RESEARCH BRIEF

Active Education: Growing Evidence on Physical Activity and Academic Performance

INTRODUCTION

One in three kids in the United States is overweight or obese. Obese youth have elevated risk for health problems like heart disease, type 2 diabetes, high blood pressure, unhealthy blood cholesterol patterns, and other health risks related to cardiovascular disease.[1] Obesity can also have serious ramifications for kids' cognitive development[2] and affect school attendance.[3, 4]

Because children spend so much time at school, schools have a unique opportunity to help children become more healthy and active. The Institute of Medicine has called on school leaders to offer more opportunities for children to be physically active before, during and after the school day.[5] Further, both childhood obesity and poor academic performance tend to be clustered in schools with a high percentage of lower-income, minority students, creating a student health issue that is especially problematic in those communities.

There is a growing body of evidence indicating that physical activity and fitness can benefit both health and academic performance for children. This research brief reviews published scientific articles that examine how physical activity and fitness may help school-aged children maximize their academic performance. It also provides an overview of the effects of physical activity on the developing brain. Together, the

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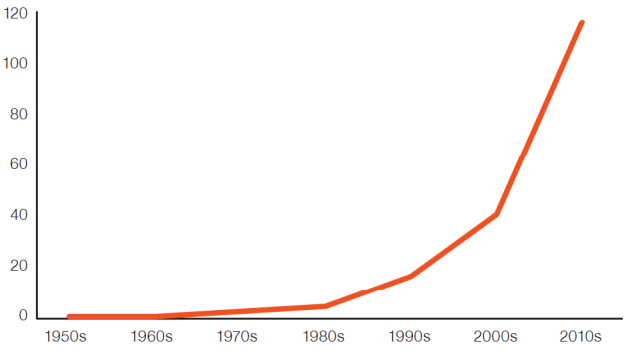
research indicates that providing physical activity for students is in line with schools' academic mission, and that schools have many opportunities for helping young people to be more active.

FIGURE 1 **Growing Evidence on Physical Activity and Academic Performance**

This graph indicates the number of published articles each year that examined the relationship between physical activity, physical fitness, and academic performance among children. A meta-analytic review suggests that the effects size of these studies has significantly increased over time.[6]



KEY FINDINGS

Physical activity can have both immediate and long-term benefits on academic performance. Almost immediately after engaging in physical activity, children are better able to concentrate on classroom tasks, which can enhance learning. Over time, as children engage in developmentally appropriate physical activity, their improved physical fitness can have additional positive effects on academic performance in mathematics, reading, and writing. Recent evidence shows how physical activity's effects on the brain may create these positive outcomes.

1. Regular participation in physical activity has academic performance benefits.

- A research project conducted with 24 elementary schools, called *Physical Activity Across the Curriculum (PAAC)*, showed that adding sessions of physical activity to a school curriculum could have long-term benefits, such as improved academic performance. When comparing improvement in standardized test scores over three years, schools were stratified and randomly assigned to receive physically active lessons did 6 percent better than their peers who had received the same lessons in a seated, inactive manner.[7]
- A recent review of 39 studies on the mental and intellectual benefits associated with school-based physical activity programs found that the greatest effects were seen when children engaged in aerobic physical activity, like jogging in place, rather than resistance activities, like push-ups or sit-ups.[8] The same review showed that children who were physically active in small groups (10 to 30 children) showed greater improvements than those in large groups (30 or more children) or very small groups (1 to 2 children). This finding is important when developing policy focused on class size.
- A study of 287 Canadian children in 4th and 5th grade who were enrolled in ten different schools found a link between physical activity and standardized test performance. The schools were clustered and randomly assigned to participate in a physical activity program (Action School in British Columbia) delivered by teachers. Children who were academically performing below their grade level and assigned to the physical activity program were more likely to increase performance on standardized tests than students who did not participate in the program and just continued their usual practice.[9]
- Over one school year, children who played active video games like *Dance, Dance, Revolution* during recess experienced more improvements in both physical fitness and academic performance in math than students who participated in traditional recess.[10]
- Several studies show that vigorous physical activities, like running and playing tag, may have larger effects on academic performance than lower-intensity activities.[11, 12]
- Eleven- and 12-year-old students participating in physical education lessons, including fitness stations and team games at varied intensities, were compared with students who sat for the same amount of time.[13] Children who participated in the physical education lessons demonstrated recall of a greater percentage of vocabulary words on a memory task, before and after class discussions (delayed recall of the same words), than the sedentary students. These findings suggest that participating in physical activity during physical education lessons may facilitate immediate and delayed memory.
- A study of 115 adolescents showed that active lessons requiring more coordination (e.g., balancing, reacting, adjusting, and differentiating) were associated with better concentration on academic tasks than traditional physical education lessons focused on team sports.[14]

- Although academic achievement tests scores were not directly related to enrollment in high school physical education, female students who both enrolled in physical education and participated in vigorous physical activity lessons had significantly higher grades than students who were not engaged in any physical education lessons.[15]
- Among 5,316 students in grades K through 5, the frequency and duration of physical education class were positively associated with standardized test performance among girls but not boys. This relationship may have been attributed to a lower baseline level of fitness for female students, which shows that the girls may have had more to gain from physical education participation.[16]

2. Single sessions of physical activity can enhance attention and memory.

Immediately after just one session of physical activity, children can increase their attention and memory, and reduce inappropriate behavior, such as being unfocused and causing others to become distracted.[17]

- A review of 19 articles about classroom physical activity breaks revealed that teachers are willing to integrate physical activity into grade level-specific lessons, and they are capable of doing so. In general, physically active lessons including physical activity breaks resulted in a 13 percent increase in the total amount of physical activity per week and a 20.5 percent reduction in time spent on non-academic tasks, such as helping students transition to a new activity and classroom management.
- In that review, studies also reported quantified pre- and post-improvement in academic achievement, such as a 20-point gain on the Florida Comprehensive Achievement Test and increased percentile ranks on the Texas Assessment of Knowledge and Skills.[18]
- A developmental study that examined physical activity and academic performance revealed that when students were randomly assigned to either sit in the classroom or do brisk walking before a test, 4th grade students who were active outperformed their seated peers on the Woodcock Johnson Test of Concentration, but the same effects were not observed among 2nd- or 3rd-grade students.[19]
- When comparing students in randomly selected classrooms that offered one 10-minute *Energizer* physical activity break daily for 12 weeks with those in classrooms that did not, the *Energizers* group was significantly more active and exhibited a higher frequency of on-task behaviors.[20]

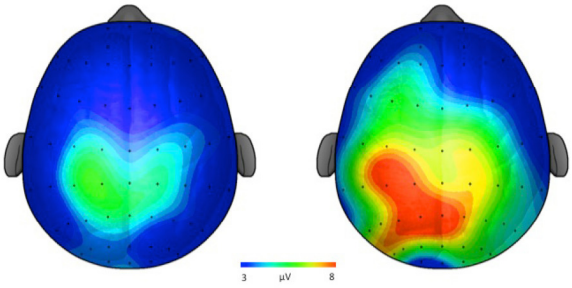
3. The effects of physical activity on brain health may explain improvements in academic performance.

Brain processes such as directing one's attention, switching attention between tasks, and moving information from short- to long-term memory are necessary actions for learning. Recently, scientists have been examining the underlying brain functions that may explain some of the immediate and more gradual academic benefits of physical activity.

- After walking on a treadmill for 20 minutes at a moderate pace, children responded to test questions (in the content areas of reading, spelling, and arithmetic) with greater accuracy, and had a more intense response within the brain, than children who had been sitting (see Figure 2). Further, children who walked for 20 minutes performed better on reading comprehension than those who sat for a similar length of time. Following physical activity, children also completed learning tasks faster and more accurately, and were more likely to read above their grade level.[21]

FIGURE 2 **Composite Attentional Allocation of 20 Students Taking the Same Test**

These two brain images, taken from the top of the head, represent the average amount of students' neural activity during a test following sitting and walking for 20 minutes. The color blue represents lower neural activity, while the color red denotes higher brain activity in a given region.



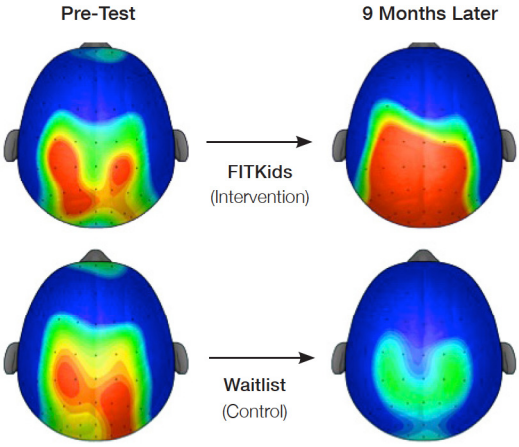
After 20 minutes of sitting quietly **After 20 minutes of walking**

Image courtesy of Charles Hillman, University of Illinois at Urbana-Champaign

- Children ages 7 to 9 were randomly assigned either to a waitlist or to participate in FITKids, an afterschool program providing 70 minutes of moderate-to-vigorous physical activity per weekday for nine months. At the end of the study, children who participated in FITKids showed greater improvements in aerobic fitness,[22] decreases in percentage of body fat,[23] and increases in working memory[24] than children on the waitlist (see Figure 3).

FIGURE 3 **Impact of Afterschool Physical Activity Program on Children's Neural Activity**

This graphic illustrates the differences in children's average amount of neural activity at the beginning and after nine months of participating in an afterschool physical activity program. The images, taken from the top of the head, use blue to represent low neural activity and red for high brain activity.



Hillman et al. (2009). *Neuroscience*, 159, 1044-1054.

- Physically fit children demonstrate memory and efficiency of the brain (i.e., by allocating more working memory to complete a given task) through two learning strategies: relational memory, which involves remembering objects by using a cue, such as turn left after you pass the school,[25,26] and working memory, which involves moving information from the short- to long-term memory.[27] This is important because children use relationships, such as understanding that "three groups of three" and "three times three" are both math facts with the same answer, to remember and recall information.
- Physically fit children have larger hippocampal volume[28] and basal ganglia.[29] Both of these brain structures have been associated with learning in children.

CONCLUSIONS

Regular participation in physical activity and higher levels of physical fitness have been linked to improved academic performance and brain functions, such as attention and memory. These brain functions are the foundation for learning. Long-term studies have demonstrated that increases in physical activity, resulting from greater time spent in physical education, were related to improved academic performance. Even single sessions of physical activity have been associated with better scores on academic tests, improved concentration, and more efficient transfers of information from short- to long-term memory. Children participating in physical activity are better able to stay focused and remain on task in the classroom, thus enhancing the learning experience.

Physical education is an opportunity for all children to be physically active and improve aerobic fitness. Given the demonstrated academic and health benefits, providing physical education—150 minutes for elementary school children[30] and at least 225 minutes for secondary school children among all grade levels—as a part of the 60 minutes of daily moderate-to-vigorous physical activity recommended by the *Physical Activity Guidelines for Americans*,[31] is a justifiable use of valuable school time. Developing or refining policies or regulations relating to physical education is a logical first step to make this requirement a reality. However, the policies must be implemented and enforced consistently to ensure students experience the benefits of physical education.[32] One study suggested that the greatest cognitive benefits from physical education resulted when physical education classes were scheduled during the early or middle part of the day, not at the end of the day.[33] Making physical education the centerpiece of the school day may improve physical health and, in turn, maximize a child's potential to be academically successful.[34]

It is incumbent on schools to maximize students' potential to learn. Accordingly, educators need to have the resources, support, training, and skills to provide a variety of physical activity opportunities for children. Educators, administrators and parents should thoughtfully integrate physical activity across the curriculum throughout the school day to facilitate learning for all students. Experiences such as biking and walking to school, playing at recess, engaging in active classroom lessons, and participating in a quality physical education program may increase the odds of children and adolescents forming lifelong habits for learning and for positive behaviors.

It is important to note that though a vast majority of the studies show benefits of physical activity and fitness on children's academic achievement, some studies show no effects—but very few studies show any negative effects. Thus, it is reasonable to recommend increased physical activity at school as an evidence-based strategy to improve academic performance. Several questions remain to be answered, such as the optimal type, intensity, and timing of school physical activity; how effects might vary for younger compared with older students; and whether similar benefits are documented for students of all income levels, races and ethnicities, and academic abilities. While waiting for studies to answer these questions, current evidence provides a strong rationale for more action to provide physical activity throughout the school day for all students.

This research brief was written by Darla M. Castelli, Elizabeth Glowacki, Jeanne M. Barcelona, Hannah G. Calvert & Jungyun Hwang of The University of Texas at Austin. It updates prior evidence on the role of physical activity in academic performance: http://activelivingresearch.org/active-education-physical-education-physical-activity-and-academic-performance. Peer reviewers were Joseph E, Donnelly, Ed.D, Professor and Director, Center for Physical Activity and Weight Management, University of Kansas and Sarah M. Lee, PhD, Team Lead, Research Application & Evaluation Team, School Health Branch, Division of Population Health, Centers for Disease Control & Prevention.

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