Optimizing Peak Performance in Kids: New Research on the Brain and How to Use Exercise and Nutrition to Achieve Better Physical and Mental Health in Children

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BDNF is THE MOTHER OF ALL BRAIN GROWTH FACTORS which regulate the survival, growth & differentiation of neurons during development and is vital to continue our Brain’s job of Adapting to the world: LEARNING.

BDNF functions to translate activity into synaptic & nerve plasticity in the adult animal.

BDNF is MIRACLE GRO for the brain and is Evolution's great gift to us that is made when we use our brain cells.

BDNF is an anti-depressant, anti-toxic stress factor and correlates with intelligence and memory.


RESEARCH CONTINUES
MAYO CLINIC

• OVER 1600 SCIENTIFIC PAPERS REVIEWED
• SHOWED THAT EXERCISE IMPROVES BRAIN
• PREVENT COGNITIVE DECLINE
• LESSENS THREAT OF ALZHEIMER’S
• IMPROVES TEST SCORES AT ANY AGE
• ALSO IMPROVES MOOD, ENERGY, MOTIVATION

Rudolph E. Tanzi

• Physical exercise
  - At least 10000 steps/day
• Healthy diet
  - Mediterranean diet: Fruits/Veggies/Nuts/Olive Oil, less red meat
  - Probiotics, Antioxidants, Limited Carbohydrates/Fats
• DHA & EPA;
• Social interaction
• Learning new things
• Get eight hours of sleep per night
  - Deep sleep clears debris from brain: Mental floss
• Reduce emotional stress - Meditation
• Use neuroplasticity and epigenetics to your advantage:

Definition: Neural plasticity, which is also known as neuroplasticity, brain plasticity, cortical plasticity, is the changing of the structure, function, and organization of neurons in response to new experiences.

Neural plasticity specifically refers to strengthening or weakening nerve connections or adding new nerve cells based on outside experiences.

THE RUNNING MAN IS THE ULTIMATE NEUROPLASTIC MAN

Our ancestors were predominantly of the hunter-gatherer type. The “Running Man” was the standard of fitness that ensured survival. Individuals who could out-run & out-plan their peers would survive.

ADAPTATION, MOVING, LEARNING
Every student at Madison Junior High completes a computer-based fitness test. Students spend one day a week in the school’s state-of-the-art fitness center.

California Department of Education 2001 Study
33% of freshmen in California were overweight or obese.

Naperville – District 203 – 2002 Study
3% of freshmen were overweight or obese. 19,000 children in the district.

TIMSS – Trends In International Mathematics / Science.
An international benchmarking test comparing the achievement of eighth-grade students. In 1999, Naperville District 203 scored #1 in science and #6 in math. An amazing 94.1% of Naperville parents were satisfied with the PE curriculum.

ANOTHER EXAMPLE OF SHAMELESS SELF-PROMOTION

www.JohnRatey.com
http://sparklinglife.org

EMOTIONAL REGULATION

EXERCISE PLAY

OPTIMIZING COGNITIVE FUNCTIONING

"That which we call thinking is the evolutionary internalization of movement.”
Lilinas, 2001

Partially funded by REEBOK
Public Magnet School  Grades 4-8  Approximately 120 children
All on school breakfast and lunch programs.
Program: Added 40 minutes of exercise in the morning
Exercise was performed in gym in station format.

Activities included:
Basketball  Dance  Dance Revolution  Double Dutch “jump roping”  Pogo stick jumping

1st Semester 2006 - 2007 Outcomes: Disciplinary Referrals

<table>
<thead>
<tr>
<th>Year</th>
<th>Referrals</th>
<th>Suspensions</th>
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<tbody>
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<td>2006</td>
<td>661</td>
<td>71</td>
</tr>
<tr>
<td>2007</td>
<td>353</td>
<td>24</td>
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Teachers reported:
Students are more focused. Students are more focused during the MAP (Measure of Academic Progress) testing as well.

Teachers observed:
Students testing immediately after morning activities did better — meeting or exceeding individual growth targets — than middle scholars taking the test late morning or in the afternoon.

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**Sweden  The Proof**

Love to measure and keep records
1.2 million boys born 1950-76; finished H.S. 15 and entered military 18. 270,000 brothers, 1300 identical twins
Tested cardio (ergonometric) muscle (knee, elbow, hand) and cognitive appraisal—both at 15 and 18.

Those that improved cardio fitness improved IQ and smarts. Not as much with muscle strength. Also those that improved went on to be better education, more satisfaction with life, and higher socio-economic standing.

Brothers, identical twins showed the same association—those that improved their physical fitness improved their brain power. Its not just about the genes.
Exercise Optimizes Learning

SYSTEMS

NEW Cell Growth

Cellular

EXERCISE

By increasing neurotransmitter activity, improving blood flow and producing Brain Growth Factors - Miracle Grow or Brain Fertilizers - Exercise readies our nerve cells to bind more easily and stronger. Exercise does this better than any other factor that we are aware of at the present time.

EXERCISE PREPARES THE LEARNER

Improves Impulse Control
Improves Behavior
Improves Attention
Decreases Nudginess
Improves Arousal - Lessens Fatigue
Improves Motivation
Helps Mood and Anxiety Regulation
Combats Depression
Improves Self-esteem
Reverses “Learned Helplessness”
Combats Toxic Effects of Stress Hormones

Growth in the brain...especially in the hippocampus

ONE HOUR after stimulus see the sprouting of new dendritic spines to connect to neighboring nerve cells—this is a structural change that is part of the cellular basis of learning.
Here we rely on the coupling between neurogenesis and angiogenesis and test whether MRI measurements of cerebral blood volume (CBV) provide an imaging correlate of neurogenesis. Eleven healthy subjects (mean age 33, ranging from 21–45 years, two males and nine females) participated in the study, completing a 3-month aerobic exercise regimen. Cognitively, individuals performed significantly better on trial 1 learning ($F_{(7,0)} P = 0.027$) after exercise, with a trend toward improvement on trial 1 learning ($F_{(0,5)} P = 0.053$) and delayed recall ($F_{(0,5)} P = 0.057$). There was no effect on delayed recognition ($F_{(0,9)} P = 0.67$) or source memory ($F_{(0,15)} P = 0.25$). To test that cognitive improvement was related to exercise per se, we found that individual changes in VO$_2$max were correlated with individual changes in trial 1 learning ($r = 0.660, P = 0.037$).


Fit vs. Not Fit

Kids who were fit and who had better memory, also had larger hippocampi

Fitness increases neurons, connectivity- 28 fit 21 non


Harvard on the Move, a new initiative sponsored by President Drew Faust (from left), kicked off with a panel discussion at Sanders Theatre on Wednesday. Panelists included Daniel Lieberman, professor of human evolutionary biology and department chair of human evolutionary biology in the Faculty of Arts and Sciences, Christopher McDougall ’85, author of "Born to Run: A Hidden Tribe, Superathletes, and the Greatest Race the World Has Never Seen," and John Ratey, an associate clinical professor of psychiatry at Harvard Medical School.
Exercise and Depression

Zoloft vs Exercise at 4 Months

Figure 3. Observed mean depression scores before and after treatment. All changes from pre-treatment to post-treatment were statistically significant (P<0.01 for all). The treatment groups did not differ on baseline or post-treatment levels of depression. Error bars represent SEs. HAM-D indicates Hamilton Rating Scale for Depression; CR, cardiorespiratory fitness.

From: Bhupathy I, Arch Intern Med, Volume 155(15), October 15, 2005:3343-3348
3 x/week for 16 weeks (30 minutes)-75-85% of Cardiac reserve.

Fitness and Well-being

FIGURE 3—Mean scores for emotional well-being by CR fitness level, adjusted for age, BMI, and years of participation. Superscripts indicate significant differences between CR fitness groups (all P values <0.0001).
10 minutes of coordinative exercise (CE) versus regular exercise (NSL)

115 children (13-16yr) of a German elite performance school, half in each group; tested executive function pre and post 10 minutes of exercise.

The total number of responses with the light line being those with just 10 minutes of regular moderate exercise, the black line with 10 minutes of aerobic plus balanced and coordination exercises.

Both groups improved as to baseline, but the balance and coordination half did much better.

Role of PA in diabetes management and prevention

Hayes, Kriska

PA lifestyle plays a vital role in both the management of type 1 diabetes and prevention and management of type 2 diabetes. PA helps with weight loss and weight management, improves insulin/glucose profiles for people with pre-diabetes, glycemic control for people with type 2 diabetes, and quality of life for everyone.

Type 2 diabetes – PA reduces the risk of cardiovascular all-cause mortality.

- 91 ADHD at risk and 107 typically developing
- assessment of aerobic fitness
- and a flanker task requiring variable amounts of inhibitory control
- the positive relation between aerobic fitness and interference control was only significant for younger children with ADHD risk
- START YOUNG WITH ADHD KIDS

The present review selected a total of 16 interventional studies

- This systematic review has investigated the acute or chronic effects of PA on cognition and behaviour in children and adolescents with ADHD. The main results showed that PA improves executive functions, increases attention, contributes to greater planning capacity and processing speed and working memory, improves the behaviour of students with ADHD in the learning context, and consequently improves AP.
- All studies have shown positive effects of PA on cognition and 35.5% on the behaviour of young with ADHD. The benefits of PA differ according to the intervention time. A PA session of 20–30 min (intensity 40–75%) will have a positive acute effect on processing speed, working memory, planning and problem solving. However, the duration of these effects on behaviour can be contradictory and vary depending on age. Systematic PA (≥30 min per day, ≥40% S. Suarez-Manzano et al. Research in Developmental Disabilities 77 (2018) 12–23 intensity, ≥three days per week, ≥five weeks) further improves attention, inhibition, emotional control, behaviour and motor control. More research is needed to justify the acute and chronic effect on the cognition and behaviour of young people with ADHD.

Exercise and ADHD 1

- The results showed a significant increase in the speed reaction and precision of response after an intervention of 20–30 min, but at a moderate intensity (50–75%). However, for Flohr et al. (2004) there was no improvement in the simple mathematical problems solving of children with ADHD after a 25 min cycloergometer intervention at low intensity. Finally, three other studies with interventions of 20–30 min of exercise in children (Chang et al., 2012; Labban et al., 2009) and adolescents (Piepmeier et al., 2015) obtained benefits in executive functions and planning and organization processes.

- PA and sports programs applied for 12 weeks—one 60 min session per week—improved motor performance, visuospatial performance and working memory. Pan et al. (2015) applied a table tennis programme—two 70 min sessions per week—for 12 weeks. The results showed improvements in locomotor and object-control skills, and in executive function and planning. Finally, two studies observed a significant increase in brain activity. Huang et al. (2014) conducted MVPA in a waterway for eight weeks—two 60 min sessions per week—and Chiu et al. (2015) conducted MVPA in a terrestrial environment for six weeks—three 90 min sessions per week. The results of both studies showed higher activation in the right frontal lobe and right temporal lobe in children, and a decrease in theta/alpha ratios in male adolescents, respectively.

- McKune et al. (2004) revealed that an intervention of MVPA—at 50–70%—improved the behaviour of young people with ADHD from the third week of treatment. In addition, at the end of five weeks, they observed improvements in emotional and attentional control, and in motor skills. These results are similar to three more recent studies which also used MVPA. On the one hand, Smith et al. (2013), observed improvements in behaviour, response inhibition, Conner’s score, oppositional score, and a decrease of inattention after eight weeks of 30 min a day at the beginning of each school day. Nida et al. (2015), after 12 weeks of aerobic 5%, obtained improvements in ADHD symptoms such as behaviour, decrease of inattention and bad mood. Furthermore, Verret et al. (2012), found improvement in muscle capacity and motor skills, attention functions, response inhibition, and information processing after 10 weeks of MVPA after three 45 min sessions per week.


Exercise and ADHD 2

- As an complement to the above strategies, treatments based on PA have recently emerged. Recent studies have shown that the PA practice is associated with an improvement in processing speed, working memory, planning and problem solving (Chuang, Tsai, Chang, Hsu, & Hung, 2015; Piepmeier et al., 2015; Pontifex, Saliba, Raine, Picchietti, & Hillman, 2013). Katz et al. (2010), observed that children with ADHD who performed high-intensity exercise in Physical Education (PE) class were able to reduce their stimulant medication intake. This was due to an increase in norepinephrine and dopamine levels in the brain, and a biological adaptive response of brain function to the stimulus generated by exercise (Wigal, Emmerson, Gehricke, & Galassoetti, 2012).

- In the majority of studies, the behaviour of young people with ADHD was measured using standardized parental questionnaires (Child Behaviour Checklist) and teacher questionnaires (Conner’s Teacher Rating Scale).

- The seven studies that analysed the acute effect of PA on cognition were longitudinal studies with intervention, all of them controlled by exercise intensity. Five used treadmills (Chang et al., 2012; Chuang et al., 2015; Labban et al., 2009; Pontifex et al., 2013; Tantillo et al., 2002) and two used a cycloergometer (Flohr et al., 2004; Piepmeier et al., 2015). Tantillo et al. (2002) submitted young people with ADHD (8–12 years) to a maximum stimulus and another submaximal stimulus of 5–25 min. In


ADHD and Diet

- There are no special diets proven to “cure” ADHD or reduce its symptoms.

- There’s no evidence that eliminating certain foods has a direct impact on ADHD symptoms.

- All kids can benefit from reducing how much sugar they eat and drink.
The Gut-brain Axis

Host genetics
Pollution
Pharmaceuticals
Diet
Stress
Microbial exposures
Psychological status
Pathobionts
Commensals
The microbiome is affected by our experiences and emotions. In turn, microbes in the gut send chemical signals (including neurotransmitters) affecting memory, emotions and behaviour in important parts of the brain. Gut microbes even alter gene expression in the gut.

Early Gut Bacteria Regulate Happiness

- Scientists have shown that brain levels of serotonin, the ‘happy hormone’, are regulated by the amount of bacteria in the gut during early life.
- Normal adult brain function depends on the presence of gut microbes during development.
- This research has multiple health implications as it shows that manipulations of the microbiota (e.g. by antibiotics, diet, or infection) can have profound knock-on effects on brain function and mental well-being, including developing microbial-based strategies for treatment for brain disorders.

Exercise Changes Microbiome

- Exercise is associated with altered gut microbial composition, but studies have not investigated whether the gut microbiota and associated metabolites are modulated by exercise training in humans. We explored the impact of six weeks of endurance exercise on the composition, functional capacity, and metabolic output of the gut microbiota in lean and obese adults with multiple-day dietary controls prior to outcome variable collection.
- METHODS:
  - Thirty-two lean (n=18 [9 female]) and obese (n=14 [11 female]), prepubescent sedentary subjects participated in six weeks of supervised, endurance-based exercise training (3 days/week) that progressed from 30 to 60 minutes/day and from moderate (60% of heart rate reserve [HRR]) to vigorous intensity (75% HRR). Subsequently, participants subsequently returned to a sedentary lifestyle activity for a six week washout period. Fecal samples were collected before and after six weeks of exercise, as well as after the sedentary washout period, with 3-day dietary controls in place prior to each collection.
- RESULTS:
  - β-diversity analysis revealed that exercise-induced alterations of the gut microbiota were dependent on obesity status. Exercise increased fecal concentrations of short chain fatty acids (SCFAs) in lean, but not obese, participants. Exercise-induced shifts in metabolic output of the microbiota paralleled changes in bacterial genes and taxa capable of SCFA production. Lastly, exercise-induced changes in the microbiota were largely reversed once exercise training ceased.
- CONCLUSION:
  - These findings suggest that exercise training induces compositional and functional changes in the human gut microbiota that are dependent on obesity status, independent of diet and contingent on the sustainment of exercise.

Recommendations

• Get the heart rate up- Martin Gibala

• DO something FUN

• Activity with others

• Get Outside

What kind of exercise? How much?

JANE BRODY- REFRAINE THE MESSAGE

• Stop thinking of future health, weight loss and body image as motivators for exercise.

• FOCUS ON IMMEDIATE-- WELL-BEING AND HAPPINESS AND JOY

• Make Physical Activity THE ELIXIR OF LIFE

• Elderly keep at it with Community, Friendships, and FUN.

• Reduce emphasis on weight loss- studies show even with consistent exercise and BP drops, waist lines shrink, energy is more, but not much weight loss.

USHHS Physical Activity Guidelines for Americans: Adults

• 150 minutes of moderate intensity physical activity per week
  or

• 75 minutes of vigorous physical activity per week
  (in bouts of at least 10 minutes)
The Copenhagen Consensus Conference 2016
From 4 to 7 April 2016, 24 researchers from 8 countries and from a variety of academic disciplines gathered in Sneekersten, Denmark, to reach evidence-based consensus about physical activity in children and youth,

- THEME 2: PHYSICAL ACTIVITY IN CHILDREN AND YOUTH: COGNITIVE FUNCTIONING
  - Physical activity and cardiorespiratory fitness are beneficial to brain structure, brain function and cognition in children and youth.
  - Physical activity before, during and after school promotes scholastic performance in children and youth.
  - A single session of moderate physical activity has an acute benefit to brain function, cognition and scholastic performance in children and youth.
  - Mastery of fundamental movement skills is beneficial to cognition and scholastic performance in children and youth.
  - Time taken away from academic lessons in favour of physical activity has been shown to not come at the cost of scholastic performance in children and youth.

- THEME 3: PHYSICAL ACTIVITY IN CHILDREN AND YOUTH: ENGAGEMENT, MOTIVATION, PSYCHOLOGICAL WELL-BEING
  - Engagement in physical activity has the potential to positively influence psychological and social outcomes for children and youth, such as well-being and relationships with peers, parents and coaches.
  - An autonomy supportive, mastery focused and caring/supportive environment, positively influences children's and youth's self-determined motivation, physical activity behaviour and holistic well-being.
  - Close friendships and peer group acceptance in physical activity are positively related to perceived competence, intrinsic motivation and participation behaviour in children and youth.
  - Parental attitudes and behaviours are strongly related to children's and youths' self-perceptions, motivation and physical activity.
  - Systematic and deliberate training enables teachers and coaches to create a positive motivational environment for children and youth.

Intensity Using Heart Rate

- Very light = <50 % of maximal heart rate
- Light = 50-63 % of maximal heart rate
- Moderate = 64-76 % of maximal heart rate
- Vigorous = 77-93 % of maximal heart rate
- Very Hard = >94 % of maximal heart rate
- Maximal = 100% of maximal heart rate

Intensity Using Heart Rate

- Target Heart rate
  - Maximal heart rate = 220-age

- Based on level of intensity a heart rate range is selected.
Intensity Using the Sing Test

- Sing Test
  - Low intensity
    - You can sing while exercising.
  - Moderate intensity
    - You can easily talk while exercising but not sing.
  - Vigorous intensity
    - It is difficult to talk while exercising.