Presbyacusis – aspekter avseende epidemiologi och kognition

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Hur hör vi i Sverige?

2 epidemiologiska us. Kvinnor och män, 20 till 90 år gamla
Åldershörselnedsättning
Presbyacusis
Age-related hearing loss
ARHL el. ARHI

Förekomst?
Orsaker?
Åtgärder?
Three Swedish Epidemiological Studies

2) The Study of Men born in 1913 and 1923 (1973)
3) Health and Psychosocial Work Conditions in Middle Aged Women (2005)

Jönsson & Rosenhall 1998
Hederstierna et al, 2007

Rudin et al, 1988
Pedersen et al, 1989
Men and women, 70 - 80 y 5 epidemiological studies from Europe and USA Unscreened populations

Remarkable good agreement between different studies from developed countries
Men and women, 80 - 90 y
6 epidemiological studies from Europe and USA
Unscreened populations

The prevalence of child and adult hearing impairment is substantially higher in middle- and low-income countries than in high-income countries, demonstrating the global need for attention to hearing impairment

Stevens et al, 2013
Gender differences
70 - 80 y, 80 - 90 y

Gender Difference, 70-80 years

Gender Difference, 80-90 years

-10
-5
0
5
10
15
20
25

dB

-10
-5
0
5
10
15
20
25

kHz

Gates et al. 1990
Pearson et al. 1995
Davis 1995
Jönsson & Rosenhall 1998
Cruickshanks et al. 1998

Gates et al. 1990
Pearson et al. 1995
Parsing et al. 1997
Jönsson & Rosenhall 1998
Cruickshanks et al. 1998
Hietanen et al. 2004
Hörselskadade i Sverige

Självskattad hörselnedsättning >1 milj.
(HRF/SCB)

Beräknat antal med HNS enligt tonaudiometri

Svår HNS – dövhet ~130 000
Måttlig HNS (M4: 40-64 dB): >0,5 milj.
Lätt HNS (M4: 20-39 dB): ~1,4 milj.
Totalt: >2 milj.

20-70 år 70+
1/3 2/3
2/3 1/3

Beräkning 2014
Antal svenskar med hörselnedsättning (tusental)

Lätt
M4 20-39 dB

Måttlig – svår
M4 ≥40 dB

0 – 20 år
43t
5t

20 - 50 år
229t
45t

51 – 70 år
629t
161t

>70 år
474t
430t
Sveriges befolkning 31/12 2013
Sveriges befolkning 31/12 2013
Sveriges befolkning 31/12 2013
Ålder, år | Beräknat behov, Hörselrehab
---|---
60 | ~ 5%
70 | 10 – 20%
80 | 40 – 45%
90 | 60 – 70%
Sveriges framtidiga befolkning 2009–2060

<table>
<thead>
<tr>
<th>Ålder</th>
<th>2009</th>
<th>2015</th>
<th>2060</th>
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<tbody>
<tr>
<td>65+</td>
<td>15%</td>
<td>17%</td>
<td>25%</td>
</tr>
<tr>
<td>80+</td>
<td>4%</td>
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<td>9%</td>
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65+ 2,7 milj. 2060
Sweden 2006

More women than men have hearing loss

PTA <20 dB

PTA 20-39 dB

PTA +40 dB

Men 50+ 1.6 m

Women 50+ 1.8 m
Vad händer med hörseln på lång sikt?

Är hörseln konstant?

Försämrar hörseln?

Förbättras hörseln?
Ökar eller minskar incidensen av hörselproblem?

Den pessimistiska synen:

Hörselproblemen ökar globalt

WHO 2002 - 2030

DALYs (Disability-Adjusted Life Years)

Adult onset hearing loss: 2002 ranking # 13 globally
Year 2030 estimated ranking # 9 (2.5 DALYs)
High-income countries # 7 (4,1 DALYs)
Middle-income countries # 9 (2,9 DALYs)
Low-income countries < #10

Mathers & Loncar, 2006
The pessimistic view

In the Alameda County Study prevalence rates of self-reported trouble with hearing nearly doubled from 1965 to 1994

Wallhagen et al, 1997

Increases in prevalence of hearing loss in adolescents from 15% to 19.5% from 1988–1994 to 2005–2006

NHANES Shargorodsky et al, 2010

Self-assessed hearing loss 1984 - 2005
Statistics Sweden, SCB
The optimistic view
Prevention
NIHL – prevention
Vaccination programmes
ARHL – life-style factors

”Americans hear as well or better today compared with 40 years ago”
NHANES, NHES  Hoffman et al, 2010

Persons from later birth cohorts had lower prevalences of hearing impairment than those from earlier birth cohorts
Beaver Dam Study, EHLS  Zhan et al, 2010
The optimistic view

75-year olds over three decades: No audiometric changes
The Gerontological and Geriatric Population Study in Gothenburg, Sweden  
Rosenhall et al, 2013
Förändras hörseln från generation till generation?

18-åriga mönstrande svenska män

![Bar chart showing prevalence of hearing loss from 1971 to 2005]

Både bättre och sämre (men mest bättre)

HNS-prevalens 3 - 6 kHz, något öra, 1971 – 2005

Muhr et al, 2016
18-åriga mönstrande svenska män

Lätt, måttlig och svår HNS i diskantområdet 1971 – 2004 (-2010), ett eller båda öronen
Histopathology of ARHL

Cochlear degeneration

- OHC degeneration in basal and apical coil
- IHC degeneration in basal coil
- Strial degeneration
- Alterations and derangement of hair bundles
- Intracellular inclusions
Types of ARHL

1) Sensory
2) Neural
3) Strial (metabolic)
4) Cochlear conductive
5) Mixed
6) Indeterminate

Schuknecht & Gacek, 1993
Sensory type

Schuknecht’s classification

Engström et al. 1987
Strial type
*Schuknecht, 1994*

A reduction in the EP is presumed
Striatal (metabolic) type
Schuknecht’s classification

Gates & Mills, 2005
Mixed: sensory + strial types

Engström et al. 1987
Age, Cohort, and Period Effects
Causes of ARHL

Intrinsic causes – Age, Cohort Effects

Biological ageing

Biological ageing is probably only a minor contributor to ARHL of ”younger elderly people”, but increases in importance in advanced age, 80+

Telomeres?

Genetic factors

Important contributors to ARHL

Mutation in mtDNA
The 4,977-bp deletion

Bai et al, 1997; Ueda et al, 1998
Genetic influences of ARHL in man

- ARHL has a multifactorial aetiology
- Familial aggregations occur for sensory and strial ARHL phenotypes
- Heritability: 35-55% (sensory type)
- The heritability estimate was greater for the strial than the sensory phenotypes
- Women: Genetic effect on ARHL
- Men: Mixed, genetically/aquired ARHL

Gates et al, 1999

- Candidate genes in man:
  10q26, 11q13.5, 11q25 (DFNB20), 11p, 14q, 18q
  KCNQ4, DFNA18

DeStefano et al, 2003; Fransen et al, 2003; Garringer et al, 2006; van Eyken et al, 2006; a.o.
Genetics and ARHL – Twin Studies

Audiometric Study of Male Twins
Variation in high frequency hearing is related to genetic and extrinsic factor. Heritability: 47%, 64+ years, men
The environmental effect becomes more important with age

Karlsson et al, 1997

Danish Twin Registry
Heritability for self-reported hearing loss ~40%, 75+ years

Christensen et al, 2001

NAS-NRC Twin Panel
Heritability: 60% (self-reported). HI susceptibility locus on chromosome 3, $DFNA18$ locus
Reed et al, 2000; Garringer et al, 2006

Finnish Twin Study on Aging
Heritability: >60%, measured hearing, 63-76 years, women
Self-reported hearing related to environmental factors

Viljanen et al, 2007
Causes of ARHL

Environmental, acquired
Period Effects

Vocational noise exposure
Ototoxic drugs
Solvents, other chemicals
e.g. carbon monoxide
Traumatic hearing loss
Infections
Middle ear disease
Heavy metals (Hg)
Noise – Unscreened
Men, 75 y (70-80 y)

Compilation of 8 studies
Highly screened for otological
disease and noise (green)
Screened for noise only (blue)
Unscreened studies, noise exposed populations (red)

Occupational Noise - No Noise
Men, 70 y

No noise (blue) vs
occupational noise (red)
H70
Interactions between Noise-Induced Hearing Loss and ARHL

Additive effect
(adopted by ISO 1999)

Less-than-additive effect
*Mills et al, 1996; 1998*

More-than-additive effect
*Miller et al, 1998*

Combined effect
Less ARHI in NIHL-frequencies (4-6 kHz) Increased ARHI in neighbouring frequencies, - 2 kHz
*Gates et al., 2000*

Animal research indicates a sensitising effect of noise
*Kujawa & Liberman, 2006*
Annual decline dB/year

Three longitudinal studies

H70 Noise vs No Noise
  Hederstierna, Rosenhall, 2015

BLSA Noise vs No Noise
  Pearson et al, 1995

MUSC No Noise
  Lee et al, 2005
Causes of ARHL

Environmental, extrinsic

Life style factors

Every day noise exposure
Leisure time noise exposure, e.g. music, shooting
Smoking
Alcohol (severe abuse)
Diet
Physical fitness
Interfererande sjukdomar
Kognitiva störningar – Demens
Metabolt syndrom – DM2
PREVALENCE OF ALZHEIMER'S DISEASE
(BY DECADES IN U.S.A. FROM 1900-2050)

This graph portrays how many Americans over the age of 65 are currently affected by Alzheimer's, and a projection of how many more will become affected with it as time passes.

AD:
3 – 10% - 65 y
25 – 50% >85 y
Hörsel och kognition hos äldre

Presbyacusis – interaktion med kognitiva störningar

Positiv effekt av hörselrehabilitering vid presbyacusis och demens
Amieva et al, 2016
Hörsel och kognition hos äldre

Centrala auditiva störningar
Central Auditory Processing Disorder (CAPD)

CAPD har påvisats vid demens och vid impressiv afasi
Ramsing et al, 1996
Auditory function in early Alzheimer’s disease and Mild Cognitive Impairment

Idrizbegovic et al, 2011

Central Auditory Processing (CAP) dysfunction is highly evident in early AD, and even in MCI.

Evaluation of CAP might provide an auditory diagnostic complement in monitoring the progression of AD and MCI.

Pure tone audiometry
Speech audiometry
  PB words in quiet (SPQ)
  In noise (SPN) 4 dB S/N
Dichotic digits test (DDT)

136 subjects, mean age: 64 years (range 50-78)
1) AD; 2) MCI; 3) SMC