Dr. Tom Martin Legacy Lecture

Aging With Brain Injury

Terrie Price, PhD, ABPP
Ability KC
October 1, 2020
Normal Changes with Aging
A review – Harada et al 2013

• Crystalized abilities such as vocabulary and general knowledge are resilient to brain aging and may improve with age. In sixth and seventh decade

• Crystalized skills are overlearned through decades of life

• Fluid abilities are innate abilities to process and learn new information, problem solve, attend and manipulate one’s environments.
• Processing speed, memory, executive functions, and psychomotor ability
• Processing speed and psychomotor abilities peak in the third decade of life
Normal Changes with Aging
A review – Harada et al 2013

• Language-
  – Vocabulary stable and can improve over time
  – Verbal confrontational naming until 7th decade
  – Verbal fluency declines

• Visuospatial /Construction-
  – Ability to see and understand space in 2 & 3 dimensions
  – Ability to put together parts to make a whole—declines
  – Object perception, ability to recognize common objects, and faces, ability to recognize physical location and in relation to others—remains intact

• Processing Speed—speed of cognitive and motor responses
  – Starts to decline after 3rd decade
  – Accounts for many cognitive changes with aging on speeded tests

• Attention—Ability to focus and concentrate
  – Increased challenge on selective and divided attention tasks, working memory
Normal Changes with Aging
A review – Harada et al 2013

• Memory
  – Impacted by slowed processing speed, difficulty with selective attention and difficulty using strategies to improve memory
  – Declarative (explicit) Memory: Conscious recall of events and facts
    • Semantic – language use, knowing the meaning of words
    • Late life decline
  – Episodic (autobiographical) Memory: recall of events that occurred on a specific date and time (memory of stories,
    • Life long decline

• Nondeclarative (Implicit) Memory: Outside of awareness
  – Such as remembering a familiar song
  – Procedural Memory- how to tie a shoe, ride a bike
• Remains unchanged across life span
• Acquisition-encoding- declines across life span
• Information previously learned is likely preserved
• Decline in retrieval or access to nearly learned memories
Normal Changes with Aging
A review – Harada et al 2013

• Executive Functions
  – “Executive functioning refers to capacities that allow a person to
    successfully engage in independent, appropriate, purposive, and self-
    serving behavior. This includes a wide range of cognitive abilities such as
    the ability to self-monitor, plan, organize, reason, be mentally flexible, and
    problem-solve.” (page 5)
  – Mental flexibility, abstraction, concept formation declines, especially
    after age 70
  – Decrease in response inhibition - give automatic response versus novel
    response
  – Decrease in speeded executive functioning tasks
  – Decrease in inductive reasoning starting in mid 4th decade
  – Defining proverbs, appreciate similarities, reason about familiar things
    stays stable

Structural Brain Changes

• Grey matter decline onset after 20’s, especially prefrontal
• More moderate decline in temporal lobes and involve decreased
  in hippocampal region
• Decrease in synaptic density - “decrease in the complexity of
  dendrite arborization, decreased dendrite length, and decreased
  neuritic spines”
• Greater decrease in white matter. (16-20% after age 70)
• Madden et al showed that loss of integrity of the central portion of
  the corpus callosum may mediate age-related cognitive decline
• Beta-amyloid accumulation implicated in development of delcine
Normal Aging

• Able to carry out regular, familiar daily activities
• Normal aging can result in subtle difficulty with complex functional tasks such as driving
• Driving safety impacted by visual attention and processing speed- Formal driving evaluation is the gold standard to assess driving safety
• Enhancing cognitive health- Intellectual stimulation, social engagement and exercise
• Cognitive Reserve

• Studies suggest 60% of general cognitive ability can be attributed to genetics
• Factors that accelerate decline include medical illness, psychological factors, and sensory deficits (vision and hearing impairment)
• Support for the benefit of active lifestyle and engaging in intellectually stimulating activities moderates decline
Juxtapose with Cognitive Changes with TBI

- Moderate to severe brain injury often results in diffuse axonal injury and differential injury to the frontal and temporal lobes-
- Memory
- Executive functions
- Processing Speed

TBI in Older Adults (≥65)

↑ Mortality and Morbidity

Comorbidities
- 38% Hypertension
- 18% Cardiac Arrhythmias
- 17% Fluid Electrolyte Disorders
- 13% other Neurological Disorders

Kumar et al (2018)
Link between TBI and Dementia  
A review: Barr (2020)

- Research on the whole identifies a general link between TBI and dementia but specifics of the link and underlying neurobiological processes poorly defined

- Methodological issues: retrospective review, variable classification of TBI and Dementia and inability to rule out confounding effects

- No conclusive or consistent findings linking a specific form of TBI and a specific type of dementia, what genetic or medical vulnerabilities might exist, when signs of dementia might appear

“As a result, from a forensic perspective, there is insufficient scientific evidence to establish a causal relationship between a TBI occurring early in life and subsequent development of any form of dementia with any acceptable level of scientific certainty.”

Although studies on the effects of repetitive brain injury and development of CTE in professional athletes have captured the public’s attention, the scientific study on this topic remains in its infancy, making it premature to base any legal decisions or changes in public policy on any definitive links between participation in contact sports and development of dementia later in life.
Link between TBI and Dementia
LoBue & Cullum (2019)

• TBI appears linked to earlier onset (ave=2-3 years) of dementia later in life in some who develop neurodegenerative condition
  – Role of genetic predisposition; other risk factors?
• Some TBI patients (severe) may be associated with greater neuropathological changes. Provides support for this phenomenon, providing a theoretical substrate as to how an earlier onset of clinical symptoms might occur.

Link between TBI and Dementia
LoBue & Cullum (2019)

• “Although TBI would appear capable of accelerating the onset of dementia later in life, the claims about TBI leading to progressive cognitive deterioration later in life, which has become entrenched in the public’s perception, has not been proven or well supported.”
• Other CNS risk factors for dementia
  – Stroke and cardiovascular conditions (HTN, High cholesterol, DM)
NIH National Institute of Aging (7/2020)

- Super agers: people age 80 years and older who have performance on memory tests comparable to people two to three decades younger.
- Thicker cingulate cortex than same-age peers
- No atrophy compared with the same brain region of the middle agers.
- Bigger hippocampus than other adults their age
Superagers

• Potential links
  – advanced education
  – mind-challenging occupations
  – genes that might support strong neural networks and offer protection against mental and physical decline
  – Strong social network

"Those who think they have no time for bodily exercise will sooner or later have to find time for illness." Edward Stanley (1826-1893)
It’s a lot to digest

Preparing for the Future

• Heart health is brain health!
  – High blood pressure
  – High cholesterol
  – Diabetes

• EXERCISE! EXERCISE!! EXERCISE!!!

• Keeping your brain engaged!
• Social Engagement
References


