

Sensory Loss and Cognition

Presenter: Nicholas Reed, AuD, PhD and Joshua Ehrlich, MD, MPH

Time	Section
01:52	<u>Introduction of Nick Reed and Josh Ehrlich</u>
03:28	<u>Hearing Loss and Cognition (Nick Reed)</u>
03:52	<u>Agenda</u> <ul style="list-style-type: none"> • Hearing, cognition, and dementia (Nick Reed) <ul style="list-style-type: none"> ○ Defining hearing loss, prevalence, shared sensory mechanisms, epidemiologic insights on hearing loss and cognitive decline, recent trials • Vision, cognition, and dementia (Josh Ehrlich) <ul style="list-style-type: none"> ○ Defining vision loss, prevalence, epidemiology of vision loss and neurocognition, sensory loss and delirium
04:27	<u>Hearing Loss: Clarity Not Volume</u> <ul style="list-style-type: none"> • Audiogram: graphical representation of the hearing test • X-axis: pitch; Y-axis: volume; the middle part is where speech is • Most hearing loss, you lose the high frequencies first (cuts speech in half) • Clarity is off, but volume remains the same
06:01	<u>How We Hear: Peripheral Encoding & Central Decoding</u> <ul style="list-style-type: none"> • Hearing loss= peripheral encoding and central decoding (garbled signal and trying to put the pieces together= effortful listening)
06:26	<u>Hearing Loss and Age in the United States</u> <ul style="list-style-type: none"> • Hearing loss is common • Over the age of 60, half of all adults in the U.S have clinically meaningful hearing loss; once over 70 it is 2/3 of all adults • Affects around 40 million people
07:20	<u>Prevalence of Hearing Loss in Adults Aged ≥ 71 Years in the US: NHATS</u> <ul style="list-style-type: none"> • By the age of 85 essentially everyone had clinical hearing loss • When getting into the late 80s and 90s it changes from having some hearing loss, to it no longer being mild. Moderate and severe hearing loss make up 80% of all hearing loss among those 90+ • Brain aging is a combo of genetic risk factors, disease, and lifestyle
08:40	<u>Healthy Aging & Hearing</u> <ul style="list-style-type: none"> • Diagram
09:00	<u>Linking Sensory Loss to Cognition & Dementia</u> <ul style="list-style-type: none"> • There is a shared mechanistic pathway between vision and hearing • Ex: social isolation leads to reduced engagement with world around us or vision loss and depression leading to cognitive decline • Recent data on cognitive load and brain structure
10:01	<u>Sensory Loss and Cognitive Load</u> <ul style="list-style-type: none"> • Cognitive Resource Capacity • Effortful listening comes at the expense of working memory • fMRI data studies: adults with hearing loss have reduced language driven activity on primary auditory pathways, but also show a compensatory language-driven activity in the prefrontal cortex areas
11:31	<u>Risk Factors for Dementia: Multi-Hit Theoretical Model</u> <ul style="list-style-type: none"> • Microvascular disease, hearing impairment, Alzheimer's neuropathology • See an independent association with decreased white matter, all brain atrophy, temporal lobe atrophy, and white matter hyperintensities being associated with hearing impairment/loss • Decreased stimulation of brain → atrophy
12:33	<u>Sensory Loss and Cognition: Social Isolation</u>

	<ul style="list-style-type: none"> • Social isolation is associated with cognitive decline • There are multiple pathways via health behaviors pathways, psychological pathways, and physiologic pathways
13:15	<p><u>Hearing Loss & Cognitive Decline HealthABC</u></p> <ul style="list-style-type: none"> • Around 2,000 adults 70 years and older followed for 6 years • If something has a lot of auditory contributions to do the task, over 6 years see a 41% faster rate of cognitive decline for those with hearing loss versus no hearing loss, whereas it is slightly attenuated when there's no auditory contribution (32% faster rate of cognitive decline)
15:01	<p><u>Hearing Loss & Incident Dementia</u></p> <ul style="list-style-type: none"> • 639 adults followed for more than 10 years in the Baltimore Longitudinal Study on Aging (healthy adults) <ul style="list-style-type: none"> ○ Looks at risk for all-cause dementia ○ Those with mild loss over the time period have essentially a two times hazard of developing dementia in that period. Moderate and severe sort of a show a dose response (but wide confidence intervals) • Health ABC study: 1889 adults followed for 9 years <ul style="list-style-type: none"> ○ Do see an association with moderate hearing loss and dementia (about 50% higher hazard)
17:16	<p><u>Hearing Loss, Dementia, Hearing Aids in Observational Data</u></p> <ul style="list-style-type: none"> • NHATS study looking at hearing aid use <ul style="list-style-type: none"> ○ Do see a slight reduction here, however... ○ People with hearing loss who use hearings aids are different to those with hearing loss who do not use hearing aids <ul style="list-style-type: none"> ▪ Income ▪ Education ▪ Health seeking behaviors ▪ Perception of hearing loss ○ Observational data can miss details (ownership ≠ use)
18:56	<p><u>State of Dementia Prevention</u></p> <ul style="list-style-type: none"> • Lancet commission → hearing loss has an 8% attributable risk fraction on global dementia <ul style="list-style-type: none"> ○ Interpretation: if you wiped out all hearing loss in the world, 8% of dementia would be gone ○ This also assumes 0 confounding • Individual vs. population risk
20:35	<p><u>Does treatment Impact These Pathways? It Should!</u></p> <ul style="list-style-type: none"> • ACHIEVE Trial <ul style="list-style-type: none"> ○ RCT recruited out of a large ongoing epidemiological trial (Atherosclerosis Risk and Community Study) ○ Randomized to a best practice hearing intervention or health education control ○ Looked over 3 years at global cognitive test battery ○ Over the 3 years, see no difference between the hearing intervention and the health education control, but if you stratify by those who have been in the trial for 30 years vs. the healthy volunteers do see a difference between the intervention and the control ○ Predicted Risk vs. Observed Effect <ul style="list-style-type: none"> ▪ Goal: Use the parent ARIC study (population-based epidemiologic study of each site) to inform predicted risk scores of cognitive decline to apply to ACHIEVE design ▪ Hypothesis: Participants with the greatest risk who were randomized to the hearing intervention will have the greatest reduction in cognitive decline compared to participants randomized to the health education control ○ Really the only group where a difference is being made is the least healthy individuals with the highest risk of cognitive decline • ACHIEVE Study Take Aways

	<ul style="list-style-type: none"> ○ Hearing and cognition derived from population-based studies and should not be interpreted or messaged on an individual level ○ The ACHIEVE trial is null and should be framed as such ○ Secondary analyses suggest a signal exists for a non-linear association between hearing intervention and cognitive trajectory <ul style="list-style-type: none"> ▪ Need for work on bi-directional synergies, increased diversity, and consideration for objective markers
26:29	<p><u>Amplifier Alone Won't Do the Job</u></p> <ul style="list-style-type: none"> • Tips for Addressing Hearing Loss
26:50	<p><u>Sensory Health, Dementia, and Delirium (Josh Ehrlich)</u></p>
27:47	<p><u>Vision Introduction</u></p> <ul style="list-style-type: none"> • When people think about vision, we use the word but different people mean different things • There is no single parameter that encapsulates what vision is • Most common construct has to do with eye chart from doctors' office (black characters on white background)—this does test one visual function known as distance visual acuity • But there are many other measures of visual function (intuitive to us but don't verbalize it as much—ex: contrast sensitivity, depth perception, peripheral vision, dark adaptation). They are not always easy to measure
29:55	<p><u>VI Prevalence with Age</u></p> <ul style="list-style-type: none"> • NHATS study • Tested near visual acuity, distance visual acuity, and contrast sensitivity across age groups (prevalence of each vision impairment increases with age—no surprise) <ul style="list-style-type: none"> ○ Near visual acuity is most affected ○ Due to aging related conditions such as cataract, glaucoma, macular degeneration
32:06	<p><u>2020 Risk Factor Model</u></p> <ul style="list-style-type: none"> • Lancet report on dementia on modifiable risk factors (vision loss conspicuously missing from model) <ul style="list-style-type: none"> ○ Has changed recently and vision impairment is now in the model
33:19	<p><u>High Prevalence</u></p> <ul style="list-style-type: none"> • 1.1 billion people are living with vision loss because they do not have access to basic eye care services (73% older adults—50 and older, 19% adults, 8% children and adolescents)
33:58	<p><u>Visual Impairment is Largely Preventable or Correctable</u></p> <ul style="list-style-type: none"> • 80-90% of vision impairment globally is preventable or has yet to be addressed • About 75% can be treated with just 2 cost effective interventions (providing glasses and providing cataract surgery)
34:36	<p><u>Hypothesized Pathways</u></p> <ul style="list-style-type: none"> • Model diagram • Testing of these hypothetical pathways has been limited by a lack of generalizable and longitudinal data • Building better population data so longitudinal analyses can help to understand how mediators are interacting with sensory health and with cognitive health
35:34	<p><u>Effect Sizes</u></p> <ul style="list-style-type: none"> • Relative risks between hearing and vision are relatively similar (they have a similar magnitude)
36:12	<p><u>Are We Measuring What We Think We Are?</u></p> <ul style="list-style-type: none"> • We believe the measurement of cognitive function is generally valid across older adults • How do we know we're measuring cognition and not just how well people can see in this case or hear in the other case the prompts for the cognitive tests? <ul style="list-style-type: none"> ○ Used LASI-DAD which is the HCAP study in India ○ Divided the items in the large cognitive battery into those that had a visual component and those that didn't have a visual component

	<ul style="list-style-type: none"> ○ Used vision independent items to anchor each individual’s latent cognitive ability for overall cognition and across each of the domains of cognitive health (visuospatial, executive function, language/fluency, and memory) ○ Then asked if people with or without vision impairment perform differently on the vision dependent items for a given underlying cognitive ability <ul style="list-style-type: none"> ▪ There was really no differential item functioning in the vision dependent items across cognitive domains in people with and without vision impairments
38:42	<p><u>Lancet Model</u></p> <ul style="list-style-type: none"> • Maybe a good reason they did not include vision impairment? So, what would happen if we try to recreate their model? <ul style="list-style-type: none"> ○ So, what was found when they re-created the model was that the attributable fraction provision was similar to risk factors that were already in the model ○ If this is extrapolated to the US population, about 100,000 cases of dementia might be preventable with good vision ○ Similar work in India (very high prevalence of vision impairment there) and found that vision impairment carries one of the highest population attributable fractions for dementia in India for the same reason hearing loss carries a high PAF in the US
40:09	<p><u>14 Potentially Modifiable Risk Factors</u></p> <ul style="list-style-type: none"> • Vision impairment now counts among the 14 potentially modifiable risk factors in the Lancet Commission’s 2024 report • Also added in 2024 was high LDL cholesterol • Lancet Commission now purports to account for about 45% of extant cases of dementia <ul style="list-style-type: none"> ○ The interpretation of this in theory that if these risk factors were eliminated, 45% of prevalent dementia cases might never have occurred • Vision impairment is weighted similarly to well-regarded and well accepted risk factors such as smoking, diabetes, and hypertension
42:17	<p><u>Correctable Forms of Vision Impairment</u></p> <ul style="list-style-type: none"> • Refractive error, presbyopia, cataract → eyeglasses, cataract surgery
43:15	<p><u>CLEVER</u></p> <ul style="list-style-type: none"> • Cognitive Level Enhancement through Vision Exams and Refraction Trial <ul style="list-style-type: none"> ○ Provides older adults who are cognitively normal at baseline with immediate refractive correction or delayed refractive correction and measuring cognitive health with the same Indian HCAP battery ○ Study is now actively recruiting
44:06	<p><u>Sensory Loss & Delirium</u></p> <ul style="list-style-type: none"> • Study out of Italy: Sensory loss common in delirium; among 3038 adults 65+ admitted to hospital: <ul style="list-style-type: none"> ○ Hearing (31% vs. 18%) ○ Vision (24% vs. 16%) ○ Dual sensory (16% vs. 8%) • Dual sensory loss independently associated with development of delirium • This thinking has also informed the development and validation of delirium risk assessment tools (DRAS= Delirium Risk Assessment Score) → unique because includes both vision and hearing among other risk factors • HELP program → intervene on 6 risk factors simultaneously including vision and hearing • VA study (modification of delirium risk through cognitive stimulation, sensory improvement, and sleep promotion)
47:36	<p><u>Concluding Thoughts</u></p> <ul style="list-style-type: none"> • VI impacts many facets of life, including brain health • Vision may be a modifiable lever to optimize late-life health and wellbeing, including dementia and delirium risk

	<ul style="list-style-type: none">• Longitudinal, generalizable, rigorous evidence is needed
48:35	<u>Questions and Answers</u>