Combined Vision and Hearing Loss in the CLSA: Prevalence, Severity and Relationships to Cognitive and Social Variables

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Disclosures

• Funding in past 5 years – peer-reviewed:

• Other funding - industry:

• Conflicts of interest: none
CLSA & Networking Resources

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• Infrastructure: Canadian Consortium on Neurodegeneration and Aging (CCNA) Team 17 - *Interventions at the Sensory-Cognitive Interface*

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• Collaborative Data Access: interRAI & CIHI
Meet the team – CCNA Team 17
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Sensory-Cognitive Aging

Lindenberger & Baltes, 1994, *Psychol. Aging*
Baltes & Lindenberger, 1997, *Psychol. Aging*
Perceptual & Cognitive Decline in Aging

(A) Cascade View
(B) Common Cause View
(C) Decline-Compensation View

FIG. 1.3. Three views of perceptual and cognitive decline in aging.

Dennis & Cabeza, 2008: Handbook of aging and cognition
Some Vocabulary

• Combined vision and hearing loss
• Dual sensory impairment
• Acquired deafblindness

• Deafblindness – umbrella term in clinic
• Dual sensory impairment - researchers

Wittich, et al. (2013). What’s in a name: Dual sensory impairment or deafblindness?
*British Journal of Visual Impairment*, 31(3), 198–207
Why Dual Sensory Impairment?

• Deaf-blind, or deafblind, is a combination of hearing and vision loss of any varying degrees that affects a person’s ability to communicate, get environmental information, participate in the community, obtain and keep a job, and maintain independence.

  American Association of the Deaf-Blind, 2010

• Deafblindness is a combined vision and hearing impairment of such severity that it is hard for the impaired senses to compensate for each other. Thus, deafblindness is a distinct disability.

  New Nordic Definition of Deafblindness, 2016
Why study Dual Sensory Impairment & Aging?

• 1+1 does NOT equal 2

• DSI & Cognition
• DSI & Social Isolation
• DSI & Rehabilitation
• DSI & Policy
• DSI & ...

DSI Prevalence

- Population stats 0.2% to 2% depending on development stats of country
- Aging stats: Age 50+ around 5%
  - Using VA and dB HL
- Higher in sub-populations
  - Residential care
  - Rural populations
  - Those with hip fractures

Home Care

- Vision Impairment: 21.2%
  - n = 11,829
- Hearing Impairment: 4.4%
  - n = 10,868
- CognitiveImpairment: 55.6%
  - n = 49,452
- Vision Impairment & Hearing Impairment: 9.4%
  - n = 21,903
- Vision Impairment & Cognitive Impairment: 24.9%
  - n = 57,888
- Hearing Impairment & Cognitive Impairment: 23.2%
  - n = 54,029

Long-term Care

- Vision Impairment: 1.8%
  - n = 1,867
- Hearing Impairment: 1.6%
  - n = 1,637
- Cognitive Impairment: 14.1%
  - n = 31,142
- Vision Impairment & Hearing Impairment: 22.3%
  - n = 30,349
- Vision Impairment & Cognitive Impairment: 30.0%
  - n = 23,142
- Hearing Impairment & Cognitive Impairment: 14.1%
  - n = 14,677

DSI and Cognition

And it matters...but does not always replicate.

Number of sensory impairments & mortality
USA, N=2,418, age: 57-97 years, 45.4% died in 15-year period starting in 2000

Hazard ratios adjusting for age & sex
One impairment: 1.40
Two or more impairments: 2.12

But only olfaction was significantly related to mortality after adjusting for subclinical atherosclerosis and inflammation.

Vision and Hearing in the CLSA

• **Hearing - performance-based**
  - Automated pure tone audiometry in quiet room at frequencies 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz

• **Hearing – self-report**
  - Is your hearing, using a hearing aid if you use one...
  - Excellent, Very good, Good, Fair, Poor
  
  • Do you find it difficult to follow a conversation if there is background noise, such as TV, radio or children playing, even if using a hearing aid as usual?
  • Yes, No
Vision and Hearing in the CLSA

• **Vision - performance-based**
  - Habitual correction visual acuity, ETDRS @ 2 meters
  - Pinhole-correction visual acuity, ETDRS @ 2 meters

• **Vision - self-report**
  - Is your eyesight, using glasses or corrective lenses if you use them...
  - Excellent, Very good, Good, Fair, Poor
• **Definitions:** Binocular acuity worse than 20/40 (0.301 logMAR) with prescribed glasses or contact lenses for distance vision, if any.
  - Binocular – **monocular in better eye**
  - **Pin-hole corrected**, habitual correction

• **Prevalence:** Already reported in the CLSA
  - 5.7% (95% CI 5.4–6.0) had visual impairment.
  - Wide variation across provinces
    - low of 2.4% (95% CI 2.0–3.0) in Manitoba
    - high of 10.9% (95% CI 9.6–12.2) in Newfoundland and Labrador

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**Visual impairment and eye care utilization in the Canadian Longitudinal Study on Aging**

**Date:** December 12, 2017  
**Speaker:** Dr. Ellen Freeman  
**Presentation slides**


CLSA & Hearing loss

• **Definitions:** Audiogram pure-tone average in the better ear across 4 frequencies (1, 2, 3 and 4 kHz)


https://www.youtube.com/watch?v=N-5sYctbJFg
Our definitions of behavioural VI, HI, DSI

• Vision impairment (binocular/habitual correction):
  • ≥ 0.2 logMAR – mild VI (clinical interest) – 20/32 or 6/10
  • > 0.3 logMAR – common in epidemiology – 20/40 or 6/12
  • > 0.48 logMAR – WHO for moderate VI – 20/60 or 6/18

• Hearing impairment (unaided):
  • 25.1-40 dB HL – WHO mild HI
  • 40.1-59.9 dB HL – WHO moderate HI
  • ≥ 60 dB HL – WHO severe HI

• Dual Sensory Impairment:
  • >25 dB HL (0.5, 1, 2, and 4 kHz) and ≥ 0.2 logMAR; Mild/Mild
  • >25 dB HL (0.5, 1, 2, and 4 kHz) and > 0.3 logMAR; Mild/Common
  • >40 dB HL (0.5, 1, 2, and 4 kHz) and > 0.3 logMAR; Moderate/Common
  • [ >40 dB HL (1, 2, 3 and 4 kHz) and > 0.48 logMAR => n = 89 ] Moderate/Moderate
CLSA baseline data (collection finished 2015)

- Comprehensive cohort
  - ~ 30,000 participants (English- & French-speakers)
  - Home visit, data collection site visit (interviews + functional testing)
  - >4000 variables recorded
  - Age @ baseline 45-85 years
  - Representative sample around 11 data collection sites

- Provide BOTH
  - performance/behaviour-based and self-report
  - vision & hearing data
    - n = 29,002 (96.4%)
Results

• Data distribution & prevalence

• Subjective reports versus behavioural measures
  • Vision
  • Hearing
  • DSI

• Why it is important to use both in combination!
• Quick link to cognition
How prevalent is vision, hearing, and dual sensory loss (DSL)?

Wittich et al., ARVO 2018, Investigative Ophthalmology & Visual Science 59 (9), 1068

Wittich et al., 2012, Ophthalmic & Physiological Optics, 32(3), 242-251
Prevalence of hearing and vision loss according to age and sex

- Dashed lines: prevalence COUNT (left axis)
- Solid lines: prevalence PROPORTION (right axis)
- Red: Females; Blue: Males
Prevalence of dual sensory loss (>40 dB, >=0.4 logMAR)

- Dashed lines: prevalence COUNT (left axis)
- Solid lines: prevalence PROPORTION (right axis)
- Red: Females; Blue: Males
Behavioural vs. Subjective Vision Measures

Is your eyesight, using glasses or corrective lens if you use them...

Blue Line =
Moderate VA loss

Orange Line =
Mild VA loss

With “normal” acuity, you can perceive your vision as fair or poor

With “poor” acuity, you can perceive your vision as excellent, very good, or good

Visual Acuity (logMAR)

Age 45-54

Age 65-74

Age 55-64

Age 75+

Behavioural vs. Subjective Vision Measures

Blue Line =
Moderate VA loss

Orange Line =
Mild VA loss

With “normal” acuity, you can perceive your vision as fair or poor

With “poor” acuity, you can perceive your vision as excellent, very good, or good

Visual Acuity (logMAR)
Behavourial vs. Subjective Hearing Measures

Is your hearing, using a hearing aid if you use one...

Within a normal audiogram range, participants can provide any functional answer. Participants perceiving their hearing as poor may have almost any pure-tone average on an audiogram.
The proportion of people self-reporting their sensory status

Most CLSA participants do not perceive any sensory impairment

N total = 29,002
The proportion of people self-reporting their sensory loss

- Slight increase in Perceived VI with age
- Slight increase in Perceived DSI with age
- Larger increase in Perceived HI with age

N total = 29,002
The proportion of people with behavioral DSI self-reporting their sensory loss

Remember pinhole versus habitual correction

Have the individuals successfully adapted?

Or are they all in denial?

Response shift: Down-ward comparison?

Disability Paradox (see Albrecht & Devlieger, 1999)

N total = 1,624
Both mild and moderate/severe deficits on audiogram increase with age
Self-reported fair/poor hearing increases with age
But Self-reported trouble hearing in noise is larger issue, for all ages
At younger ages (< 60), perceived difficulties hearing
are not captured by audiogram
At younger ages (< 75), perceived difficulties hearing in noise
are not captured by audiogram
At older ages (> 60), audiogram over-"estimates" perceived difficulties
At older ages (> 75), audiogram over-"estimates" perceived trouble hearing in noise
Audiogram alone may not tell you what you need to know!
Comparing Behavioural vs. Subjective Measures

Behavioral visual impairment increases with age both
• with best correction (pinhole - GREY)
• and with habitual correction (ORANGE)
Difference is correctable (BLUE)! (also see Aljied et al. 2018)

Across all ages, self-reported fair/poor vision remains below/around 10%

Under the age of 60, pinhole acuity “UNDER”-estimates self-reported problems

Over the age of 60, pinhole acuity “OVER”-estimates self-reported problems
Comparing Behavioural vs. Subjective Measures

• Behavioural DSI (acuity & PTA) increases exponentially with age

• Self-reported DSI slightly increases with age

• Under age 60, behavioural measures “under”-estimate the perceived impairment

• Over age 60, behavioural measures “over”-estimate the perceived impairment
Linking Sensory & Cognitive Measures

• Principal Component Analysis of Cognition Measures

• Executive function (PC1)
  • Animal fluency test: # of different animals named in 60 s
  • Controlled Oral Word Association Test: # of words in 60 s
  • Mental alternation test: 1-A-2-B...
  • Stroop test: Green

• Memory (PC2)
  • Rey Auditory Verbal Learning Test – delayed recall of 15 words (5 min)
  • Ratio of delayed to immediate recall; REY2/REY1
Executive Function

![Graphs showing the relationship between Principal Component (PC1) Score and hearing or vision measures.](image)
Memory

HEARING

VISION

Principal Component (PC2) Score vs. Better-hearing ear PTA dB HL

Principal Component (PC2) Score vs. Pinhole-corrected logMAR in better eye
Extrapolation, using census data (2011 & 2016) and CLSA recruitment weights (sex, age, province)

- In 2016, among Canadian **males** aged 45-85 years, approximately
  - 1.5 million had hearing loss > 25 dB HL,
  - 1.8 million had vision loss ≥ 0.2 logMAR, and
  - **570,000 males had both impairments.**
- In 2016, among Canadian **females** aged 45-85 years, approximately
  - 1.2 million had hearing loss > 25 dB HL,
  - 2.2 million had vision loss ≥ 0.2 logMAR, and
  - **450,000 females had both impairments.**

- Prevalence increased 8.7-16.9% between 2011 and 2016.

- Hearing loss and **dual sensory loss prevalence proportion increased exponentially with age** whereas the increase was more linear for vision.

- **Males were more likely to have hearing loss and dual sensory loss,** whereas females were more likely to have vision loss only.
Strengths & Weaknesses

• CLSA strengths in terms of examining DSI at population level:
  • Large sample size and age range
  • Access to lots of people with MILD sensory loss
  • Most of whom don’t recognize/report/experience they have it:
  • Only 8% of those with behavioural DSI self-report this impairment

• Weaknesses:
  • “Simple” assessment of hearing and vision: nothing on speech in noise, contrast sensitivity, visual field, ...
  • Sample/recruitment is biased towards healthy people (no ASL, LSQ in CLSA)
  • Very mild impairments at baseline
  • Not fully representative of general population
The CCNA-CLSA-interRAI studies

• **Prevalence** is vision/hearing/dual impairment in CLSA
  
  (Mick et al, under revision, Can J Aging)

• Relationship of **self-reported and behavioural** sensory measures
  
  (Hämäläinen et al., under revision, Ear & Hearing)

• **Age-effects** among behavioural and self-reported sensory measures
  
  (Pichora-Fuller, et al., in prep, Ear & Hearing)

• Associations between **cognitive and sensory** function in older adults
  
  (Phillips et al., in prep, Gerontologist)

• Association between **social factors and sensory/cognitive** function
  
  (Hämäläinen et al., submitted, Scientific Reports)

• **Optimizing** evaluation of older adults with vision and/or hearing loss
  
  (Urqueta Alfareo, et al., under review, BMC Geriatrics)

• **Sensitivity & Specificity** of the interRAI for identifying sensory loss
  
  (Urqueta Alfareo, et al., in prep, PLoS ONE)

• **Portrait** of older adults with DSI
  
  (Urqueta Alfareo, et al., in prep, TBA)
Next Directions

• Sensory Impairments as Multimorbidity

• Wave 2 of CLSA data:
  • Predictors of sensory decline
  • Predictors of cognitive decline
  • Predictors of social participation/loneliness
  • ...
Interested in vision/hearing/DSI for YOUR CLSA study?

• Talk to us!

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Thank you - Merci

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