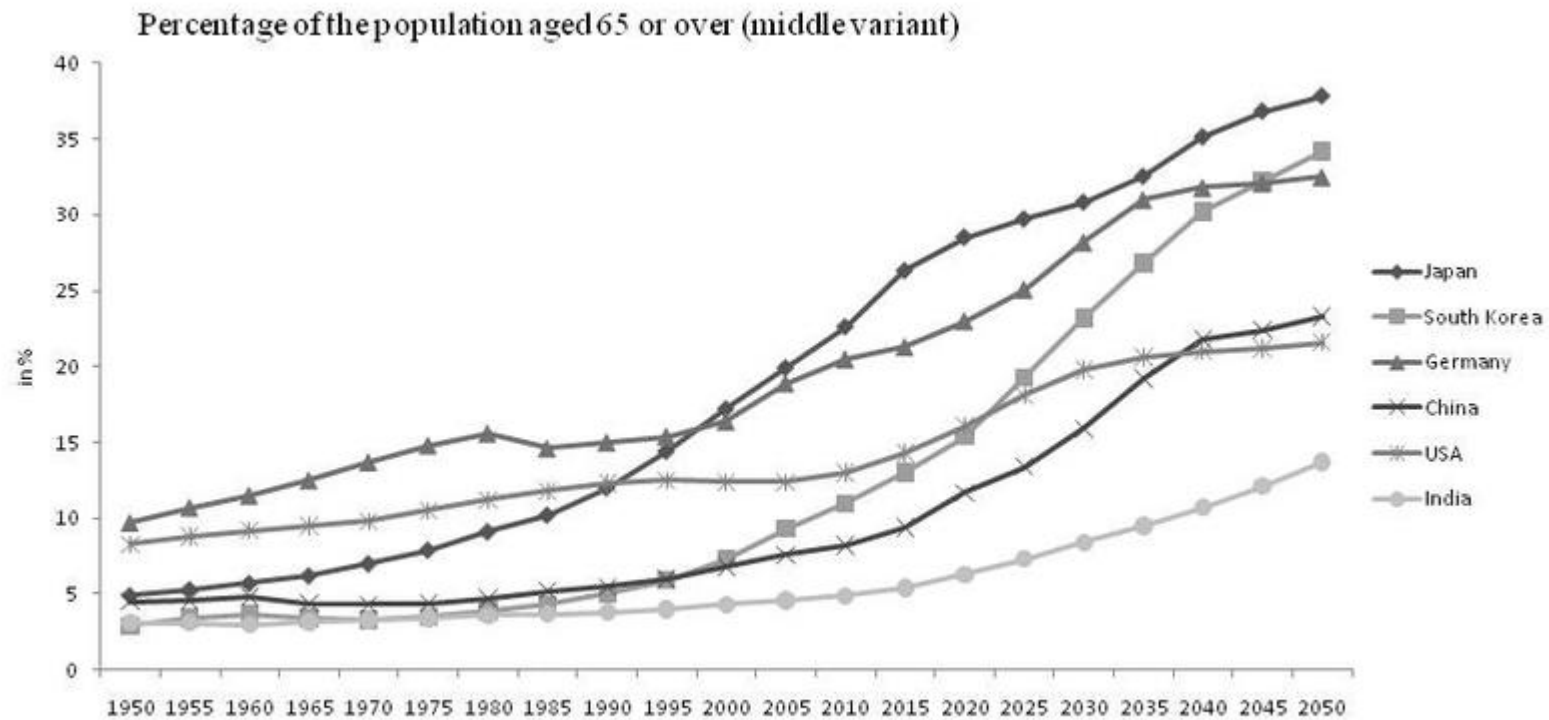
WHY?

Definition
Prevalence
Impact
Solutions

World Health Organization 2018 (Key findings)

- There are currently around 466 million people with disabling hearing loss globally
- There will be 630 million people living with disabling hearing loss by the year 2030
- Over 900 million by 2050

World aging 1950-2050



Source: UN Population Division DESA, World Population Prospects – The 2008 Revision Population Database, 2009

Countries with the highest shares of 60+ population (%) 2011-2050 (UN 2011)

2011

Japan 31
Italy 27
Germany 26
Finland 25
Sweden 25
Bulgaria 25
Greece 25
Portugal 24
Belgium 24
Croatia 24

2050

Japan 42
Portugal 40
Bosnia and Herzegovina 40
Cuba 39
Republic of Korea 39
Italy 38
Spain 38
Singapore 38
Germany 38
Switzerland 37

European federation of 'Hard of Hearing' people 2015

- Approximately one third of people over 65 years of age are affected by disabling **hearing loss** (Mar 20, 2019)

Hearing loss in Italy

- Age-related hearing loss and the risk of cognitive impairment and dementia in later life. 2018 (Bari; multi-centered)
 - ARHL prevalence :
 - **25–30% in aged 65–74**
 - **63.1% over 80 years**
 - **80.6% over 85 years**
 - Hearing difficulties may be not related only to the peripheral auditory system impairment but also to the **central auditory processing disorder**, problems in understanding speech in a background noise

Bari, Florence, Milan, Padua, Palerm, Quaranta A and N, 1996, 2015

Italian Sistema Statistico Nazionale-Istituto Nazionale di Statistica (2001)

- More men than women
- The difference in gender is greater among the elderly (65 to 74 years of age and ≥ 75 years of age).
- the highest population of Italians who have hearing loss live in the Nord-Oriental region of Italy (19 per thousand) and the Central region of Italy (17.7 per thousand):
 - Umbria (24.2 per thousand)
 - Emilia Romagna (21.9 per thousand)
 - Tuscany (21 per thousand)
 - Friuli Venezia Giulia (21 per thousand).

Hearing loss in Israel

- A recent study estimated that over 800,000 people in Israel have some hearing loss
- Non-even distribution
- The annual (average) growth of the population is ~1.6%
 - People >65Y = 11% (2015), 14.3% (2040), 15.3% (2060)

Levels of 'noise' in life

Moderate— Safe listening for any time period

70 dBA = group conversation, vacuum cleaner,

60 dBA = typical conversation, dishwasher,
clothes dryer

50 dBA = moderate rainfall

40 dBA = quiet room

Very loud— Dangerous to hearing

91 dBA = subway, **passing motorcycle**

Extremely loud— Dangerous to hearing

112 dBA = maximum output of some MP3 players

106 dBA = gas leaf blower

100 dBA = tractor, **listening with earphones**

94 dBA = hair dryer, kitchen blender, food processor

Hearing impairment categories

the better ear hearing threshold (dB)

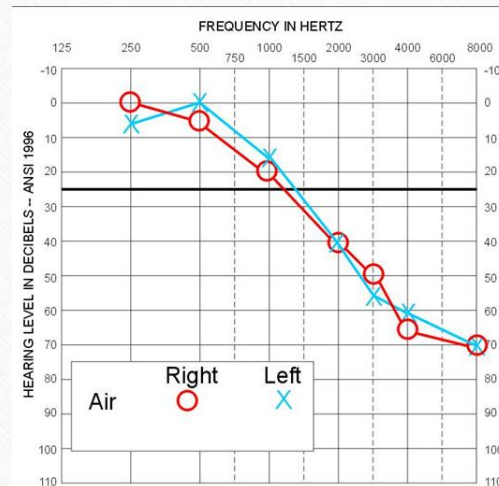
Degree of Hearing Loss	HearingLoss Range (dB HL)
Normal	-10 to 15
Slight	16 to 25
Mild	26 to 40
Moderate	41 to 55
Moderate/Severe	56 to 70
Severe	71 to 90
Profound	91+

Source: Clark, J. G. (1981). Uses and abuses of hearing loss classification. *Asha*, 23, 493-500.

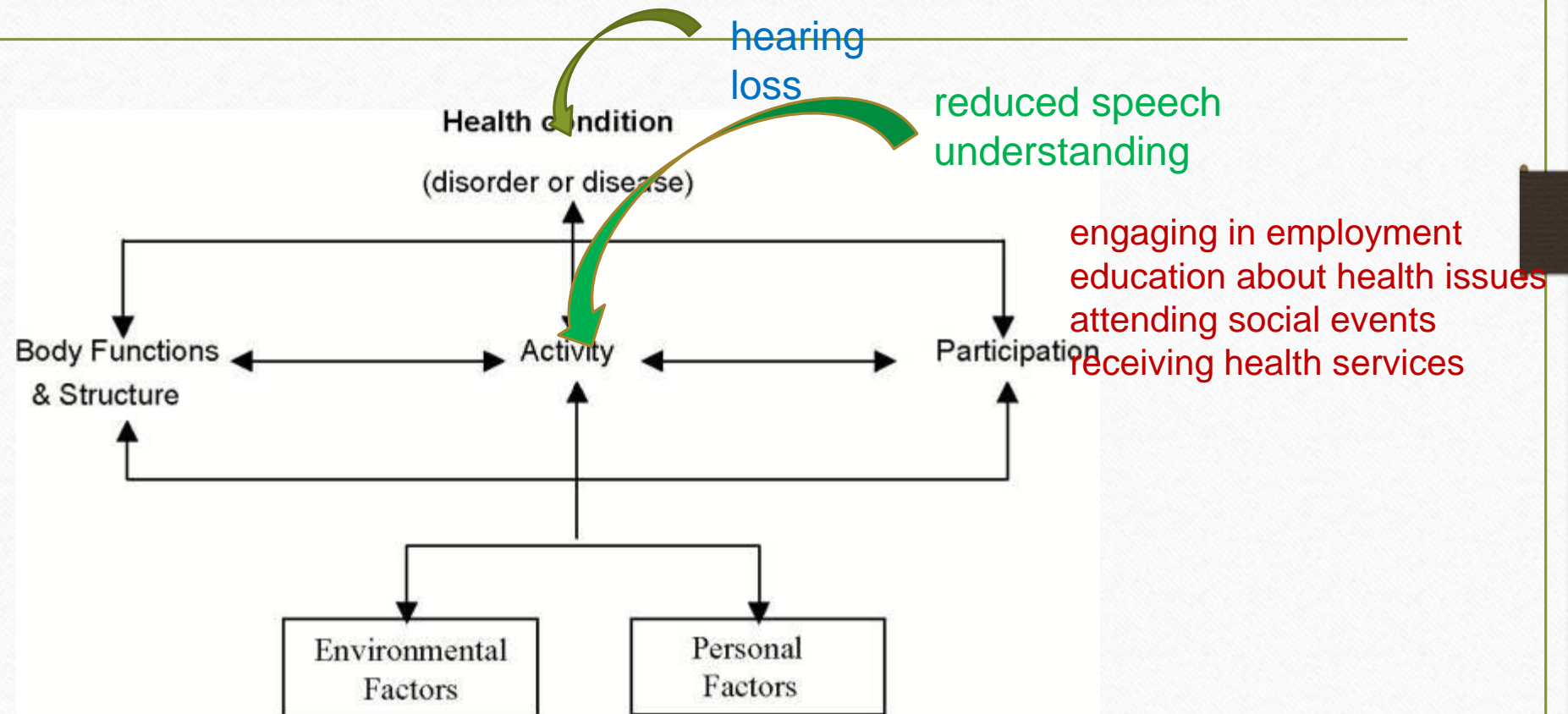
impairment category	Better ear hearing level (dBHL)	Hearing in a quiet environment	Hearing in a noisy environment
Mild	20-34	Does not have problems hearing what is said	May have real difficulty taking part in a conversation
Moderate	35-49	May have difficulty hearing a normal voice	Has difficulty hearing and taking part in conversation
Moderately Severe	50-64	Can hear loud speech	Has great difficulty hearing and taking part in conversation
Severe	65-79	Can hear loud speech directly in one's ear	Has very great difficulty hearing and taking part in conversation
Profound	80-94	Has great difficult hearing	Cannot hear any speech

Characteristics of hearing loss of the elderly - “Presbycusis”

- Progressive; Bilateral; Symmetrical; Sensorineural
- Most marked at higher frequencies (high-pitched sounds)
- Typically begins in the mid-age, but the sharpest rise in prevalence occurs at > 80 years (50–80% are affected)
- No cure



Health condition, and its bio-psycho-social-environmental context



The effects of hearing loss

- Decreases social engagement
- Increases symptoms of depression
- Increase the risk of falling
- Negative impact on cognitive performance

Economic effects of hearing loss

The effects of hearing loss on work participation may interfere with plans to extend the retirement age

Cognitive decline and hearing loss

- Consensus:
 - A link between ARHL and cognitive decline, impaired performance across cognitive domains, and increased risk for dementia
- The Lancet Commission statement (2017):
 - Hearing loss = the largest **potentially modifiable risk factor** for dementia among nine health and lifestyle factors

Hearing loss and dementia

- Hearing impairment is independently associated with a 30%–40% rate of accelerated cognitive decline
- Individuals with a mild, moderate, and severe hearing impairment, respectively, had a X2, 3X, and 5X increased risk of incident all-cause dementia over >10 years of follow-up

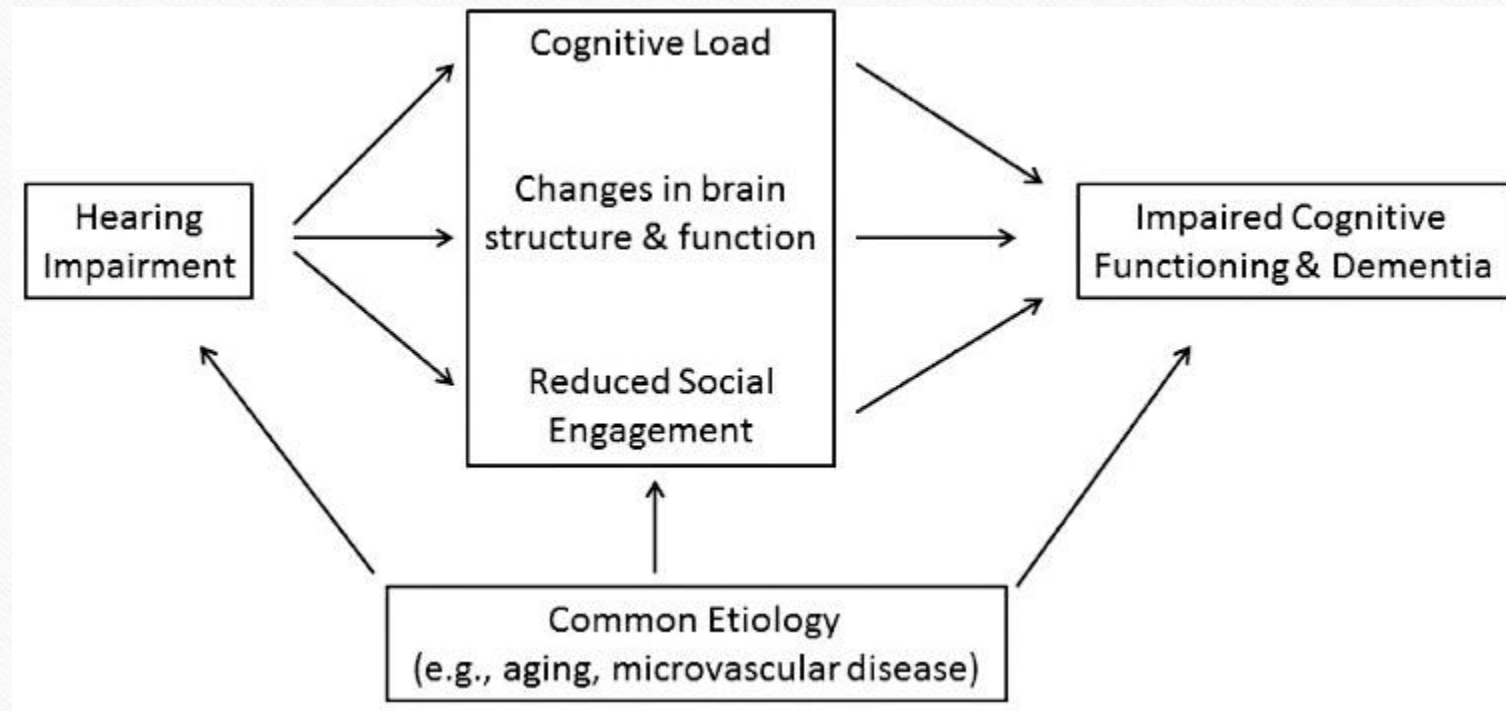
Linkage hypothesis

- **Cognitive load hypothesis**

- **The cognitive capacity in working memory is limited**

- Hearing loss leads to degraded auditory signals
- Greater cognitive resources being required for auditory perceptual processing
- Diversion from other tasks to effortful listening, eventually resulting in cognitive reserve depletion

A model of association of hearing impairment with cognitive functioning and dementia.



Repair ?

- Cochlear tissues have a very limited repair capacity and mature cochlear cells do not regenerate, making any cellular loss permanent
- **Rehabilitation** may be achieved by amplification (hearing aid) or implantation (by-passing the end organ hair cells)

Hearing aids use

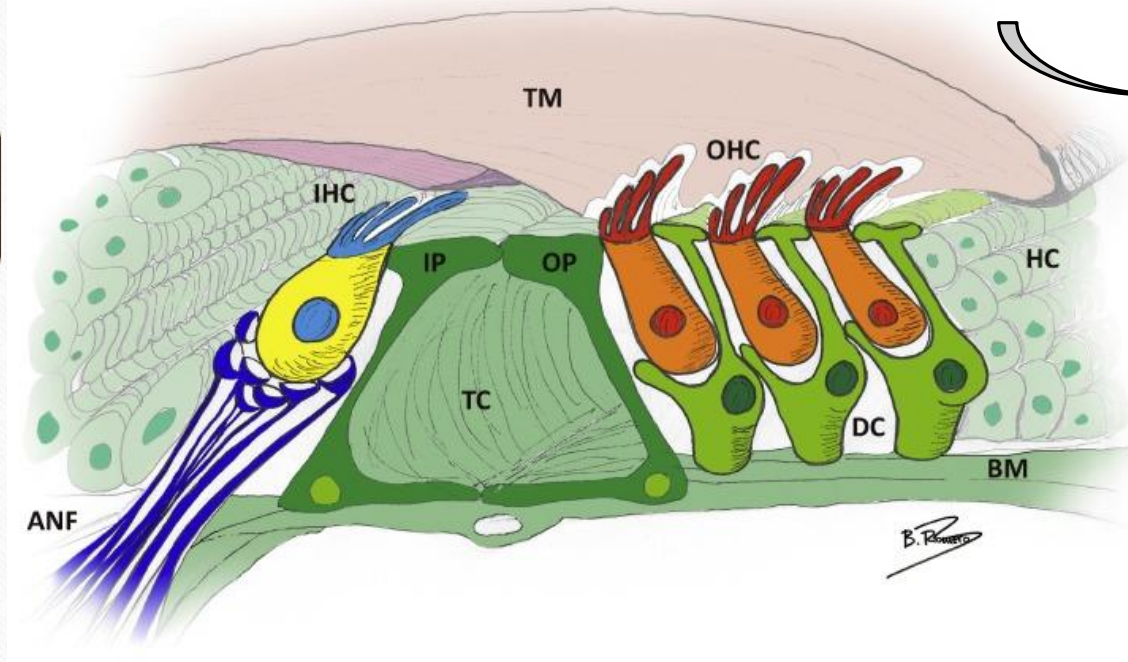
- Only a minority of individuals with hearing difficulties are using hearing devices
 - 4-22% in elderly with a mild-to-moderate HL in the US
 - 14-27% in mild HL (of all ages) in Germany, France, and UK

Hearing aids (not) use *(Trends Hearing 2018)*

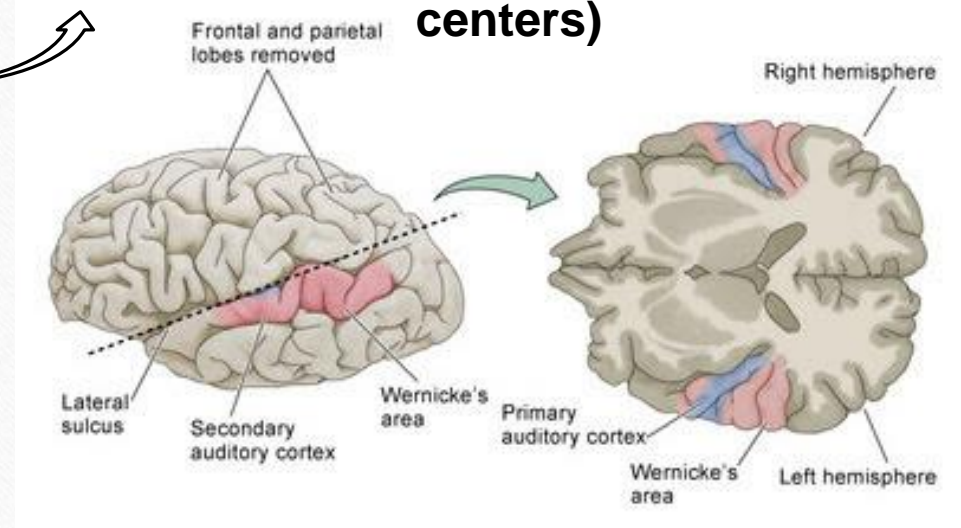
- Unawareness - gradual onset of age-related hearing loss
- Stigma (by gender)
- 'Locus of control', faith in the ability to personally control what happens to oneself
- Severity of HL
- Technology control
- Socio-economic status

Structural basis of cochlear function and system

Hair cells = mechano-electrical transducers



Auditory cortex (primary and secondary centers)



Courtesy of Bárbara Romero and Francisco Carricondo. Department of Ophtalmology and Otorhinolaryngology. University Complutense of Madrid (Spain).

Cochlear hair cells regeneration

- **In birds**, complete regeneration was observed in 10 days, following acute phonal trauma
 - It is currently thought that, in birds, hair cell renewal can occur and that there is a regenerative capacity

Cochlear hair cells regeneration

- **In mammals**, however...
- Only a few adult tissues, i.e. skin, blood or placenta showed the ability to regenerate
- The current consensus is that **inner ear hair cells do not regenerate**

In a chinchilla model

- Following aminoglycosides administration...
 - There was a clear recovery of the epithelium while the percentage of supporting cells was maintained close to normal

Recent advances in regeneration of cochlear HC and auditory neurons

- 3 pass-ways:
 - Survival factors to protect non-damaged cells
 - Regeneration with endogenous cells
 - Regeneration with exogenous cells

Survival factors of protection

- A **therapeutic window** between HC insult and neuronal injury
- Antioxidants (i.e. melatonin, resveratrol, DHA-docosahexaenoic acid) can exert neuro-protective effect

Possible ways of regeneration

- Endogenous cells
- Exogenous cells; cell therapy
- Fibroblast trans differentiation
- Adult stem cells

Regeneration with endogenous cells

- Retinoblastoma 1 (RB1)
 - an endogenous protein
 - plays an essential role in regulating cellular proliferation and differentiation

Fibroblast transdifferentiation

- There are transcription factors involved in adult fibroblast reprogramming into a cell phenotype which can be differentiated into a variety of cell types
- Transplantation of neural stem cells could be useful for preventing the damage to hair cells that occurs after transient ischemia of the cochlea ?

Adult stem cells

- Exist in nearly every tissue
- Ethically accepted:
 - no tumors, very low immunoreactivity

In conclusion

- Hearing loss in the elderly = “presbycusis” is a very common disorder
 - Expressed by difficulties in hearing and understanding
 - A critical effect upon social and cognitive achievements
- Hearing improvement delays Dementia
- Hearing improvement is a key factor in quality of life among older-aged people

Message

- Bringing together health specialists of all domains will better address hearing loss in the context of brain and cognitive aging and quality of life improvement
- We all need to be involved in -
 - Accepting hearing aids as “ear glasses”
 - Encouraging ‘hard of hearing’ to be involved in society
 - Maintain accessibility in all circumstances

Thank you

Toda
raba

Grazie mille