Physical Exercise & Cognitive Health

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Cognitive Aging: Much Variability Observed

McArdle, Advances in Statistical Analysis, 2011
What Contributes to Variability?

- Environment
  - Education/Intellectual Engagement
  - Social Network
  - Physical Activity
  - Nutrition
  - Sleep

Cognitive Reserve or “Resilience” (Yaakov Stern)
GCBH experts agree that brain health is positively affected by physical activity. **Purposeful exercise** is proven to benefit brain structure and functioning, while an **active lifestyle** is proven to lower risk of cognitive decline.
Physical Activity for Brain Health

• “Cohort”
  ▪ No prescribed treatment/intervention
  ▪ Physical activity level
    ▪ Questionnaires
    ▪ Accelerometry data

• “Randomized Trials” (RCT)
  ▪ Treatments/interventions are randomly prescribed
  ▪ Purposeful exercise

Baseline Measurement → Randomization → Follow-Up Measurement

- Aerobic Training
  - Follow-Up Measurement

- Resistance Training
  - Follow-Up Measurement

- Sham Exercise
  - Follow-Up Measurement
Active Lifestyle & Dementia Risk

Larson et al., Annals of Internal Medicine, 2006
Physical Activity for Brain Health

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Diagram:
- Baseline Measurement
- Randomization
- Aerobic Training
  - Follow-Up Measurement
- Resistance Training
  - Follow-Up Measurement
- Sham Exercise
  - Follow-Up Measurement
Exercise is Medicine

- Exercise
  - Subcategory of PA

- Types of Exercise
  - Aerobic Training
  - Resistance Training
  - Anaerobic Training
  - Balance/Agility Training
  - Others: Yoga, Tai Chi, dance
  - Multimodal
Aerobic Training Improves Executive Functions and Associated Functional Plasticity

- A 6-month, 3x/week (moderate-intensity) walking program improved:
  - Selective attention and response inhibition (Ericksen Flanker Task)
    » Colcombe *et al.*, PNAS, 2004
  - Functional plasticity associated with Flanker Task performance
  - Neural efficiency
Aerobic Training Improves Memory and Increases Hippocampal Volume

• A 12-month, 3x/week (moderate-intensity) walking program improved/increased:
  – Cognitive performance of spatial memory
  – Hippocampus volume by 2%
  • Reversing age-related loss in volume by 1-2 years
    » Erickson et al., PNAS, 2011
Aerobic Training and Mild VCI*

- A 6-month, 3x/week (moderate-intensity) walking program improved/increased:
  - Cognitive performance
  - Neural efficiency (task-based fMRI)
    » Liu-Ambrose et al., Neurology, 2016
    » Hsu et al., BJSM, 2017

* VCI = Vascular Cognitive Impairment
- Neuroimaging evidence of cerebral small vessel disease
- MoCA < 26/30
- No impairment in iADLs
Aerobic Training may be Particularly Beneficial for Females

Barha et al., JAD, 2017
What about resistance training?
Lifting Weights is a Good Option!

Liu-Ambrose et al., 2010 & 2011
Nagamatsu et al., 2012 & 2013
Bolandzadeh et al., 2015
Resistance Training for Brain Health

- Women aged 65 to 75 years
- Otherwise healthy & community-dwelling

» Liu-Ambrose et al., 2010 & 2011
Resistance Training Improves Executive Functions and Functional Plasticity

- Lifting weights 1x/week or 2x/week significantly improved executive functions.
- Lifting weights 2x/week induced functional plasticity during the Flanker task.
Resistance Training Moderated Disease Progression

Risk factors
- Age
- Hypertension
- Diabetes
- Dyslipidemia

Small Vessel Disease
White Matter Lesions
Lacunes


These “silent” lesions are associated with increased risk of stroke, slow gait, falls, and dementia.
Lifting weights 2x/week significantly reduced progression of white matter lesions.

» Bolandzadeh et al., JAGS, 2015
“I’ve been working out for six months, but all my gains have been in cognitive function.”
Cognition and Mobility

Exercise

Mobility (Falls) ↔ Cognition
Primary Aim: To assess the efficacy of exercise as a secondary falls prevention strategy.

- Aged 70 years and older
- Presented to a health care provider (ED or GP) due to a fall

- Liu-Ambrose et al., JAMA, 2019
- Liu-Ambrose et al., JAGS, 2008
Otago Exercise Program (OEP)

• Home-based, delivered by PT
  – Strength and balance retraining (3x/week)
  – Walking (2x/week)

  » Campbell et al., BMJ, 1997 & 1999
Underlying Mechanism: Improved Cognitive Function?
Conclusions & Considerations

• Sufficient evidence for exercise to be included in practice guideline on mild cognitive impairment
Conclusions & Considerations

- Multimodal training likely provides the most benefit
Conclusions & Considerations

• Physical activity is a legitimate medical therapy for promoting cognitive health
  – Degree of benefit equal or exceeds that of pharmaceutical agents
  – Minimal adverse effects

• Reducing physical inactivity by 25% could prevent one million cases of dementia worldwide

» Barnes and Yaffe, Lancet Neurol, 2011
Sedentary Behaviour

Limiting our daily sitting/lying to just 23.5 hours: too ambitious?

Karim Khan
CLSA Project

Cognitive Function

Sleep

Sedentary Behaviour

Physical Activity
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