

EXERCISE:

**If it is good for the heart,
it is good for the BRAIN**

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**10 slides are shown
of 42 slides**

Presentation's Outlines

- Basic **definition & concepts** of physical activity
- Major **physiologic** responses to exercise (brief)
- Benefits of Physical Activity to the **BRAIN**
- **Neuroplasticity & exercise**
- **Hippocampus & the Prefrontal Cortex & exercise**
- **Cognitive function, learning & exercise**
- Exercise prescription for **brain health**

What do heart and brain have in common?

Aside from the specialized neurons in the heart that are part of the autonomic system (ganglia or clusters of neurons) network.

Both the heart and the brain rely on healthy blood vessels to supply them with oxygen and nutrients.

Exercise **improves** blood vessels and **augment** blood flow to both the heart and the brain.

**Inactivity can damage blood vessels in the HEART.
It can also damage micro-vessels in the BRAIN.**

Benefits of Physical Activity to the Brain (2)

- ❖ It increases cerebral blood volume.
- ❖ Leads to an enhancement of neural connectivity to hippocampus & hippocampal perfusion.
- ❖ Modulates the major CNS neurotransmitters (dopamine, norepinephrine, serotonin (improve sleep) & Beta endorphin), the later promotes a sense of euphoria and well-being & decreased sensitivity to pain.
- ❖ Exercise increase the expression levels of brain-derived neurotrophic factor (BDNF), insulin-like growth factor (IGF-1), vascular endothelial growth factor (VEGF) & other trophic factors, thus promoting neurogenesis, angiogenesis & synaptogenesis.

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Olver TD, et al. Exerc Sport Sci Rev. 2019; 47: 66-74.

Exercise training increases size of hippocampus and improves memory

- A randomized controlled trial with 120 older adults
- Moderate-intensity aerobic exercise 3 d/wk for one year
- Control group did stretching and toning exercises

Findings: aerobic exercise training:

- ❖ Enhanced the hippocampal volume by reversing hippocampal volume loss in late adulthood
- ❖ Increased the serum BDNF
- ❖ Increased in the spatial memory function.

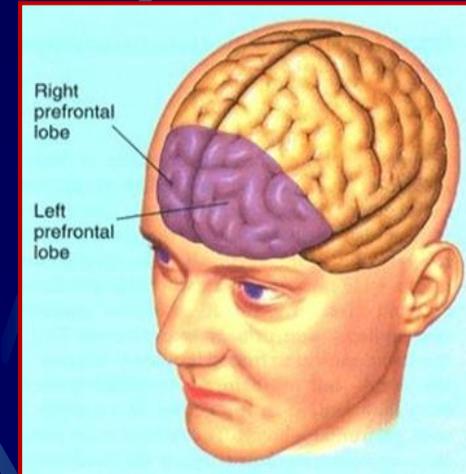
The Association between Aerobic Fitness, Hippocampal Volume, & Memory Performance in Pre-adolescent Children

- ❖ Magnetic resonance imaging was used to investigate whether higher- and lower-fit (9-10-year-old children; n=49) would show differences in hippocampal volume & if the differences were related to performance on relational memory task.
- ❖ Results showed higher-fit children have greater bilateral hippocampal volumes and superior performance in relational memory task compared to lower-fit children (those who were fit and had better memory, also had larger hippocampus size).
- ❖ Furthermore, bilateral hippocampal volume was found to mediate the relationship between fitness level (VO₂ max) and relational memory.

Exercise & Prefrontal Cortex

It plays A Major Role in Executive Function (2)

- ❖ Studies have shown that the parts of the brain that control thinking and memory (the **prefrontal cortex & medial temporal cortex**) have greater volume in people who exercise versus people who don't.
- ❖ Moderate intensity exercise enhances the **prefrontal cortex** activity associated with working memory performance in older adults.



Chang YK, et al. Brain Res. 2012;1453:87-101.

Loprinzi PD, et al. Am J Health Promot. 2018; 32: 691-704.

Moriya M, et al. . Adv Exp Med Biol. 2016; 923:203-208.

Roig M, et al. Exerc Sport Sci Rev. 2016;44(2):81-8.

Tsujii T, et al. Adv Exp Med Biol. 2013; 765: 293-298.

Physical activity improves learning a second language

- 40 Chinese speakers with basic knowledge of English (undergraduate students with high physical fitness level).
- Forty English written words & the corresponding black-and-white pictures were selected from the categories of food, animals, objects, and professions.
- 40 picture-name pairs were presented. Each picture-name pair was displayed for 5 sec.
- Were randomly assigned to 1 of 2 conditions: **simultaneous physical activity during learning** or **conventional learning**.
- PA group were asked to ride a bicycle ergometer during stimulus presentation. HR was used for exercise intensity.

Physical activity improves learning a second language

Findings:

- The participants benefited from physical activity while learning a set of new words.
- Better performance emerged in a Semantic Judgment task.
- Explanation favor synaptic plasticity and increases in the availability of specific neurotrophic substances in the brain, such as brain-derived neurotrophic factor) that facilitate learning.

Exercise Prescription for Brain Power