Physical activity and brain health in children

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What am I worried about?
Physical inactivity in youth

In 2016 only 21.6% of 6 to 19-year-old children and adolescents in the United States attained 60 or more minutes of moderate-to-vigorous physical activity on at least 5 days per week.
Inactivity health consequences

- Increase the risk of factors that cause:
  - Cardiovascular disease
  - High blood pressure
  - Breast, colon, and lung cancer
  - Low bone density
  - Obesity
  - Type 2 diabetes

Diagnosed Diabetes Percentage from 2004-2010*

https://www.cdc.gov/healthyschools/physicalactivity/facts.htm
Leading causes of death (non-communicable)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of Death</th>
<th>Percent of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Blood Pressure</td>
<td>12.8%</td>
</tr>
<tr>
<td>2</td>
<td>Tobacco Use</td>
<td>8.7%</td>
</tr>
<tr>
<td>3</td>
<td>High Blood Glucose</td>
<td>5.8%</td>
</tr>
<tr>
<td>4</td>
<td>Physical Inactivity</td>
<td>5.5%</td>
</tr>
<tr>
<td>5</td>
<td>Overweight &amp; Obesity</td>
<td>4.8%</td>
</tr>
<tr>
<td>6</td>
<td>High Cholesterol</td>
<td>4.5%</td>
</tr>
<tr>
<td>7</td>
<td>Unsafe Sex</td>
<td>4.0%</td>
</tr>
<tr>
<td>8</td>
<td>Alcohol Use</td>
<td>3.8%</td>
</tr>
<tr>
<td>9</td>
<td>Childhood Underweight</td>
<td>3.8%</td>
</tr>
<tr>
<td>10</td>
<td>Indoor Smoke Solid Fuels</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

Source: WHO
What is changing?
Youth play has shifted.

Academic priority has changed.

Academics

Physical Activity

Kellert et al., 2017
Are we missing something?
Cognition

• Set of mental processes that are utilized in a systematic order to accomplish an intended goal or outcome.
  • Memory
  • Perception
  • Attention
  • Knowledge
  • Judgement
  • Problem solving
  • Reasoning
  • Learning
  • Creativity
  • Language
Cognitive Control

Goal-directed mental operations that guide selection, scheduling, maintaining, and coordinating processes that underlie action.

Inhibition  Working Memory  Cognitive Flexibility

Age

Inhibition
Working Memory
Healthy development of cognitive control

- Physical Exercise
- Diet & Nutrition
- Medical Health
- Sleep & Relaxation
- Cognitively Engaging Activities
- Social Engagement
Exercise and cognitive control

- Investigate change in fitness and change in cognition from 2nd to 4th grade.

- 290 children from six separate elementary schools.

- Tracked PACER (progressive aerobic cardiovascular endurance run) performance across three years.

Exercise and cognitive control

Exercise and cognitive control

- Increasing fitness over a 3-year period in Elementary age children is associated with improved cognition.

- Significant implications for physical activity as a means to support necessary brain function for academic success.

Is there a connection with healthy brain development?
The FITKids Randomized Controlled Trial


308 children 8-9 years old

9-month PA afterschool intervention

Wait-list control

• Error Related Negativity (or ERN) represents brain function associated with making an error.

• Research suggests that normal development should demonstrate no change in ERN brain activity over a 9-month period.

• However, the children who were not in the physical activity intervention demonstrated significant change in brain function after 9-months.

• Inactivity may be a marker of atypical cognitive development.

• Prior-research demonstrates increased ERN in youth with symptoms of obsessive compulsive disorder, negative affect, and anxiety.
• Subsample of 143 children from FITKids performed MRI scans at pre- and post-test.

• Evaluated brain microstructure of white matter tracts.

• White matter is important for transmitting information between brain regions. White matter during development increases with cognitive development.


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• Children who participated in the 9-month physical activity intervention revealed increased white matter microstructure in the corpus callosum (typical development).

• However, no change in white matter microstructure was observed in children in the control group (atypical development).
• Corpus callosum integrates cognitive information between left and right hemispheres.

• Abnormal development of the corpus callosum has been observed in children with attention-deficit hyperactivity disorder, autism, and schizophrenia (Swayze et al., 1990; Barnea-Goraly et al., 2004).

Where can we start?

(End where I started)
Acute Physical Activity in Children

Acute Physical Activity in Children

Flanker Accuracy

Flanker Reaction Time

Acute Physical Activity in Children

Drolette et al. (2014) Developmental Cognitive Neuroscience, 7, 53-64.
Acute Physical Activity in Children

Drollette et al. (2014) Developmental Cognitive Neuroscience, 7, 53-64.
Acute Physical Activity in Children

• Brain function associated with attention.

• Increased activation suggests greater allocation of attentional resources.

• Results suggest that a single bout of exercise improves brain and cognitive function in children who need it most.

Drollette et al. (2014) Developmental Cognitive Neuroscience, 7, 53-64.
Conclusion

Diagnosed with anxiety or depression among children 6-17 years old

Diagnosed mental, behavioral, and developmental disorder age 2 - 8 years old
Conclusion
Acknowledgements

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Thank you!

Questions?