We Can Grow New Neurons and Rewire Our Brain At Any Age:

A Case Study in Elderly with MCI

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Neuroplasticity in the Human Brain: Translational Research

Modifiable factors that alter the size of the hippocampus with ageing

Majid Fotuhi, David Do and Clifford Jack

Abstract | The hippocampus is particularly vulnerable to the neurotoxic effects of obesity, diabetes mellitus, hypertension, hypoxic brain injury, obstructive sleep apnoea, bipolar disorder, clinical depression and head trauma. Patients with these conditions often have smaller hippocampi and experience a greater degree of cognitive decline than individuals without these comorbidities. Moreover, hippocampal atrophy is an established indicator for conversion from the normal ageing process to developing mild cognitive impairment and dementia. As such, an important aim is to ascertain which modifiable factors can have a positive effect on the size of the hippocampus throughout life. Observational studies and preliminary clinical trials have raised the possibility that physical exercise, cognitive stimulation and treatment of general medical conditions can reverse age-related atrophy in the hippocampus, or even expand its size. An emerging concept—the dynamic polygon hypothesis—suggests that treatment of modifiable risk factors can increase the volume or prevent atrophy of the hippocampus. According to this hypothesis, a multidisciplinary approach, which involves strategies to both reduce neurotoxicity and increase neurogenesis, is likely to be successful in delaying the onset of cognitive impairment with ageing. Further research on the constellation of interventions that could be most effective is needed before recommendations can be made for implementing preventive and therapeutic strategies.


Changing perspectives regarding late-life dementia

Majid Fotuhi, Vladimir Hachinski and Peter J. Whitehouse

Abstract | Individuals over 80 years of age represent the most rapidly growing segment of the population, and late-life dementia has become a major public health concern worldwide. Development of effective preventive and treatment strategies for late-life dementia relies on a deep understanding of all the processes involved. In the centuries since the Greek philosopher Pythagoras described the irrevocable loss of higher cognitive functions with advanced age, various theories regarding the potential culprits have dominated the field, ranging from demyelination, through “hardening of blood vessels”, to Alzheimer disease (AD). Recent studies suggest that atrophy in the cortex and hippocampus—now considered to be the best determinant of cognitive decline with aging—results from a combination of AD pathology, inflammation, Lewy bodies, and vascular lesions. A specific constellation of genetic and environmental factors (including apolipoprotein E genotype, obesity, diabetes, hypertension, head trauma, systemic illnesses, and obstructive sleep apnoea) contributes to late-life brain atrophy and dementia in each individual. Only a small percentage of people beyond the age of 80 years have “pure AD” or “pure vascular dementia”. These concepts, formulated as the dynamic polygon hypothesis, have major implications for clinical trials, as any given drug might not be ideal for all elderly people with dementia.

Objectives

- What happens to our brain with aging?
- Can we reverse age-related brain atrophy?
- Brain Fitness Program
Short-term: Hippocampus
Long-term: Cortex
Hippocampus
Neurons in Hippocampus
With Aging, Hippocampus Atrophies Faster than the Rest of the Brain

- Hippocampus shrinks by about 0.5% per year after age 40.
- That is the reason memory lapses become more frequent after age 40.
What Causes Atrophy in Hippocampus?

- Insomnia
- Sleep Apnea
- Obesity
- Smoking
- Diabetes
- Concussion
- Alzheimer’s
- Stress
- Depression
More Depression, Obesity, Stress, and Insomnia, Smaller Hippocampus

Depression¹

Obesity²

Cortisol / Stress³

Insomnia⁴

2- Brain Research, 2009, Pages 186–194
4- Ho et al; J Clin Neurol. 2012 Jun;8(2):130-8
More Traumatic Brain Injury (TBI), Smaller Hippocampus
Multiple Risk Factors, Much Smaller Hippocampus
Objectives

- What happens to our brain with aging?
- Can we reverse age-related brain atrophy?
- Brain Fitness Program
More Walking, Bigger Hippocampus

Erikson, PNAS 2011
More Exercise, Bigger Hippocampus, Even After 3 Months

Before

After

Arch Gen Psychiatry, 2010
More Omega-3 Fatty Acids, Bigger Hippocampus
More Omega-3 Fatty Acids, Bigger Hippocampus

More Learning, Bigger Hippocampus

Draganski et al. J Neurosci 2006; 26:6314–7
Neurofeedback

- Performed by a certified EEG neurofeedback specialist
- Live EEG feedback is provided through auditory and visual responses to help the patient move brain activity towards an optimal state
- Benefits are long-lasting
More Neuro-feedback, Bigger Cortex

Ghaziri et al. Clin EEG Neurosci 2013; 44 (4) 265-72
Better Sleep, Bigger Hippocampus

Grey-Matter increase in post-treatment OSA

Canesa, American Journal of Respiratory Medicine, 2011
Better Peace of Mind, Bigger Hippocampus

Holzel, Psychiatric Research, 2011
Hippocampus Grows Bigger
When You Start Early
Objectives

- What happens to our brain with aging?
- Can we reverse age-related brain atrophy?
- Brain Fitness Program
Brain Fitness Program: Overview

- Initial appointment with neurologist
- Diagnostics
- Brain Fitness Program: Level 1, Level 2, Level 3
- Follow-Up
Brain Fitness Program: Initial Exam

Conditions that impact brain function:

- Depression, Anxiety, ADHD
- Smoking
- Gum disease
- Thyroid problems
- Lung disease
- Liver damage
- Back pain
- Sexual dysfunction and menopause
- Insomnia
- Vision problems
- Snoring
- Hearing loss
- Allergies
- Medications
- Heart disease
- Vitamin D deficiency
- Urinary frequency
- Edema
- Numbness
Brain Fitness Program: Comprehensive Diagnostic Tests

- Cardiopulmonary Testing
- Brain MRI
- Neurocognitive Evaluation
- Carotid Ultrasound
- Brain Mapping qEEG
- Blood Test
- Sleep Health Assessment
Brain Fitness Program: A Personalized Set of Interventions

Brain Coaching and Counseling

Cognitive Skills Training

Neurofeedback Training

Weekly Monitoring
Brain Fitness Program:
One example: 69 year old with Alzheimer’s
Brain Fitness Program: Statistical Analysis of 127 Patients with MCI

≥3 areas of cognitive function Improved, p<0.05

84%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

Low or No Impact
Moderate Impact
High Impact

7% 9%
MRI Results

Before

After

HC

2.86 cm³

HC

3.14 cm³
Significant increases in the volume of hippocampus in 2/3 of patients
Sustained Benefits

Hippocampus Volume (cm³)

- Baseline: 7.29
- 3 Months: 7.92
- 1 Year: 7.94

8.6% increase in HC volume
Diabetes
Hypertension
Obesity
Sleep Apnea
Head Trauma
Genes
Stress

Brain-healthy Diet
Physical Fitness
Cognitive Stimulation
Brain Fitness Program
THANK YOU!

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