Defining the “triple threat”: Frequency of co-occurrence and notable disparities

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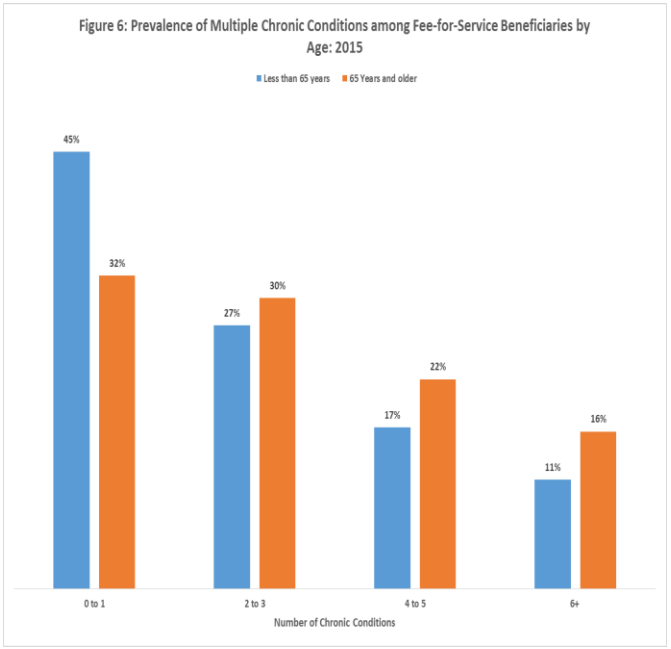
Epidemiology of
Hearing Loss Study

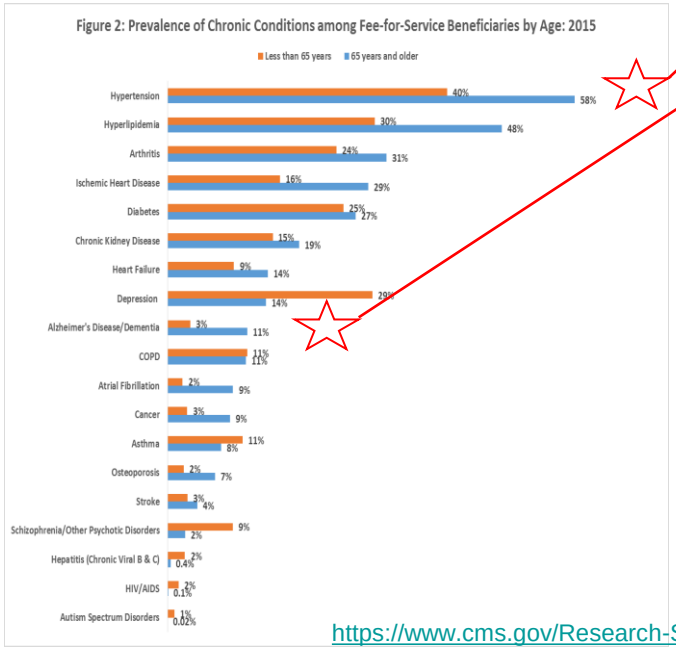
Beaver Dam
Offspring Study

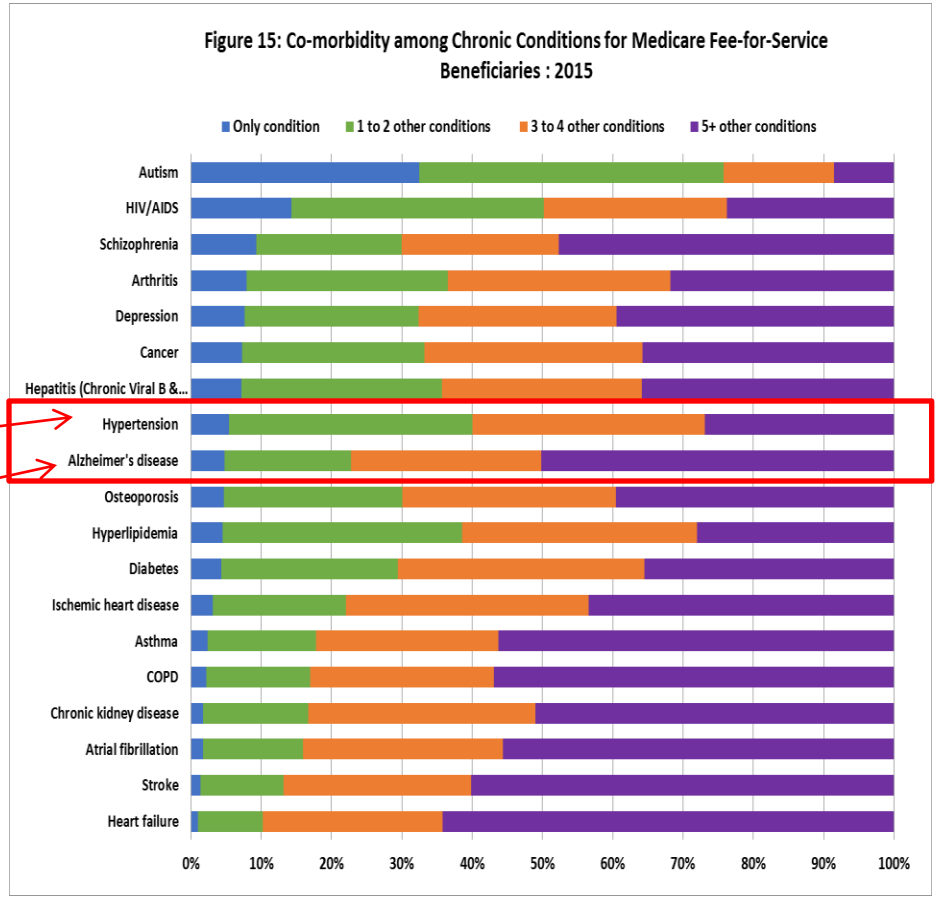
Overview

- Aging and co-morbidity
- Sensory co-morbidity and cognition
- Gaps and opportunities

Co-morbidities and Aging

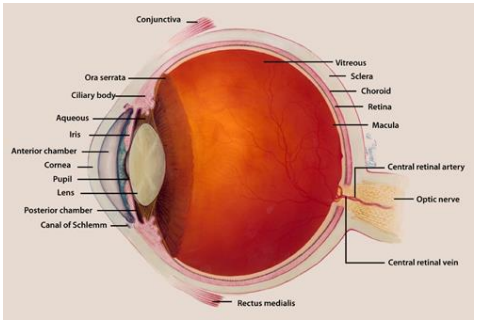


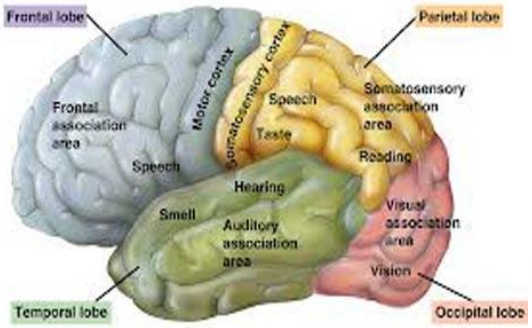


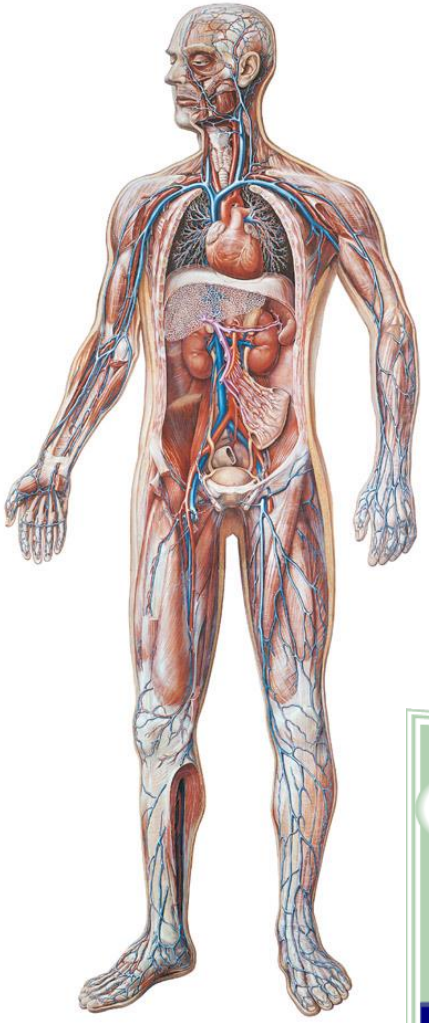


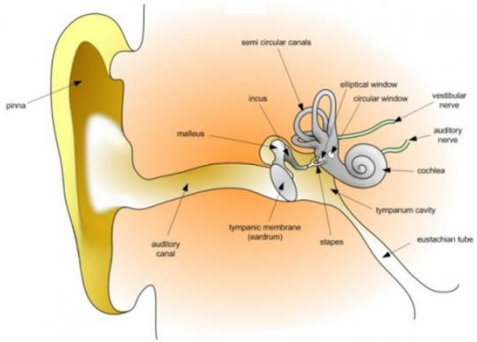
https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/Chartbook_Charts.html

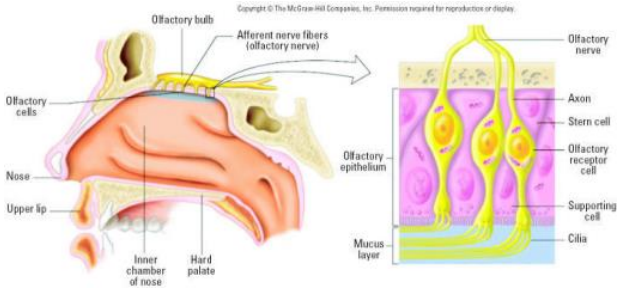
Sensory and cognitive systems involve neural processing and share a common environment



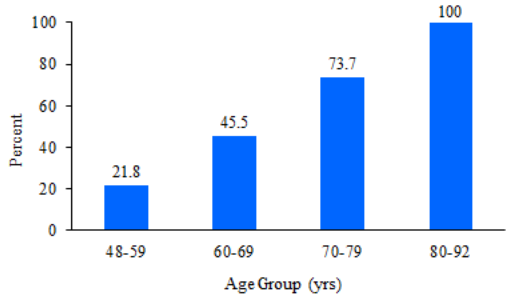






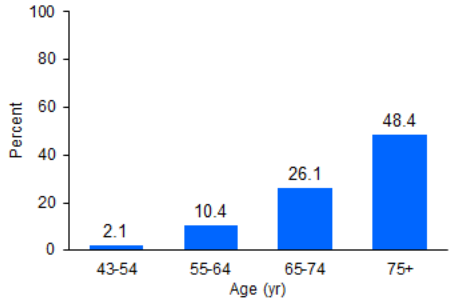


10-yr Cumulative Incidence of Hearing Impairment by Age



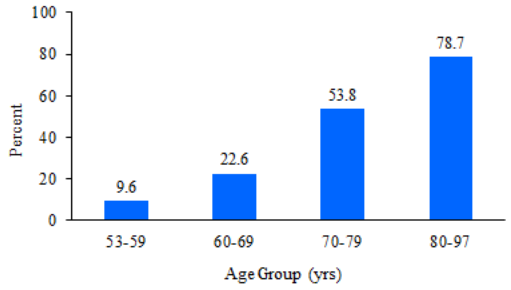
Cruickshanks KJ, et al., Hear Res 2010;264:3-9

10-yr Cumulative Incidence of Visual Impairment by Age



Klein R, et al., Ophthalmology 2001;108:1757-1766

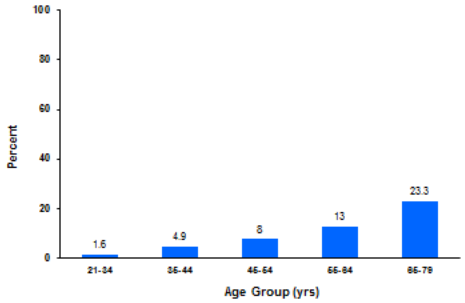
10-yr Cumulative Incidence of Olfactory Impairment by Age



Schubert CR et al., JAMA Otolaryngol Head Neck Surg 2013;139(10):1061-1066

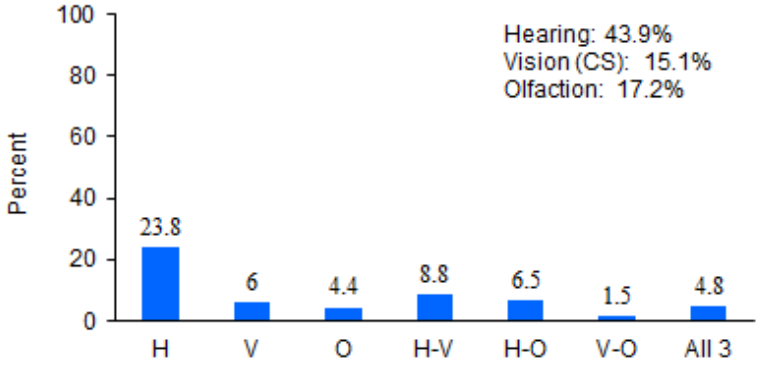
Beaver Dam Offspring Study

5-yr Incidence of Hearing Impairment by Age



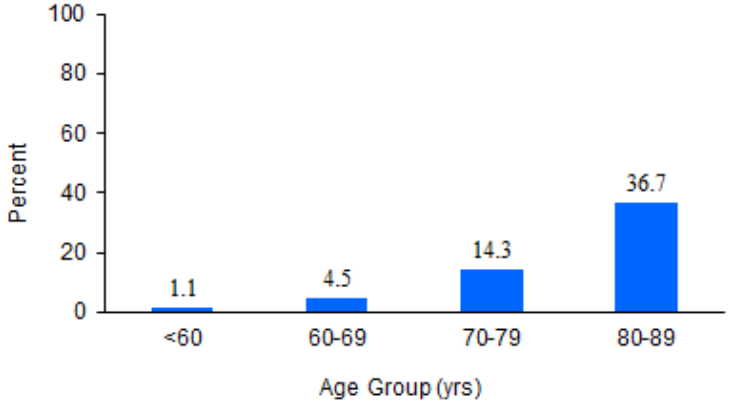
Fischer, ME, et al., *Atherosclerosis*. 2015;238(2):344-9

Sensory Co-morbidity: EHLS



Fischer ME et al., J Am Geriatr Soc 2016 Oct;64(10):1981-1987

10-yr Incidence of Cognitive Impairment: EHLS



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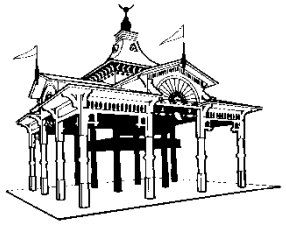


Sensory Impairments and 10-yr Incidence of Cognitive Impairment

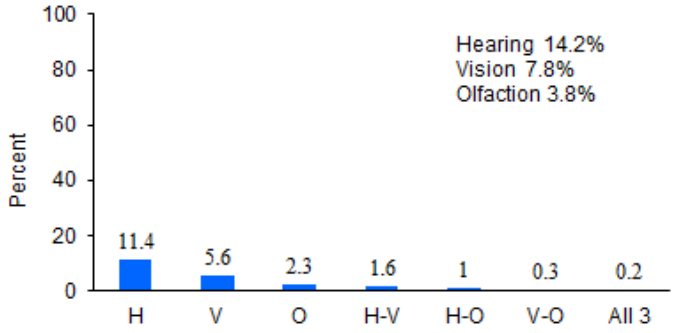
	HR	95%CI
Hearing	1.90	1.11,3.20
Vision	2.05	1.24,3.38
Olfaction	3.92	2.45,6.26

	Sens	Spec	PPV	NPV
H	72.9	59.0	14.6	95.7
V	46.4	81.3	19.3	94.0
O	47.6	85.8	24.5	94.4
All 3	21.7	96.9	40.0	92.8

Adjusted for age, sex, education, smoking status, BMI, exercise, alcohol consumption, hypertension, diabetes mellitus, number of high inflammatory markers, non-HDL cholesterol, mean IMT, frailty score, longest held job, cold or stuffy nose, nasal polyps, deviated septum, allergies, head injury, stroke/TIA, and epilepsy.

Fischer ME et al., J Am Geriatr Soc 2016 Oct;64(10):1981-1987

Sensory Co-morbidity: BOSS



Schubert CR et al., J Gerontol: Med Sci 2017;72(8):1087-1090

Sensory Impairment and Cognitive Function: BOSS

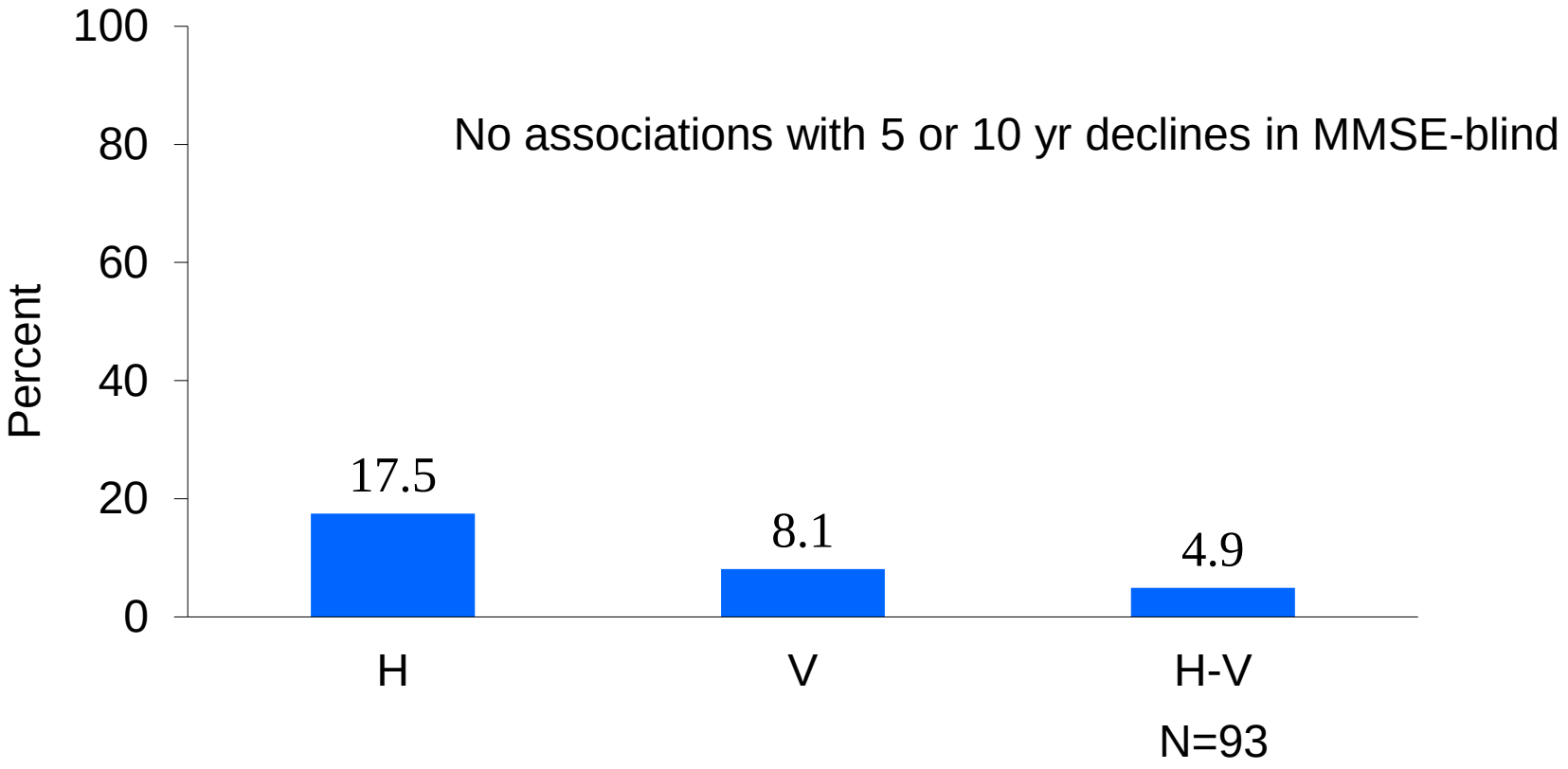
Test (N)	TMTA (2453)	TMTB (2450)	GPT (2450)
	β (95%CI)	β (95%CI)	β (95%CI)
Hearing	1.7 (0.67, 2.8)	5.0 (1.6, 8.4)	4.2 (2.3, 6.0)
Olfaction	6.4 (4.5, 8.3)	10.2 (4.3, 16.1)	4.0 (0.7, 7.3)
Vision	2.7 (1.3, 4.0)	9.6 (5.3, 13.8)	5.1 (2.7, 7.5)

Adjusted for age, sex, education, smoking, waist, exercise, carotid plaque, hsCRP>3.0 mg/L, VCAM. 635.4 ng/mL, a1c, non-HD cholesterol, depressive symptoms.

Schubert CR et al., J Gerontol: Med Sci 2017;72(8):1087-1090

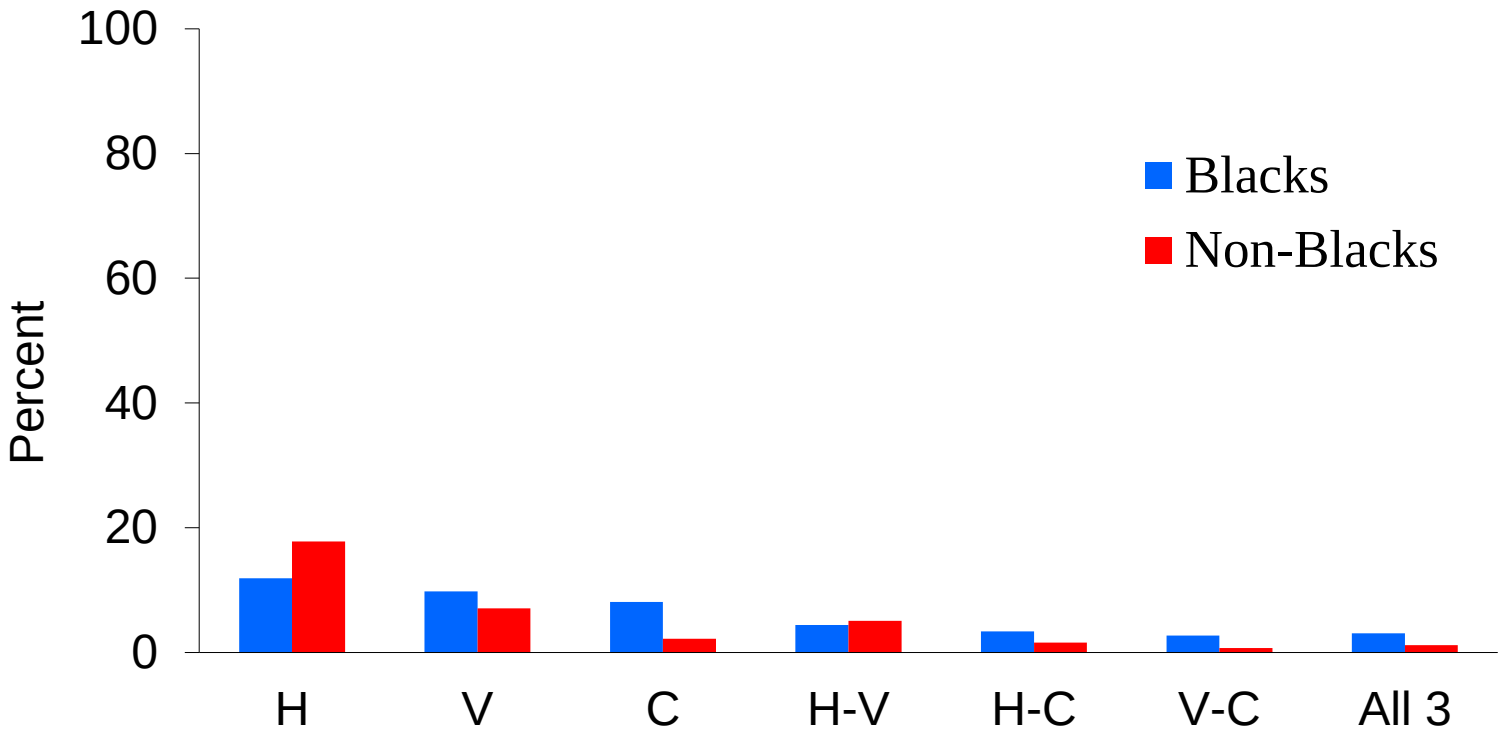
All 3: 14, 35 and 17 seconds longer

Sensory Co-morbidity: Blue Mountains Eye Study



Hong T, et al., PLoS One. 2016 Jan 25;11(1):e0147646.

Sensory and Cognitive Co-morbidity: NC EPESE



Liu PL et al., Gerontol & Geriatric Med Jan-Dec 2016:1-9.

Changes in Sensory and Cognitive Function: Maastricht Aging Study

- N=418, Mean age 66 years
- Best Corrected VA (Landolt-C), binocular, <=0.5 (n=36)
- Audiometry (1,2 and 4 kHz), better ear, >35 dB (n=30)
- Visual Verbal Learning Test
- Stroop Color Word Test
- Concept Shifting Task (mTMT)
- Verbal Fluency Test
- Letter-Digit Substitution Scale

Cross-sectional

- Baseline vision associated with SCWT, CST, LDST
- Baseline hearing not associated

Longitudinal (6 years)

- ΔVA (but not baseline) associated with declines in VVLT, SCWT, CST, LDST
- Δ hearing associated with declines in VVLT; baseline associated with declines in SCWT, LDST

Valentijn SA, et al., J Am Geriatr Soc. 2005 Mar;53(3):374-80.

Functional Measures

Hearing

- Acuity or sensitivity
- Speech understanding
- Gap detection
- Self-report

Vision

- Distance acuity
- Near acuity
- Contrast sensitivity
- Self-report

Cognition

- Executive function
- Memory
- Processing speed
- Self-report

Sensory measures differ in scale, severity, and require central processing
Cognitive tests rely on sensory input

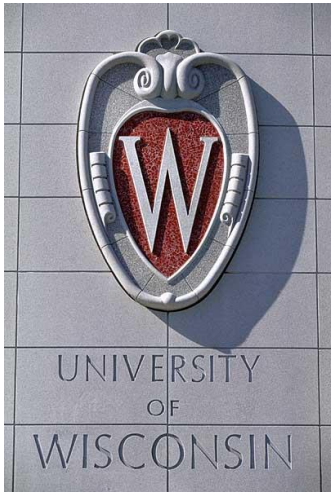
Knowledge Gaps

- What aspects of function should we measure?
- When do declines in sensory and cognitive function begin?
- What causes early changes in sensory and cognitive function?
- Which comes first – changes in hearing, vision, olfaction, cognition, or do they co-occur?
- Are sensory changes an early warning sign of neurodegenerative disease? Why?
- Are there racial/ethnic differences in these associations or pathways?

Research Opportunities

- Improved measures of visual and auditory systems and cognitive function; imaging techniques; collaborative studies, interest in sensory function
- Longitudinal studies of sensory and cognitive function across the lifespan
- Epidemiologic studies in racially/ethnically diverse cohorts
- Multinational studies of patterns over time, geographic location, and migration
- Impact of sensory and cognitive co-morbidities on independence and quality of life in aging

Acknowledgements



- Participants in the studies
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- Collaborators, students and staff
- Funding from NIH, RPB, and UW