

# **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.

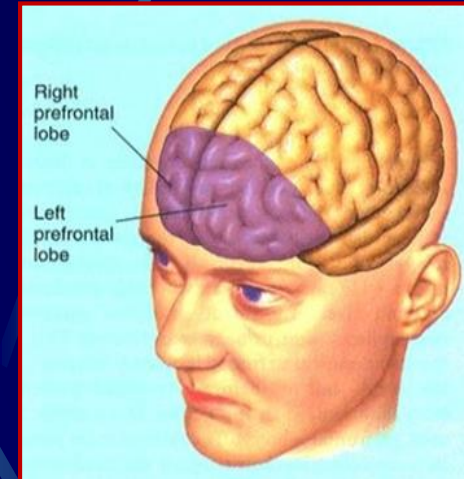
# The Association between Aerobic Fitness, Hippocampal Volume, & Memory Performance in Pre-adolescent Children

- ❖ 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 (VO<sub>2</sub> 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.



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

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

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# 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