MENS SANA IN CORPORE SANO

a healthy mind is a healthy body

Rachael Piver
Advisor: Enette Larson-Meyer
Exercise and the Brain
Honors Program
Exercise’s Effect on the Brain

- Neurotransmitters and exercise
  - 5-HT (serotonin) dopamine, epinephrine

- Transient Hypofrontality Theory
  - What it is
  - Why Exercise utilizes it
    - ‘The Runners High’
  - How it effects disease
    - I.e. Depression

- BDNF
  - What is it
  - Why Exercise affects it
  - How it effects diseases
    - Alzheimer's
Neurotransmitters

- What is a neurotransmitter?
- How they Work
Neurotransmitters

- **Dopamine**
- **Adrenaline**  
  - (or epinephrine)
- **Noradrenaline**  
  - (or norepinephrine)
- **5-hydroxytptamine (5-HT)**  
  - (serotonin)

**Functions**
- Reward (motivation)
- Pleasure, euphoria
- Motor function (fine tuning)
- Compulsion
- Perseveration

**Functions**
- Mood
- Memory processing
- Sleep
- Cognition

Image from: Pharmacology2000.com
Exercise and Neurotransmitters
or the neuroendocrinological connection

- Adrenaline/noradrenaline
  - Important to glycolysis
  - Alertness
- Dopamine
- 5-Ht
- Animal models have shown increase in the brain

Images from: thebrain.mcgill.ca
The Transient Hypofrontality Theory

- From the cerebral cortex to the cerebellum
- The prefrontal Cortex
  - Its function
- Down regulation of the higher order functions
  - I.e. holistic mental approach
    - Frith & Dolan

Image from: iawaketechnologies.com
Image from: Dietrich, Functional Neuroanatomy of altered state consciousness
1. “The brain has a finite energy supply
2. Physical motion is ...an extremely demanding task
3. Information processing in the brain is based on competitive interaction among neurons”
   - Arne Dietrich
Altered states of Consciousness

- 6 types of altered consciousness
- Transient deregulation
  - The Runners High
  - Chronic vs. acute exercise

Exercise, THT and Depression

Depression

- Hyperactivity/hypermetabolism in dorsolateral prefrontal cortex and ventromedial aspect
- Hyperactivity in hypothalamic-pituitary-adrenal (in Major Depression)
- Overemphasis of negative events
- Loss of cognitive flexibility

How exercise can help

- Down-regulates these areas
  - Normalizes/returns frontal cortex to homeostasis
    - Provides ‘brain break’
    - Neurogenesis
      (discussed next)

image from: www.webmd.com/fitness-exercise
Brain Derived Neurotrophic Factor

- Neurotrophic Factor
  - Induces survival and growth of neurons and neural cells
- Growth factor/protein
- Vital to memory
- Can cause neurogenesis
  - Mice born without this factor die soon after birth and have limited neural pathways

Image from: Phoenixpeptide.com
Structure & Genetics

- It coded on the short arm of chromosome 11 from base pair 27,654,892 to base pair 27,722,057 (or 1 position 13)
- 3D Structure of BDNF
  - Binds to TrkB
  - Binds to LNGFR

Image from: http://en.wikipedia.org/wiki/Brain-derived_neurotrophic_factor
Exercise and BDNF

- Shown to immediately improve cognition
  - Study on mice and rats
    - Piepmeier & Etnier
- Long term
  - Voluntary exercise increase axon regeneration from neurons
    - Molteni et. al.
- Both showed positive difference between active and non-active animals
  - Few example of human testing

Image from: http://a.abcnews.com/images/US/GTY_mouse_wheel_tk_140521_16x9_608.jpg
Illness in the Brain and BDNF

These are the areas of the brain that experience neurodegenerative disease

Research on how to target these areas with BDNF

Image from: http://www.nature.com/nrd/journal/v10/n3/fig_tab/nrd3366_F1.html
Works Cited

Questions?