Exercise and Brain Health
Centre for Healthy Brain Ageing (CHeBA)
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Exercise and Brain Health

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The mission of medicine is the assertion and the assurance of the human potential.

Walter Bortz, MD
Brawn Vs. Brains

The eternal fight between meatheads and nerds, but a victor must be choosen.
Questions

• Does exercise prevent dementia?
• Does exercise improve cognition and brain health?
• How does exercise work?
• What kind of exercise is best?
Higher Hippocampal volume associated with higher aerobic fitness in older adults.

Figure 8. Greater mean hippocampus volume (across left and right hemispheres) is associated with higher cardiorespiratory fitness levels as quantified by VO$_2$ peak, the gold standard measure of aerobic fitness, in 165 older adults without dementia (data adapted from Erickson and others 2009).
Weakest women had worst memory
Higher Muscle Strength Related to Cognition in Rush Aging Study

- Lower risk AD
- Slower rate of decline

**Figure 1.**
Cumulative hazard of developing AD for participants with low (10th percentile, dotted line) versus high muscle strength (90th percentile, solid line).

**Figure 2.**
Decline in global cognitive function for participants with low (10th percentile, dotted line) versus high muscle strength (90th percentile, solid line).
Higher brain size related to larger lean body mass
Relationship between fitness and cognitive function

- Higher cardiovascular fitness related to greater brain volume/activation and decreased risk of dementia
- Higher muscle mass related to greater brain volume in healthy elderly and AD
- Low muscle strength linked to rate of cognitive impairment and risk of dementia
- Mechanisms unclear
Exercise addresses risk factors for cognitive decline and dementia.
What kind of exercise is best for your brain?

Memory improved with weight lifting but not aerobic exercise or stretching control.

EXCEL TRIAL  86 women, Mean age 75
Mild Cognitive Impairment at baseline
6 mo exercise, 2x/wk
Average magnitude of improvement in cognitive function across all types of cognitive tasks based on results of randomized trials involving aerobic exercise training alone (average of 52 effect sizes) and exercise training that combined both aerobic and strength training (average of 49 effect sizes). Adapted from Colcombe and Kramer.\textsuperscript{85}

Both physical training types enhanced executive function and functional mobility. The findings also support the emerging indication that PRT positively influences executive functions, challenging the traditional view that aerobic training is necessary to obtain cognitive benefits.
Study of Mental Activity and Regular Training (SMART) in at risk individuals: A randomised double blind, sham controlled, longitudinal trial

Nicola J Gates¹, Michael Valenzuela¹,²,³, Perminder S Sachdev¹,²,⁴, Nalin A Singh⁵,⁶, Bernhard T Baune⁷, Henry Brodaty¹,²,⁸, Chao Suo¹, Nidhi Jain⁹, Guy C Wilson⁹, Yi Wang⁹, Michael K Baker⁹, Dominique Williamson⁹, Nasim Foroughi⁹ and Maria A Fiatarone Singh⁹,¹⁰
Would the combination of cognitive training and weight lifting improve brain health and function in those with mild memory impairment?
Isolated PRT superior to combined PRT and Cognitive Training for Executive and Global Cognitive Function over 18 mo in MCI.
- PRT increased cortical thickness
- Increased brain size related to improvement in overall cognition

Suo. C, in press 2015
Physically demanding novelty interventions. Dancing, Tai Chi, cybercycling, and theater arts depict examples of this combined physical cognitive approach. In contrast to traditional novelty interventions, they include physical demands in addition to highly variable, novel tasks and thus enhance the transfer to unspecific cognitive based abilities.
Modality of Exercise for Brain Health

• Aerobic exercise/physical activity/play
• Resistance exercise
• Cognitively complex exercise?
  – Tai Chi
  – Balance/coordination
  – Biofeedback
  – Dual tasking
  – Games of skill (tennis, WiiFitness, etc)?
Some exercise types not shown to improve cognition

- Stretching/Flexibility in isolation
- Seated calisthenics
- Toning/range of motion
- Gentle exercise class
- Balance exercises alone
- Low intensity aerobic exercise/walking
- Low intensity weight lifting exercise
Dose of Exercise for Brain Health

- **Frequency**
  - 3-7 days/wk aerobic
  - 2-3 d/week resistance training

- **Volume**
  - 45-60 min/session
  - Sufficient to reduce body fat/metabolic health if that is a goal

- **Intensity**
  - Fitness outcomes proportional to intensity
  - Fitness outcomes proportional to brain/cognitive changes
  - Therefore, highest intensity feasible in given cohort
Resistance training in supervised settings for frail or cognitively impaired
Adaptation occurs in response to a challenging or novel exposure
Keep in mind individual preferences, health conditions, and need for lifelong participation.
Summary

• Observational evidence of direct relationships between aerobic fitness, muscle mass, muscle strength, participation in aerobic and strength training exercise and better cognitive function/reduced risk of dementia

• Beneficial effects of aerobic exercise and weight lifting on risk factors for cognitive decline

• Overall moderate benefit of exercise on cognition in healthy older adults, MCI, dementia, older adults with frailty

• Improvement in brain size after exercise in healthy older adults and those with mild cognitive impairment
Where do we go from here?
Exercise and Cognition: Future Directions

- Clinical relevance of changes
- Prevention of incident dementia
- Mechanisms of benefit
- Dose-response studies
- More direct comparisons of exercise modalities
- Identification of genetic and other predictors of adaptation
The future may be in your hands…