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Hearing loss, social engagement and mental health in older adults: evidence from population-based studies

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Presenter Disclosures

- Financial: Jennifer A. Deal is an Assistant Professor of Epidemiology and Otolaryngology-Head & Neck Surgery at the Johns Hopkins University. She received an honorarium for this presentation. She also receives funding from the National Institute of Health Grant and Velux Stiftung.
- Non-financial: Jennifer A. Deal has no relevant non-financial relationships to disclose.

Content Disclosure

- This learning event does not focus exclusively on any specific product or service.
- This session discusses content regarding topics such as social isolation and loneliness, depression and anxiety.
- Sponsor Disclosure: There is no external sponsor for this course.

Course Description

- This course will review and evaluate recent public health research that demonstrates an association between hearing loss and social engagement (loneliness, social isolation) and mental health outcomes in older adults, with a focus on depression and depressive symptoms.

Learning Objectives

As a result of this course, participants will be able to:

- Summarize and interpret current epidemiologic evidence for an association of hearing loss and social engagement and mental health outcomes in older adults
- Evaluate potential explanations for epidemiologic associations of hearing loss with social engagement and mental health outcomes in older adults
- Identify key epidemiologic and public health questions pertaining to hearing loss and gerontology/geriatrics that remain unanswered

Agenda

- Interpreting & evaluating public health studies
- Hearing loss & social connection
- Hearing loss & mood disorders
- Concluding thoughts

Interpreting & Evaluating Public Health Studies



Goal of This Section

- Our goal is to evaluate population health studies
- We will start by introducing some key methodological considerations to provide a framework for evaluation

Science of Public Health

- Epidemiology = science of public health
- Study of how health states are distributed in populations & what factors influence or determine this distribution
- At a population level, we can see (and predict!) patterns that we cannot discern at the level of the individual

Types of Epidemiologic Studies

- Experimental studies (randomized trials)
 - Patient randomly assigned to treatment or control
 - Groups, on average, balanced with respect to factors related to the outcome
 - Any observed difference in the outcome comparing treatment to control group due solely to the treatment
- Observational study designs
 - e.g., cohort, case-control, cross-sectional

Summary – Study Designs 1

- Because we cannot determine cause from observational studies, our focus today will be on randomized studies for hearing loss treatment to improve social engagement

Summary – Study Designs 2

- Because we cannot randomize people to hearing loss, **our focus today will be on observational studies for hearing & social connection outcomes**
- But that means we need to carefully consider sources of bias when interpreting them

Challenges to Interpreting Observational Studies

- Bias exists in all observational studies (whether cross-sectional or prospective)
- If we find an association, we must consider all possible reasons we see that association, including bias

Possible Reasons for Associations

- Chance
- Bias
 - Selection bias
 - Information bias
 - Confounding
- Cause

Exposure does **not** cause the outcome

Exposure causes the outcome & if we intervene on the exposure, we can prevent the outcome!



Created by Ariel Kotzer
from the Noun Project

- We can't study everyone, so we need to sample people into our studies
- Associations in our sample may differ from the true association in the larger population
- Repeating the same study in different populations at different times is therefore *very* important!

Summary – Chance

- Novelty is overrated
- Replication is good!
- Our focus today will be studies that synthesize results across a variety of populations and settings → Systematic reviews & meta-analyses

Possible Reasons for Associations

- Chance
- Bias
 - Selection bias
 - Information bias
 - Confounding
- Cause

Exposure does **not** cause the outcome

Exposure causes the outcome & if we intervene on the exposure, we can prevent the outcome!

Selection Bias

- Beyond the scope of this presentation
- However, not all selection is selection bias
- And some issues related to selection are worth considering...

Selection: Clinic vs. Population - based Samples

- Clinic samples include patients who self-select to seek and participate in healthcare
- Patients who seek care may be different from people who do not
- Results in a clinic-based study may therefore not apply to the broader population
- Our focus today will be on population studies

Information Bias

- Information bias = systematic measurement error
- Error in measurement of exposure, outcome or any other factors in our study
- Importance of using a validated instrument to measure factors in a study

Measuring Hearing in Population Studies

Audiometry

- Measures cochlear function

Self-report

- Measures perceived hearing loss within a social context

Associations With Outcomes Depend on How Hearing is Measured

N=1,669, 70+ years, National Health and Examination Survey, 2005-6 & 2009-10

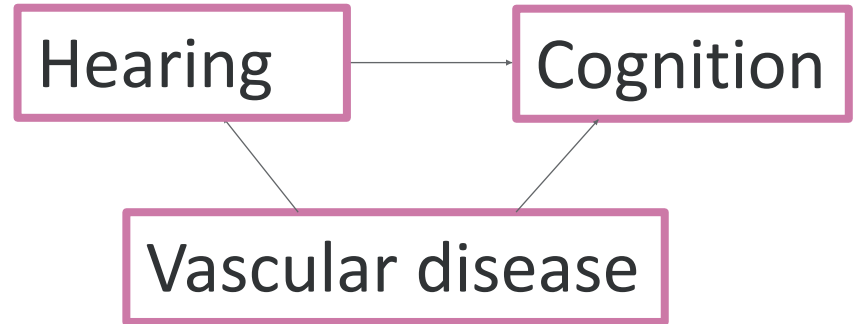
Outcome	Audiometric		Self-reported	
Objective	Mild*	≥Moderate*	Little trouble*	≥Moderate*
Accelerometry	2.3	1.9	0.8	1.2
Hospitalizations	1.2	1.6	1.3	1.1
Subjective				
Physical activity	1.2	1.4	1.5	2.4
Disability	1.4	1.7	1.1	2.4
Memory/confusion	1.2	1.5	1.3	2.0

* vs. no hearing loss

Hearing Measurement Matters

- If hearing loss and exposures are both measured by self-report, that can lead to bias
- “Same-source” bias
 - Association because measurement error in exposure and outcome is correlated
 - The level of one measure influences the reporting of the other (e.g., clinical depression could influence how someone reports their hearing)

Confounding



- A third factor that:
 - Causes the outcome
 - Is associated with the exposure
 - Is not a consequence of the exposure
- Biases our association if we don't account for confounders
 - Restrict/stratify
 - Match
 - Adjust in our regression models

Summary – Bias

- Our focus today will be on studies that:
 - Are from population samples
 - Measure hearing using audiometry
 - Use a validated instrument to measure social connection outcomes
 - Adjust for possible confounders

Putting it All Together

- We'll review the studies that:
- Have the strongest possible level of evidence
 - Observational design for association studies
 - Randomized trials for effect of hearing loss treatment
- Are population based
- That address important sources of bias

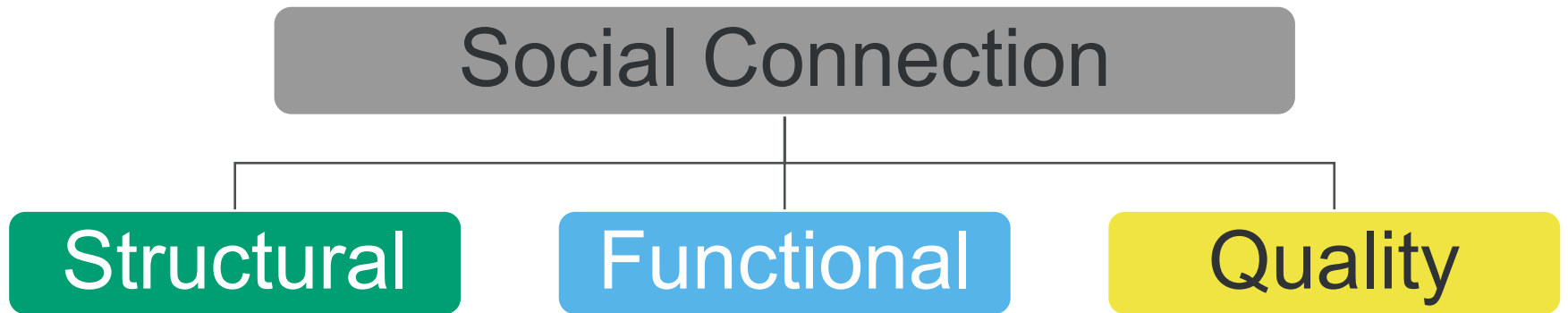
Hearing Loss & Social Connection



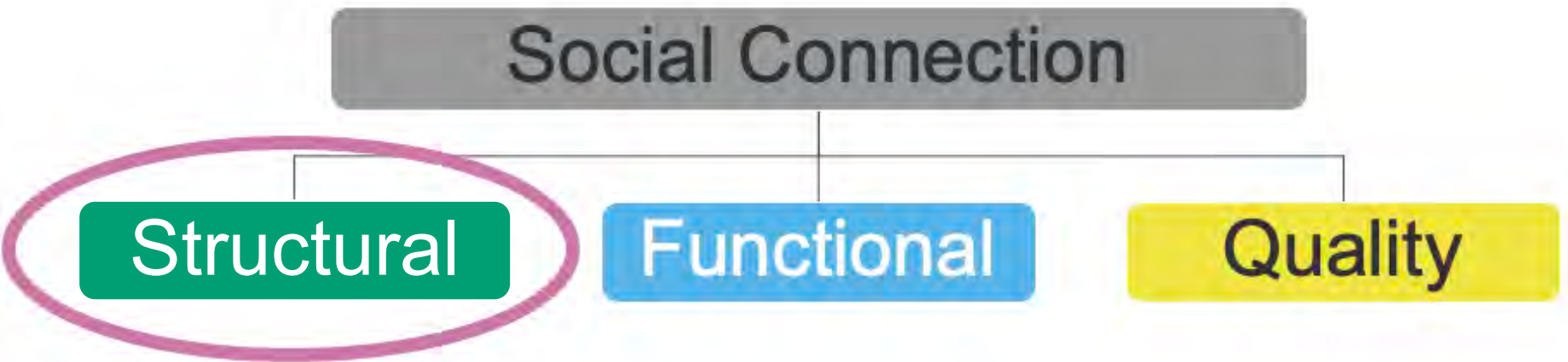
Social Connection

- An umbrella term that encompassing the different conceptual and measurement approaches represented in the literature
- Multiple components (structural, functional, quality)

Social Connection Framework

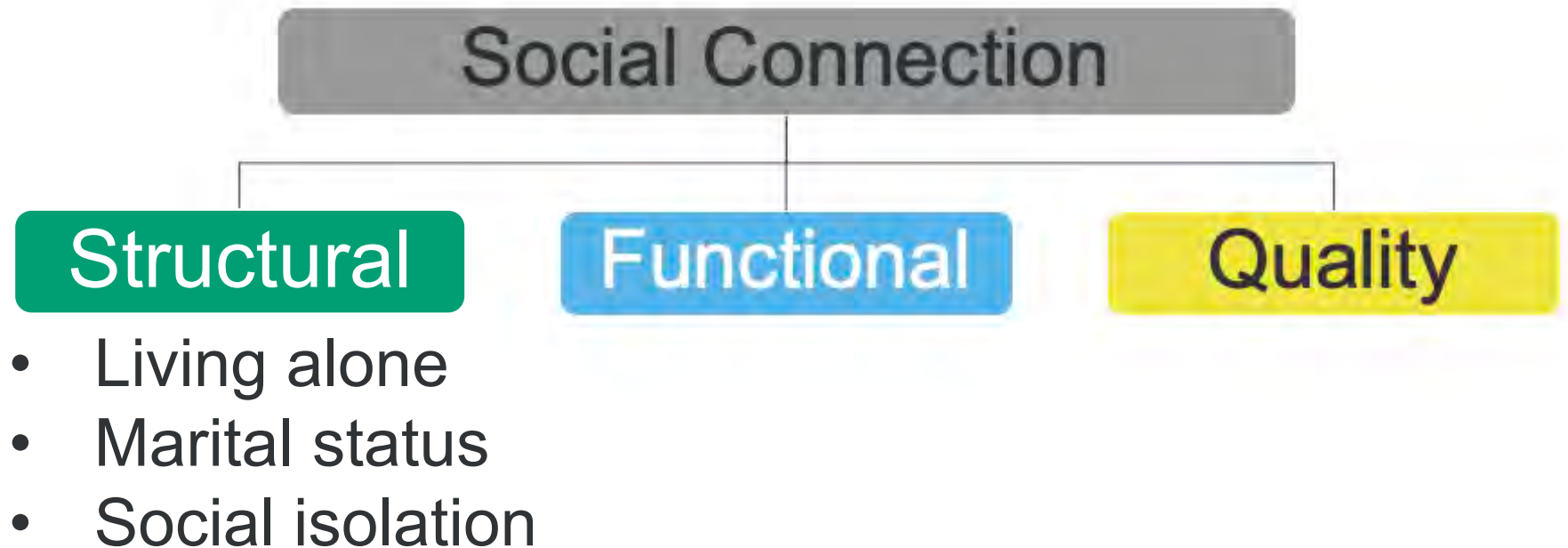


Structural Aspects



Existence of (& interconnections among) different social relationships and roles

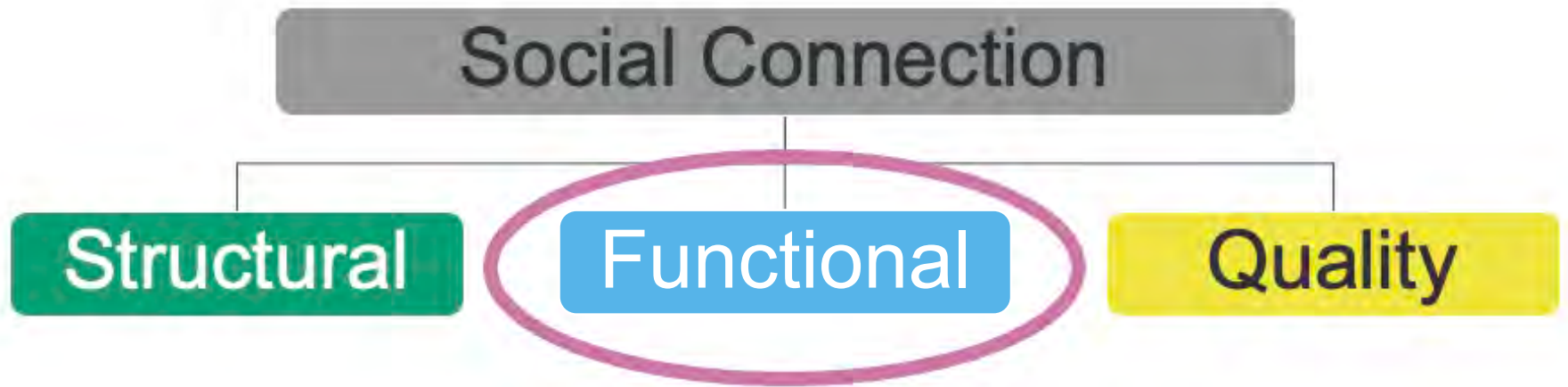
Structural Aspects



Social Isolation Definition

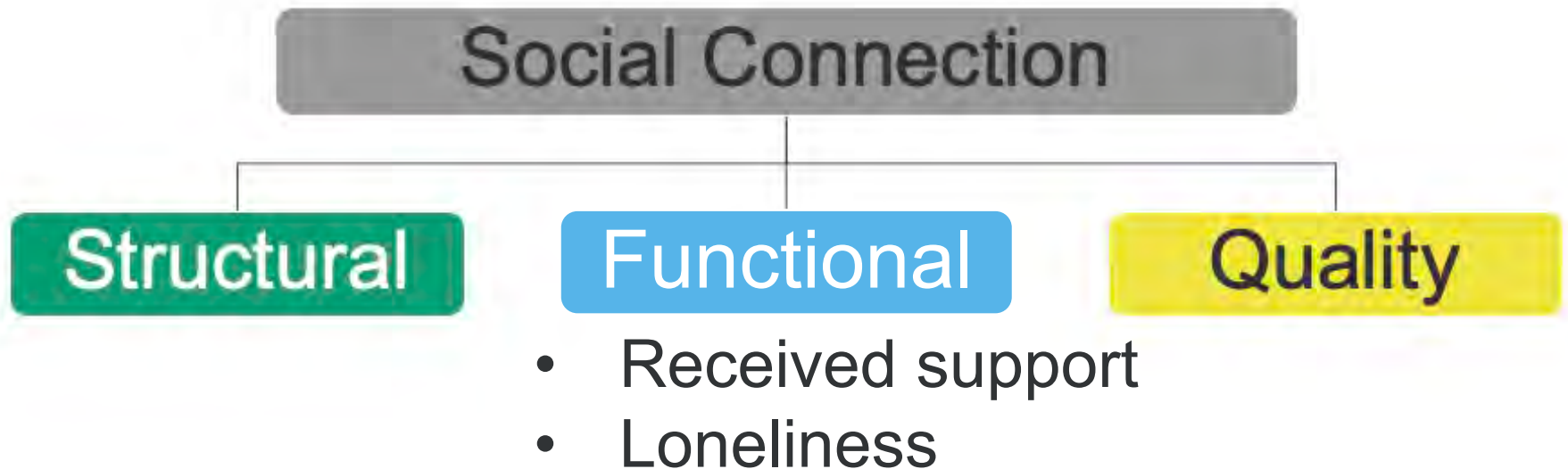
- Objective lack of (or limited) social contact with others
- Marked by few social network ties, infrequent social contact, or, potentially, living alone

Functional Aspects



Functions provided by or perceived to be available because of social relationships

Examples of Functional Aspects



Loneliness Definition

- Perception of social isolation or the *subjective* feeling of being lonely
- Marked by a discrepancy between a person's actual social connections and their needed/wanted social connections

Social Isolation vs. Loneliness

Social Isolation



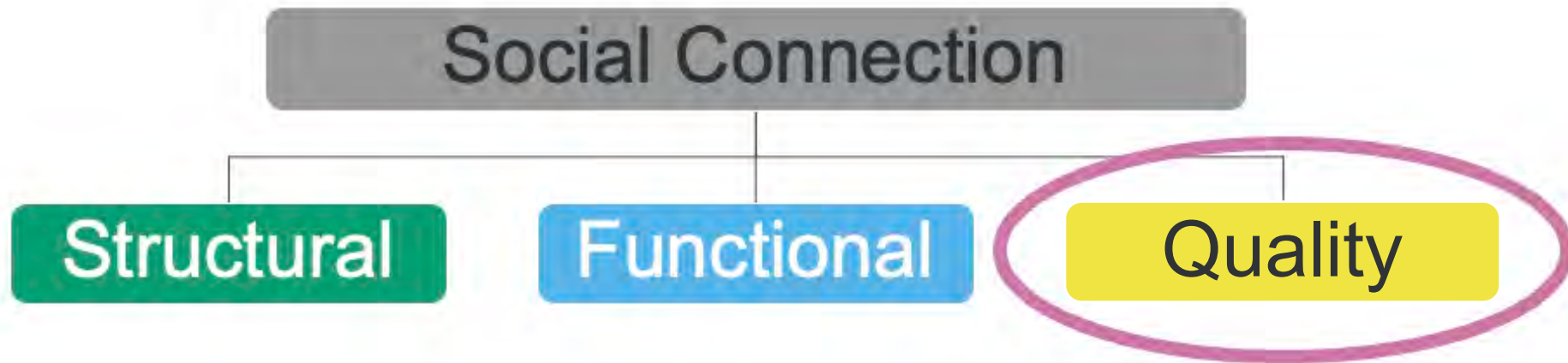
*Number/quality of
social connections*

Loneliness



*Perceived lack of
social connection*

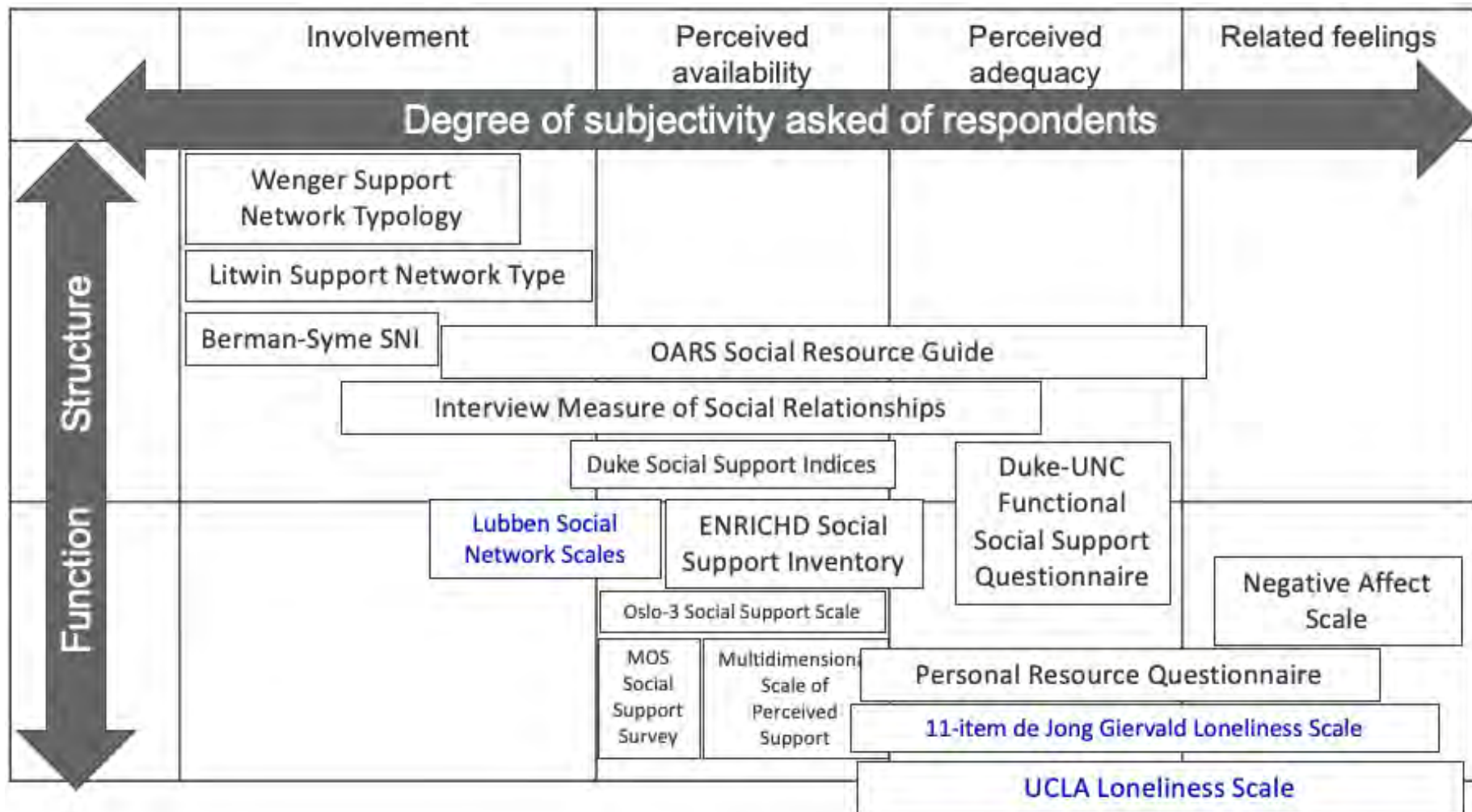
Quality Aspects



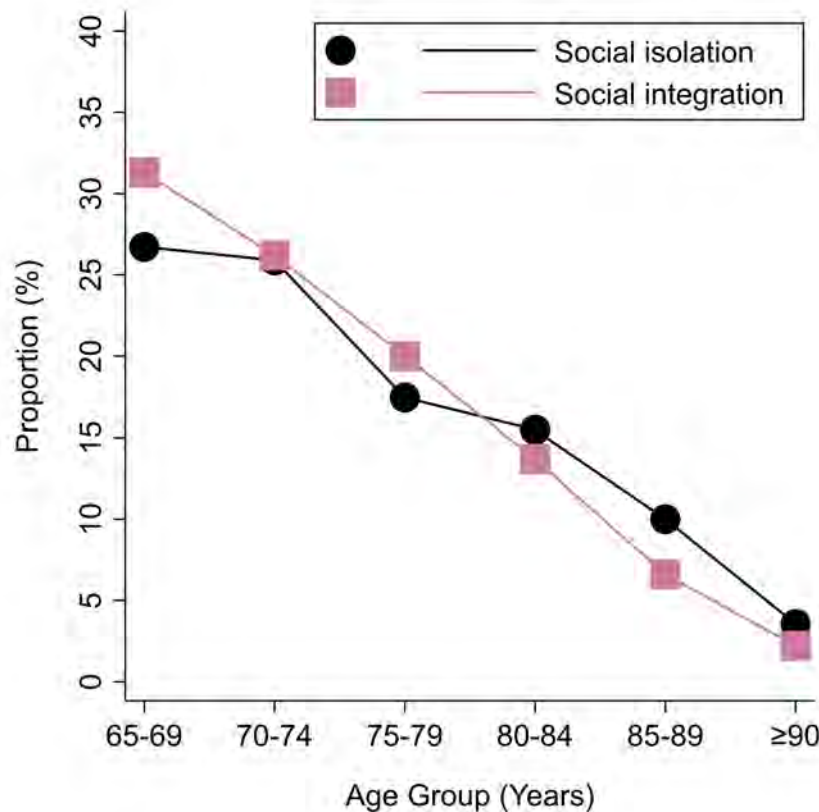
Positive and negative aspects of social relationships

- Marital quality
- Relationship strain
- Social inclusion or exclusion

There Are Many Measures of Social Connection

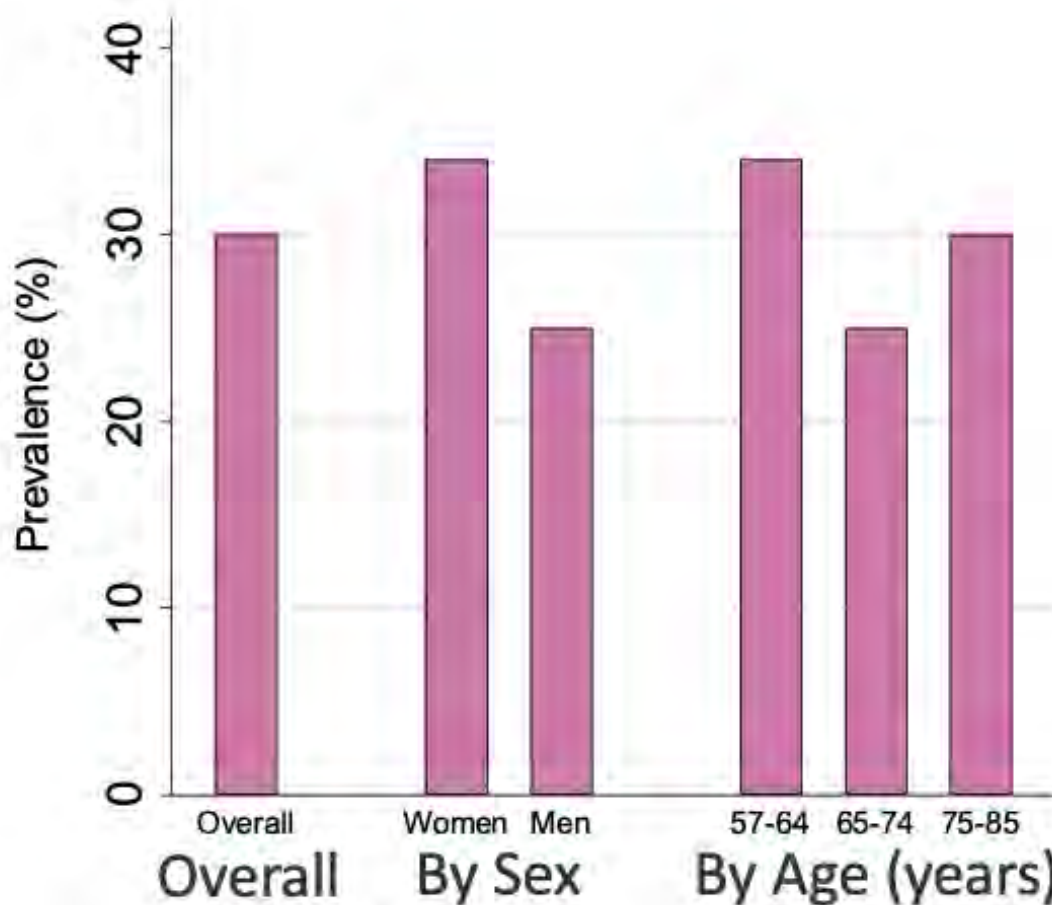


% Affected by Social Isolation



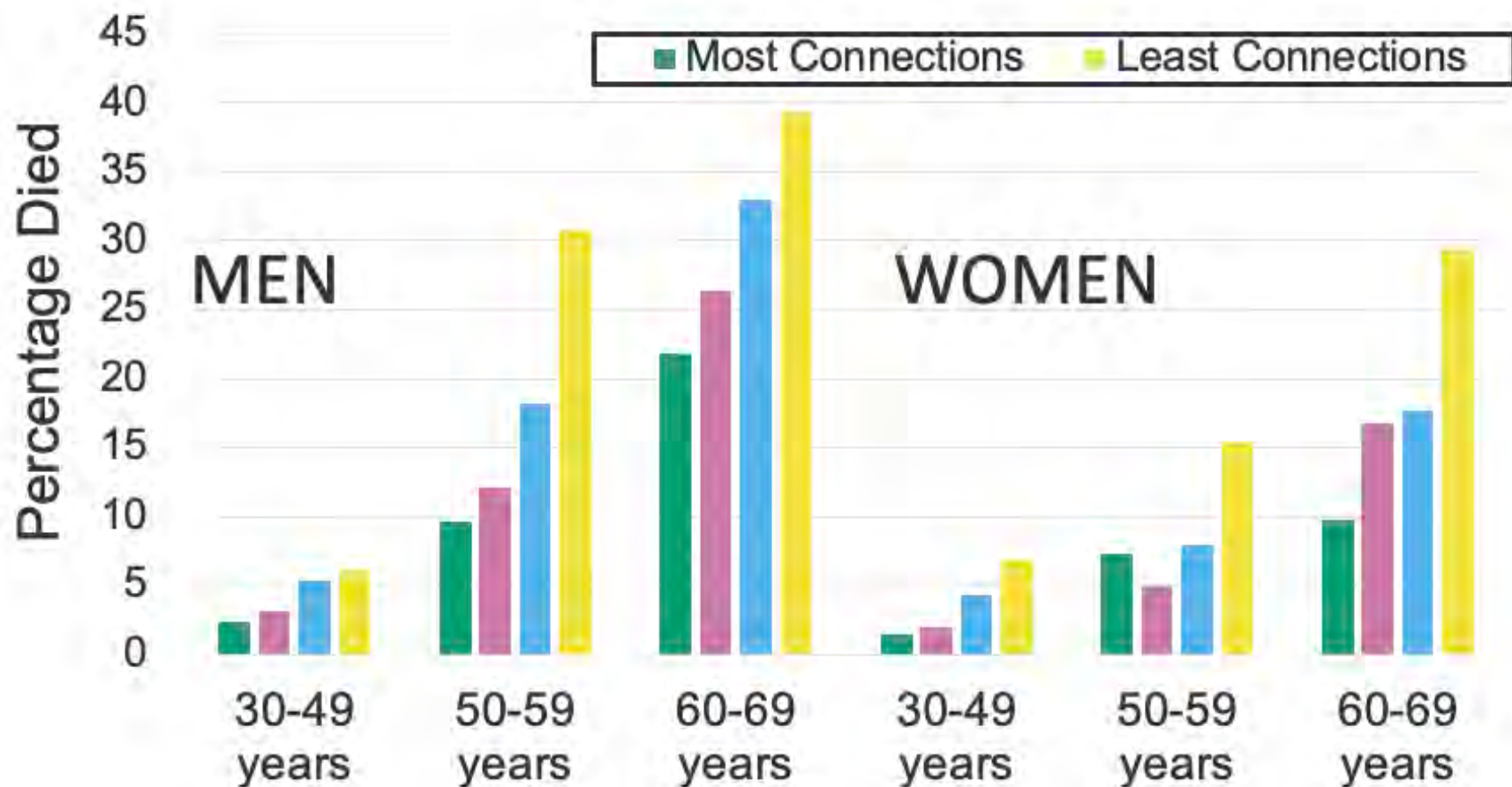
- 1 in 4 US adults aged ≥ 65 years
- 7.7 million

% Affected by Loneliness



- 1 in 3 US adults

Social Networks & Mortality



Social Isolation & Mortality

- Systematic review & meta-analysis
- 148 prospective studies (mean follow-up 7.5 years)
- 308,849 participants
- 50% increased survival for stronger (vs. weaker) social connections (95% CI: 1.42-1.59)

Loneliness & Mortality

- Systematic review & meta-analysis
- 35 prospective studies (mean follow-up 13 years)
- 77,200 participants
- Loneliness associated with 22% increased risk of all-cause mortality (95% CI:1.10, 1.35)

Social Connection & Mortality

- *“[S]ocial relationships, or the relative lack thereof, constitute a major risk factor for health—rivaling the effect of well-established health risk factors such as cigarette smoking, blood pressure, blood lipids, obesity, and physical activity.”*

Social Connection & Dementia

- The Lancet Commission on Dementia Prevention, Intervention and Care determined the global risk of dementia associated with a number of modifiable risk factors:
 - Hearing loss – 9%
 - Less education – 8%
 - *APOE* e4 – 7%
 - Smoking – 5%
 - Depression – 4%
 - Physical inactivity – 3%
 - Hypertension – 2%
 - **Social isolation – 2%**
 - Obesity – 1%
 - Diabetes – 1%

Linking Social Isolation/ Loneliness to Outcomes

- Mood disorders (e.g., depression)
- Increased inflammation
 - Increased microglial activity (animal models)
 - Up-regulation of pro-inflammatory genes (human studies)
 - Increased circulating cytokines (human studies)

Cacioppo JT, et al. Psychol Aging. 2010 Jun;25(2):453-63..

Calcia MA, et al. Psychopharmacology (Berl). 2016 May;233(9):1637-50.

Cole SW, et al. Genome Biol. 2007;8(9):R189.

Smith KJ, et al. Neurosci Biobehav Rev. 2020 May;112:519-541.

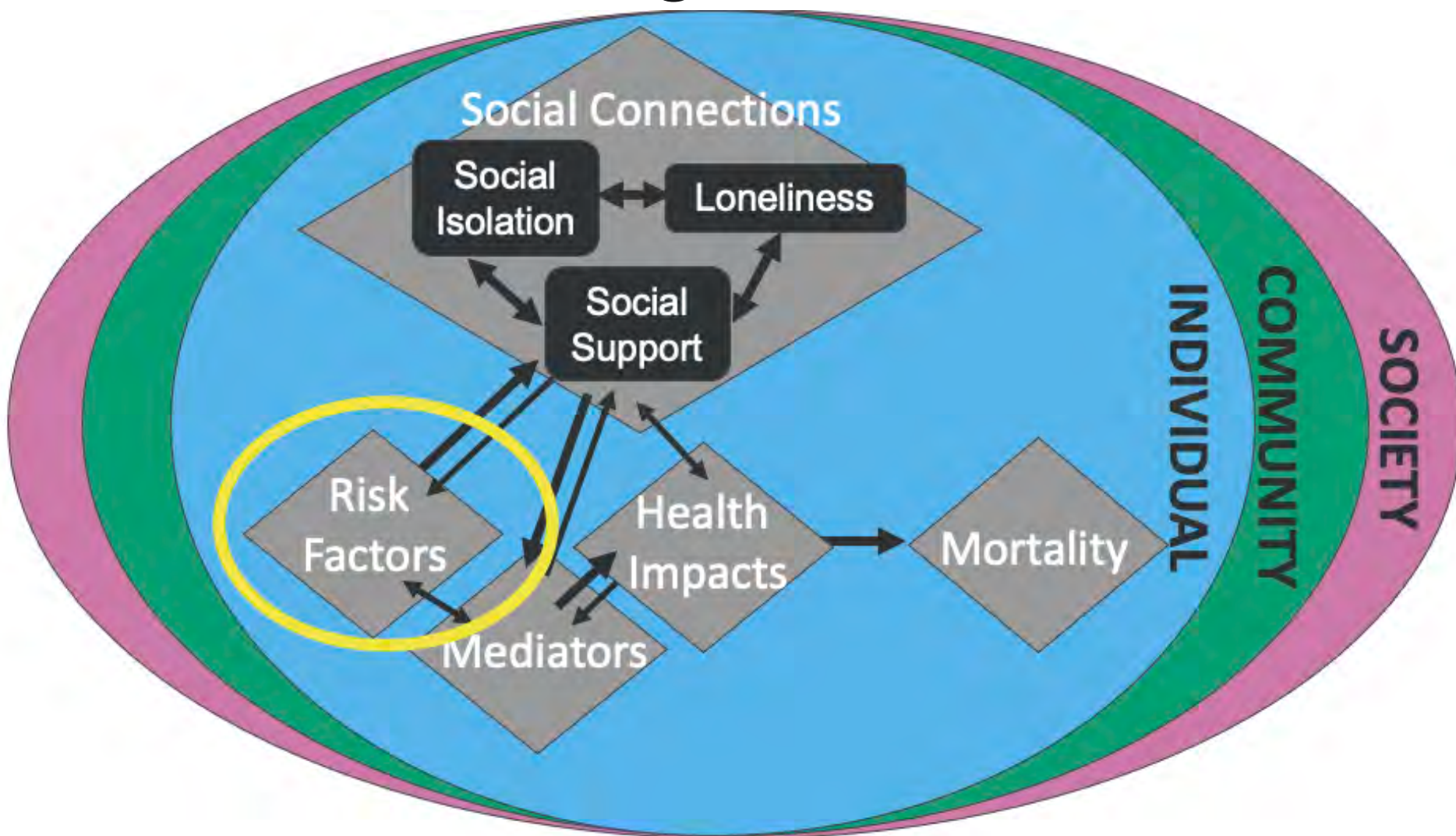
Public Health Significance of Social Isolation & Loneliness

Social Isolation
And Loneliness
In Older Adults

Opportunities for the
Health Care System

- 2020 Consensus Report of the National Academies of Sciences, Engineering and Medicine (NASEM)

NASEM Guiding Framework



Risk Factors for Social Isolation/Loneliness

- Chronic disease
- Disability
- Frailty
- Depression
- Cognitive impairment
- Disruptive life events
- Social factors (e.g., transportation, housing)
- Sensory function

Hearing Loss & Social Connections

- Potential to impact communication, interpersonal relationships

Hearing Loss & Social Connections: Qualitative Studies

“The worse my hearing got, the less sociable I got”

Theme	Key Points
Experience	• Hearing loss can lead people to become disconnected and withdrawn during social events or to cease attending them • Hearing loss can affect social roles and identity; can impede formation and maintenance of relationships
Complexity	• It can be difficult to pinpoint the cause of isolation • Many factors exacerbate or ameliorate isolation
Downstream effects	• Hearing loss & isolation can impair other aspects of well-being, including mental health • Hearing loss & isolation are both stigmatized

Hearing Loss & Social Connections: Quantitative Studies

- Extensive literature showing an association between hearing loss and social connection
- In 356 participants aged 65-95 years from Alameda County Study (59% female), hearing loss associated with 80% increased odds of feeling lonely (95% CI: 0.90-3.58) over 6 years

Epidemiologic Evidence

Hearing Loss, Loneliness, and Social Isolation: A Systematic Review

- 14 population studies
- 3 with audiometry

Study 1 with Audiometry

- 80 male veterans recruited from Veteran's Affairs Medical Center aged 65-88 years
- No control for confounding variables
- Objective isolation correlated with hearing measures (audiometry, hearing handicap, speech detection)

Study 2 with Audiometry

- National Health and Aging Nutrition Examination (population sample)
- Waves 1999-2004 (ages 60-69 years; N=860)
- Waves 2005-2006 (aged 70+ years; N=593)
- Adjusted for demographic and clinical covariates
- Each 25 dB increase in hearing loss associated with 2.14-fold increased odds in 60-69-year-olds (95% CI: 1.29, 3.57)
 - This association in women, but not in men
- No association for adults ≥ 70 years

Study 3 with Audiometry

- National Health and Aging Nutrition Examination (population sample)
- Waves 1999-2004 (ages 60-69 years; N=839)
- Waves 2004-2005 (aged 70+ years; N=465)
- Adjusted for demographic and clinical covariates
- Each 10 dB increase in hearing loss associated with 52% increased odds in 60-69-year-olds (95% CI: 1.19, 1.93)
- No association for adults ≥ 70 years (1.08, 95% CI: 0.77, 1.52)

Impact of Hearing Loss Treatment – 2 Pilot Studies

- Aging and Cognitive Health Evaluation in Elders (ACHIEVE) Pilot Study
- Walk, Talk and Listen Pilot Study

Deal JA, et al. *Alzheimers Dement* (N Y). 2017 Jun 21;3(3):410-415.

Jones CA, et al. *BMJ Open*. 2019 Apr 14;9(4):e026169.

ACHIEVE

- 40 participants aged 70-84 years with mild-to-moderate hearing loss
- Hearing intervention vs. health education control intervention
 - 1:1 stratified randomization by level of hearing loss
- 6-months follow-up

Deal JA, et al. *Alzheimers Dement* (N Y). 2017 Jun 21;3(3):410-415.

ACHIEVE – 6-month Standardized Change

Outcome	Hearing Intervention	Health Education Control Intervention
	Mean (SD); N=20	Mean (SD); N=20
Loneliness*	-0.19 (0.96)	0.22 (0.94)
Social Network**		
Diversity	0.17 (0.65)	-0.42 (0.66)
Number of people	0.15 (1.25)	-0.12 (0.66)

* Measured by UCLA Loneliness Scale; Lower scores are better

**Measured by Luben Social Network Scale; Higher scores are better

†p<0.01

Walk, Talk and Listen

- 10-week, single-masked, randomized study in 58 adults mean with self-reported hearing loss ages 75 years (57% male)
- Intervention: Group exercise + health education vs. Group exercise only
- Outcomes: Loneliness (de Jong) and social support (Medical Outcomes Trial-Social Support Survey)

Walk, Talk and Listen

- Loneliness improved more in the control group
- No differences in social support

Summary – Social Isolation & Loneliness:

- Are common – 25%-30% of older adults
- Are associated with adverse outcomes (mortality, dementia, mood disorders)
- Evidence base for hearing loss as a risk factor is large, but study quality varies
- Impact of treatment (at population level) is unknown

Hearing Loss & Mood Disorders



Depression

- ≥ 5 symptoms during the same 2-week period. At least one of the symptoms should be either depressed mood or loss of interest or pleasure.
 - Depressed mood
 - Diminished interest or pleasure in all, or almost all, activities
 - Significant weight loss, weight gain, or decrease or increase in appetite
 - Slowing down of thought, reduction of physical movement
 - Fatigue or loss of energy
 - Feelings of worthlessness or excessive or inappropriate guilt
 - Diminished ability to think or concentrate, indecisiveness
 - Recurrent thoughts of death, suicidal ideation, or a suicide attempt

Late-life Depression

- Prevalence is high among older adults (10%)
- Prevalence is nearly twice as high among older adults with hearing loss (19%)

Cao C, et al. J Affect Disord. 2020 May 15;269:51-57.

Gopinath B, et al. J Am Geriatr Soc. 2009 Jul;57(7):1306-8.

Linking Hearing Loss to Late-life Depression

Sensation and Psychiatry: Linking Age-Related Hearing Loss to Late-Life Depression and Cognitive Decline

Aging Processes

- Changes in the Ear (e.g., hair cells, stria vascularis atrophy)
- Decreased activation of thalamus & auditory cortices

Neural Mediators

- Compensatory recruitment to support effortful listening
- **Dysfunctional auditory-limbic connectivity**
- **Atrophy of primary auditory cortex**

Behavioral Outputs

- **Cognitive decline/ Executive dysfunction**
- Dysfunctional emotion regulation
- Altered emotion reactivity & hedonic experience

Epidemiologic Evidence: Depression

Hearing Loss and Depression in Older Adults: A Systematic Review and Meta-analysis

- 35 studies; 147,148 participants
- 39% increased odds (95% CI: 1.16-1.67) in 11 prospective studies
- Of those 11 studies, 1 used audiometry

Study with Audiometry

- 1,611 adults aged (51% men) in the Australian Longitudinal Study of Aging with up to 5 visits over 16 years
- Adjusted for demographic and clinical covariates
- Faster rates of increase in depressive symptoms after hearing loss
- Results explained by changes in social engagement

Epidemiologic Evidence: Anxiety

Prevalence of anxiety disorders and symptoms in people with hearing impairment: a systematic review

- 25 studies; 17,135 participants
- 9 studies in community samples
- Of those, 5 compared hearing loss to normal hearing
- Of those, 1 cohort design (retrospective)

Cohort Study

- Longitudinal Health Insurance Database of 2000 (Taiwan)
- 25,215 participants aged 20+ years
- Hearing loss identified using claims data
- Hearing loss associated with 2.4-fold risk over 12 years
- Adjusted for demographic and clinical covariates

Impact of Hearing Loss Treatment – Study 1

- 194 veterans from primary care clinics at Veteran's Affairs hospital
- Hearing aids or waitlist
- Depression improved in hearing aid users over 4-month follow-up

Quality of Life Changes
and Hearing Impairment
A Randomized Trial

Impact of Hearing Loss Treatment – Study 2

Hearing Rehabilitative Treatment for Older Adults with Comorbid Hearing Loss and Depression: Effects on Depressive Symptoms and Executive Function

- 25 participants ≥ 60 years of with major depressive disorder and moderate to profound hearing loss
- Hearing aids or sham
- No impact on depressive symptoms after 12 weeks

Impact of Hearing Loss Treatment – Study 3

Age-related hearing loss, depression and auditory amplification: a randomized clinical trial

- N=61 patients aged ≥ 65 years with moderate hearing loss from ENT at a tertiary hospital
- Randomized 1:1 to hearing aids or control
- Hearing aids improved depressive symptoms over 4 weeks

Summary – Depressive Symptoms:

- Are common – 10% of older adults
- Related to social isolation/loneliness
- Evidence base for hearing loss as a risk factor is large, but study quality varies
- Impact of treatment (at population level) is unknown

Concluding Thoughts



Hearing & Social Connection and Mood Disorders

- Big picture: population-based studies suggest an association but are of varying quality (more work to do!)

Hearing & Social Connection and Mood Disorders

- **Unanswered Questions:** Does hearing treatment improve loneliness, depression in the general population?
- Clinically, patients may seek hearing treatment because they feel isolated/lonely or depressed
- But not everyone with hearing loss feels isolated/lonely or depressed

Interpreting Population-Level Studies for Patients

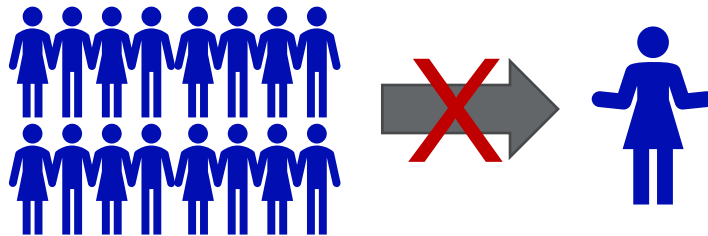
- We presented results of a systematic review showing that hearing loss is associated with a ~1.4x increased estimated risk of depression
- An 80-year old patient with hearing loss asks you what is risk of depression is
- How do you respond?

How Do You Respond?

- Compared to someone who has normal hearing, your risk of getting depression is 50% higher
- Compared to a group of people who had normal hearing, risk was 50% greater in participants with hearing loss, but your individual risk may be lower or higher

Interpreting Population-Level Studies for Patients

- We cannot determine individual risk from epidemiologic studies, which are, by nature, an average across the population



- An individual's risk of developing dementia is 0 or 1. They will get it or not

Interventions for Social Isolation/Loneliness

- Generally successful, but effect size & evidence base is weak
 - **Social facilitation/befriending interventions:** interest groups/clubs, friendship groups
 - **Psychological therapies:** mindfulness, reminiscence therapy, clinically administered
 - **Health and social care provision:** administered by health professionals in formal care settings
 - **Animal interventions:** dogs, cats, robotic pets
 - **Leisure/skill development interventions:** gardening programs, volunteer
- Do not include hearing!

Thank you!
Questions?

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