Physical Activity, Physical Fitness, & Academic Performance

Joseph E. Donnelly, ED.D., FACSM
Professor, Internal Medicine
Director, Energy Balance Laboratory
Director, Center for Physical Activity & Weight Management
The University of Kansas Medical Center
The University of Kansas-Lawrence
Overview

• Metabolic syndrome and obesity in children and youth
• 2 for 1 model for health and academic achievement
• Approaches to increase physical activity and impact health and learning in schools
• CDC and other reviews
• Barriers and potential solutions
• Summary
Distribution of the Metabolic Syndrome & Its Related Components

DuBose et al., Acta Paediatr, 2006
Theoretical Model to Improve Health & Academic Achievement

Cardiovascular Fitness

Physical Activity

Body Fat

Cognitive Function

Academic Achievement

Schools are Sedentary

• Bus ride can be > 60 min each way
• Recess and physical education has declined to levels that cannot provide adequate stimulus (energy expenditure) for fitness or to protect against fatness
• Motor time off task is discouraged and disciplined
• Traditional teaching paradigm- sit down and be quiet
Physical Education by Itself is not Adequate to Provide Fitness or Prevent Fatness in the Current Environment

• PE and recess have diminished, offered 2-3 X week
• PE duration as little as 20 minutes
• MET value frequently just at or below the definition of moderately vigorous
• Inadequate facilities & equipment
• PE teacher shared among schools, poor training/no training
Physical Activity Across the Curriculum (PAAC)

A 3-year, randomized controlled trial of physical activity and academic achievement for elementary school children in grades 2 & 3

Major Aims of PAAC

• Increase physical activity by using classroom teachers to teach existing lessons with using physical activity

• Primary aim-
  ➢ Diminish increases in BMI

• Secondary aims-
  ➢ Determine association between physically active lessons and academic achievement
  ➢ Characterize metabolic syndrome
The PAAC Program

• A classroom-based approach to reduce sedentary behavior **while maintaining the focus on academics**
• NO DECREASE in academic instruction time
• PAAC is a technique to deliver existing academic instruction through movement
Traditional VS. PAAC Classroom
Conceptual Framework

• Minimal intervention
• Enhances learning
• No additional teacher preparation time
• No additional cost
• Easily perpetuated and replicated
• Desirable for both teacher and student (i.e., FUN)
• Students “must” participate in classroom lessons
The PAAC Program

Integrate 10 minute periods of physical activity within academic lessons for a total of 90 min/wk (i.e. 1 ten min lesson in morning and afternoon.

• Language art
• Math
• Science
• History
Design

• Cluster randomized, controlled trial N=22
• 3 year intervention
• Grades 2&3
• Target 90 minutes of moderate to vigorous physical activity/wk
• Use classroom teachers to deliver existing academic lessons using physical activity
Active Lesson
Learning to Spell
Learning Math
Learning Spanish
Level of Physical Activity

Mean SOFIT by Semester

Control

Intervention
Energy Expenditure of Exercise

38 boys & girls
Grades 2-5
PAAC lessons of ≥ 10 min duration
Average MET = 3.4 (lower end of moderate to vigorous)

Honas et al., MSSE, 2008

Will more vigorous exercise provide a greater response for cognitive function (and perhaps academic achievement?) Davis et al., Health Psychol, 2011
BMI Change Across 3 Years for PAAC Schools Receiving 75+ min of PA or < 75 min PA

9 schools 75+ min
5 school <75 min

P=0.0003
Academic Achievement - Individual Categories

Donner Adjusted t for Each Category p ≤ 0.01
**Relationship Between Teacher Modeling & Physical Activity Levels in Students**

(intervene with teachers to benefit students?)

*P<0.0001; dose-response relationship between teacher modeling and PA level

Gibson et al., IJBNPA, 2008
9-Months Post Intervention Teacher Survey

Percentage Use

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 d</td>
<td>90%</td>
</tr>
<tr>
<td>2-4 d/wk</td>
<td>50%</td>
</tr>
<tr>
<td>most or every</td>
<td>30%</td>
</tr>
<tr>
<td>did not use</td>
<td>10%</td>
</tr>
</tbody>
</table>
A+PAAC Design- Emphasis on Academic Achievement

- Adequately powered, cluster randomized trial
- 17 elementary schools, (9 intervention, 8 control)
- ~20 children from 2\textsuperscript{nd} & 3\textsuperscript{rd} grades followed 3 yrs. to 4\textsuperscript{th} and 5\textsuperscript{th} grades (~40/school, 682 children total)
- 20 minutes of A+PAAC lessons/day

DK85317, Donnelly PI
The students are in a standing position and hopping in place off of both feet. The teacher gives them a problem involving “elapsed time.” For example, the movie started at 5:00 pm and ended at 8:00 pm. How much time passed? Students continue hopping and give a verbal answer. If the answer is correct, the students are asked to do 3 lunges, each lunge representing 1 hour.

Variation: The elapsed time could be in 30 minute periods or 15 minute periods. Jumps and/or jumping jacks would be good movements for this variation. (1 jump or 1 jumping jack = 1 minute)
A+PAAC Outcomes

• Academic achievement measured by Wechsler Individual Achievement Test III
• State administered achievement tests with individual identifiers
• Cognitive function- Flanker, n-back (Hillman)
• Anthropometrics, fitness (Pacer), blood chemistry, blood pressure, attention-to-task (Mahar), energy expenditure of A+PAAC lessons (indirect calorimetry via CosMed)
• 4 revisions of the program have been completed -- all with teacher input.

• TAKE 10! continues to be designed with a "school system fit" orientation:
  - little change is required in an elementary classroom.
  - no special equipment or training is needed.
  - grade-specific linkages

Reach: over 55,000 elementary classrooms from Oct 2002 to Present
Energy Expenditure

- 3 Classrooms, CSA accelerometers & digital pedometers
- 10-minute sessions

<table>
<thead>
<tr>
<th>Grade</th>
<th>Avg MET levels</th>
<th>Avg kcal expenditure</th>
<th>Pedometer step counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; Grade</td>
<td>5.72-7.05</td>
<td>25.6-27.8</td>
<td>644-931</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Grade</td>
<td>5.51-6.77</td>
<td>27.6-33.9</td>
<td>659-1376</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt; Grade</td>
<td>4.98-7.19</td>
<td>29.7-42.9</td>
<td>1002-1041</td>
</tr>
</tbody>
</table>

How Does Physical Activity Influence Academic Achievement?

• Brain function
• Attention-to-task
• Body fatness
• Physical fitness
• Physical activity
• Parent characteristics, SES
Mean percentage of intervals of on-task behavior during baseline and intervention for one fourth grade class.

Darla M. Castelli, PhD
University of Texas at Austin

JED note- Comprehensive “Saturated Environment”
Comprehensive School-based Physical Activity Program (CSPAP)

1. Quality PE
2. PA in class
3. PA breaks
4. Active Recess
5. Before or After School
6. Intramurals
7. School sports
8. Walk-Bike-to-School
9. Family, Community PA
10. School Employee

Sources: Castelli & Beighle, 2007; NASPE, 2008; USDHHS, 2009
Physical Activity During the School Day

• Embed physical activity in the school curriculum
• No more than 60-mins of sedentary time
• At least 10-mins of physical activity after sedentary time
• Consider activity type, intensity, and the academic task
• Measure physical activity intensity
• Become NASPE certified Director’s of Physical Activity
• Provide opportunities for:
  – Formally structured physical activity
  – Informal physical activity – play
  – Content-rich physical activity
DIRECTOR OF PHYSICAL ACTIVITY

Launch!

March 13, 2012
AAHPERD Convention
Boston, MA
NASPE DPA Certification

National Association for Sport and Physical Education
### Action Plan

**NASPE Director of Physical Activity Certification**

**Action Plan**

<table>
<thead>
<tr>
<th>Name:</th>
<th>School:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What would you like to do?</strong></td>
<td><strong>School:</strong></td>
</tr>
<tr>
<td><strong>Your action plan:</strong></td>
<td><strong>Physical Activity Before and After School</strong></td>
</tr>
<tr>
<td>- Plan, organize, set-up, and facilitate “Terrific Fit Tuesdays” (T.F.T.) which will consist of 4-5 fitness stations before school on Tuesday mornings when school starts 40 minutes late for staff training.</td>
<td><strong>Administrative Approval Teacher Approval Facilities and Equipment Supervision</strong></td>
</tr>
<tr>
<td>- I will have 3 teacher helpers.</td>
<td>- The benefits of station physical activities will allow students to pick and choose activities they enjoy.</td>
</tr>
<tr>
<td>- Stations will be for students in 6th-8th grades.</td>
<td>- Students will be allowed to switch stations as long as they do not abuse this privilege.</td>
</tr>
<tr>
<td>- Stations will change weekly</td>
<td>- Discipline will be handled by Mr. Busche and Mr. Reed</td>
</tr>
<tr>
<td><strong>Step 1: Planning</strong></td>
<td><strong>Physical Activity Before and After School</strong></td>
</tr>
<tr>
<td>- Plan schedule with times for</td>
<td><strong>Administrative Approval</strong></td>
</tr>
<tr>
<td></td>
<td>- Met with Mr. Reed, our principal and discussed D.P.A. and</td>
</tr>
<tr>
<td><strong>What CSPAP component will it address?</strong></td>
<td><strong>Who will help you do it?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>When will it be done?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>What artifacts will you collect?</strong></td>
</tr>
<tr>
<td><strong>Physical Activity Before and After School</strong></td>
<td>Mr. Reed</td>
</tr>
<tr>
<td></td>
<td>Fall 2011</td>
</tr>
<tr>
<td><strong>Administrative Approval Teacher Approval Facilities and Equipment Supervision</strong></td>
<td>Mr. Kerschen Mrs. Mayo Mrs. Keim</td>
</tr>
<tr>
<td><strong>Step 1: Planning</strong></td>
<td><strong>Action Plan</strong></td>
</tr>
</tbody>
</table>
43 articles reporting 50 unique studies
Coded by physical activity context
Investigated increasing time spent in physical education or physical activity

www.cdc.gov/HealthyYouth, April, 2010
Results of CDC Review

• General findings
  ➢ Positive or no relationship between time in physical education/recess/sports and academic achievement and indicators of cognitive function
  ➢ Positive relationships between classroom physical activity and indicators of academic achievement, classroom behavior, and cognitive function
Reviews of Physical Activity, Cognitive Function and Academic Achievement


• Physical activity and student performance at school.


How to Increase Physical Activity in Schools Without Decreasing Academic Instruction

• Increase time children are physically active in current physical education and recess
• Provide access to physical activity before and after school
• Promote active transportation
• Provide physically active lessons
What is Needed to Avoid Barriers and Promote Non-Traditional Physical Activity in Schools

• Low teacher burden for lesson preparation
• Activity disconnected from motor skills
• Additional evidence to link physical activity/fitness & learning

➢ Plausible biological model combined with evidence from well designed interventions linking to state academic achievement tests

• Low cost/no cost, sustainable programs through university teacher preparation (i.e., additional cost = $0.00)
Evidence for Physical Activity & Academic Achievement

• Fitness (aerobic capacity) seems to be associated with academic achievement
• Academic lessons taught with physical activity have been shown to improve academic achievement and attenuate increases in BMI (2 for 1) even without increases in fitness (PAAC)
• Physically active lessons may improve attention-to-task, a behavior associated with learning, and critical to classroom management

There is no evidence that removal of physical activity programs results in greater academic achievement
Training Programs

- Physical Activity Across the Curriculum (A+PAAC)
- Take 10!
- Let’s Move in School
- Energizers
- The Kinesthetic Classroom: teaching and learning through movement. Mike Kuczala Regional Training Center (Randolph, NJ)
- Others
“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”
Research Questions

- How much PA is needed to improve academic performance and how much can the school be expected to provide
- Are there temporal effects of PA on academic performance and are any observed improvements lasting
- Are any positive effects of PA mediated by cognitive function or are other factors equally important
- Are fitness and fatness independently associated with academic performance
- For which students will active lessons provide the greatest benefits
- Do academic lessons taught by physical activity provide greater benefits compared to fitness breaks
- Etc.