

A Study of the importance of physical education for Today's Student Community

Dr. Satyadev Pachori Assistant Professor,

In charge, Department of Physical Education

Seth P.C Bagla P.G. College Hathras.

Abstract Children respond faster and with greater accuracy to a variety of cognitive tasks after participating in a session of physical activity. A single bout of moderate-intensity physical activity has been found to increase neural and behavioral concomitants associated with the allocation of attention to a specific cognitive task. And when children who participated in 30 minutes of aerobic physical activity were compared with children who watched television for the same amount of time, the former children cognitively outperformed the latter. Visual task switching data among 69 overweight and inactive children did not show differences between cognitive performance after treadmill walking and sitting. When physical activity is used as a break from academic learning time, postengagement effects include better attention and improved academic performance. Comparisons between 1st-grade students housed in a classroom with stand-sit desks where the child could stand at his/her discretion and in classrooms containing traditional furniture showed that the former children were highly likely to stand, thus expending significantly more energy than those who were seated. More important, teachers can offer physical activity breaks as part of a supplemental curriculum or simply as a way to reset student attention during a and when provided with minimal training can efficaciously produce vigorous or moderate energy expenditure in students. Further, after-school physical activity programs have demonstrated the ability to improve cardiovascular endurance, and this increase in aerobic fitness has been shown to mediate improvements in academic performance as well as the allocation of neural resources underlying performance on a working memory task.

Keywords: children. Quality. health-enhancing. physical activity

Introduction. The relationship of physical activity and physical fitness to cognitive and brain health and to academic performance is the subject of this chapter. Given that the brain is responsible for both mental processes and physical actions of the human body, brain health is important across the life span. In adults, brain health, representing absence of disease and optimal structure and function, is measured in terms of quality of life and effective functioning in activities of daily living. In children, brain health can be measured in terms of successful development of attention, on-task behavior, memory, and academic performance in an educational setting. This chapter reviews the findings of recent research regarding the contribution of engagement in physical activity and the attainment of a health-enhancing level of physical fitness to cognitive and brain health in children. Correlational research examining the relationship among academic performance, physical fitness, and physical activity also is described. Because research in older adults has served as a model for understanding the effects of physical activity and fitness on the developing brain during childhood, the adult research is briefly discussed. The short- and long-term cognitive benefits of both a single session of and regular participation in physical activity are summarized.

Before outlining the health benefits of physical activity and fitness, it is important to note that many factors influence academic performance. Among these are socioeconomic status, parental involvement, and a host of

other demographic factors. A valuable predictor of student academic performance is a parent having clear expectations for the child's academic success. Attendance is another factor confirmed as having a significant impact on academic performance. Because children must be present to learn the desired content, attendance should be measured in considering factors related to academic performance.

State-mandated academic achievement testing has had the unintended consequence of reducing opportunities for children to be physically active during the school day and beyond. In addition to a general shifting of time in school away from physical education to allow for more time on academic subjects, some children are withheld from physical education classes or recess to participate in remedial or enriched learning experiences designed to increase academic performance. Yet little evidence supports the notion that more time allocated to subject matter will translate into better test scores. Indeed, 11 of 14 correlational studies of physical activity during the school day demonstrate a positive relationship to academic performance. Overall, a rapidly growing body of work suggests that time spent engaged in physical activity is related not only to a healthier body but also to a healthier mind.

Over the past three decades, several reviews and meta-analyses have described the relationship among physical fitness, physical activity, and cognition (broadly defined as all mental processes). The majority of these reviews have focused on the relationship between academic performance and physical fitness—a physiological trait commonly defined in terms of cardiorespiratory capacity (e.g., maximal oxygen consumption; see). More recently, reviews have attempted to describe the effects of an acute or single bout of physical activity, as a behavior, on academic performance. These reviews have focused on brain health in older adults as well as the effects of acute physical activity on cognition in adults. Some have considered age as part of the analysis. Reviews focusing on research conducted in children have examined the relationship among physical activity, participation in sports, and academic performance.

Review of Literature Trudeau and Shephard, 2008, physical activity and mental and cognitive health and physical activity, nutrition, and academic performance. The findings of most of these reviews align with the conclusions presented in a meta-analytic review conducted by . The studies reviewed by Fedewa and Ahn include experimental/quasi-experimental as well as cross-sectional and correlational designs, with the experimental designs yielding the highest effect sizes. The strongest relationships were found between aerobic fitness and achievement in mathematics, followed by IQ and reading performance. The range of cognitive performance measures, participant characteristics, and types of research design all mediated the relationship among physical activity, fitness, and academic performance. With regard to physical activity interventions, which were carried out both within and beyond the school day, those involving small groups of peers (around 10 youth of a similar age) were associated with the greatest gains in academic performance.

Singh et al., 2022 The number of peer-reviewed publications on this topic is growing exponentially. Further evidence of the growth of this line of inquiry is its increased global presence. Positive relationships among physical activity, physical fitness, and academic performance have been found among students from the Netherlands and Taiwan.

Chih and Chen, 2021. Broadly speaking, however, many of these studies show small to moderate effects and suffer from poor research designs. conducted a comprehensive review of how children's health and health disparities influence academic performance and learning. The author's report draws on empirical evidence suggesting that education reform will be ineffective unless children's health is made a priority. Basch concludes that schools may be the only place where health inequities can be addressed and that, if children's basic health needs are not met, they will struggle to learn regardless of the effectiveness of the instructional materials used. More recently,

Efrat (2020) conducted a review of physical activity, fitness, and academic performance to examine the achievement gap. He discovered that only seven studies had included socioeconomic status as a variable, despite its known relationship to education

Physical Fitness as a Learning Outcome of Physical Education and Its Relation to Academic Performance Achieving and maintaining a healthy level of aerobic fitness, as defined using criterion-referenced standards from the National Health and Nutrition Examination Survey (NHANES; is a desired learning outcome of physical education programming. Regular participation in physical activity also is a national learning standard for physical education, a standard intended to facilitate the establishment of habitual and meaningful engagement in physical activity Yet although physical fitness and participation in physical activity are established as learning outcomes in all 50 states, there is little evidence to suggest that children actually achieve and maintain these standards

Evidence suggests that increasing physical activity and physical fitness may improve academic performance and that time in the school day dedicated to recess, physical education class, and physical activity in the classroom may also facilitate academic performance. Available evidence suggests that mathematics and reading are the academic topics that are most influenced by physical activity. These topics depend on efficient and effective executive function, which has been linked to physical activity and physical fitness. Executive function and brain health underlie academic performance. Basic cognitive functions related to attention and memory facilitate learning, and these functions are enhanced by physical activity and higher aerobic fitness. Single sessions of and long-term participation in physical activity improve cognitive performance and brain health. Children who participate in vigorous- or moderate-intensity physical activity benefit the most. Given the importance of time on task to learning, students should be provided with frequent physical activity breaks that are developmentally appropriate. Although presently understudied, physically active lessons offered in the classroom may increase time on task and attention to task in the classroom setting. Although academic performance stems from a complex interaction between intellect and contextual variables, health is a vital moderating factor in a child's ability to learn. The idea that healthy children learn better is empirically supported and well accepted and multiple studies have confirmed that health benefits are associated with physical activity, including cardiovascular and muscular fitness, bone health, psychosocial outcomes, and cognitive and brain health

Physical Activity, Physical Education, and Academic Performance In contrast with the correlational data presented above for physical fitness, more information is needed on the direct effects of participation in physical activity programming and physical education classes on academic performance. In a meta-analysis, found a positive relationship between physical activity and cognition in school-age youth (aged 4-18), suggesting that physical activity, as well as physical fitness, may be related to cognitive outcomes during development. Participation in physical activity was related to cognitive performance in eight measurement categories (perceptual skills, IQ, achievement, verbal tests, mathematics tests, memory, developmental level/academic readiness, and "other"), with results indicating a beneficial relationship of physical activity to all cognitive outcomes except memory). Since that meta-analysis, however, several papers have reported robust relationships between aerobic fitness and different aspects of memory in children. Regardless, the comprehensive review of was important because it helped bring attention to an emerging literature suggesting that physical activity may benefit cognitive development even as it also demonstrated the need for further study to better understand the multifaceted relationship between physical activity and cognitive and brain health.

The authors conclude that spending time in physical education with a specialist did not have a negative effect on academic performance. Shortcomings of this research include the amount of data loss from pre- to posttest, the use of results of 2nd-grade testing that exceeded the national average in performance as baseline data, and the use of norm-referenced rather than criterion-based testing. In seminal research conducted by six different conditions of physical activity (no activity; 20, 30, 40, and 50 minutes; and posttest no activity) were completed by 106 2nd graders during physical education. Each physical activity session was followed by 5 minutes of rest and the completion of 36 math problems. The authors found a potential threshold effect whereby only the 50-minute condition improved mathematical performance, with no differences by gender.

A longitudinal study of the kindergarten class of 1998–1999, using data from the Early Childhood Longitudinal Study, investigated the association between enrollment in physical education and academic achievement). Higher amounts of physical education were correlated with better academic performance in mathematics among females, but this finding did not hold true for males.

Single Bouts of Physical Activity. Beyond formal physical education, evidence suggests that multi-component approaches are a viable means of providing physical activity opportunities for children across the school curriculum. Although health-related fitness lessons taught by certified physical education teachers result in greater student fitness gains relative to such lessons taught by other teachers, non-physical education teachers are capable of providing opportunities to be physically active within the classroom. Single sessions or bouts of physical activity have independent merit, offering immediate benefits that can enhance the learning experience. Studies have found that single bouts of physical activity result in improved attention, better working memory, and increased academic learning time and reduced off-task behaviors. Yet single bouts of physical activity have differential effects, as very vigorous exercise has been associated with cognitive fatigue and even cognitive decline in adults. As seen in [Figure 1](#), high levels of effort, arousal, or activation can influence perception, decision making, response preparation, and actual response. For discussion of the underlying constructs and differential effects of single bouts of physical activity on cognitive performance,



FIGURE 1

For children, classrooms are busy places where they must distinguish relevant information from distractions that emerge from many different sources occurring simultaneously. A student must listen to the teacher, adhere to classroom procedures, focus on a specific task, hold and retain information, and make connections between novel information and previous experiences. demonstrated that a single bout of moderate-intensity walking (60 percent of maximum heart rate) resulted in significant improvements in performance on a task requiring attentional inhibition (e.g., the ability to focus on a single task). These findings were accompanied by changes in neuroelectric measures underlying the allocation of attention (see [Figure 2](#)) and significant improvements on the reading subtest of the Wide Range Achievement Test. No such effects were observed following a similar duration of quiet rest. These findings were later replicated and extended to demonstrate benefits for both mathematics and reading performance in healthy children and those diagnosed with attention deficit hyperactivity disorder). Further replications of these findings demonstrated that a single bout of

moderate-intensity exercise using a treadmill improved performance on a task of attention and inhibition, but similar benefits were not derived from moderate-intensity exercise that involved exergaming). It was also found that such benefits were derived following cessation of, but not during, the bout of exercise. The applications of such empirical findings within the school setting remain unclear.

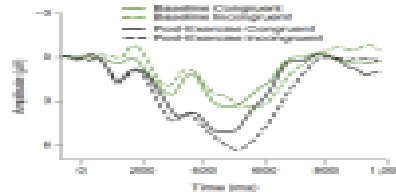


FIGURE 2

Effects of a single session of exercise in preadolescent children. SOURCE: Hillman et al., 2009. Reprinted with permission. A randomized controlled trial entitled Physical Activity Across the Curriculum (PAAC) used cluster randomization among 24 schools to examine the effects of physically active classroom lessons on BMI and academic achievement. The academically oriented physical activities were intended to be of vigorous or moderate intensity (3–6 metabolic equivalents [METs]) and to last approximately 10 minutes and were specifically designed to supplement content in mathematics, language arts, geography, history, spelling, science, and health. The study followed 665 boys and 677 girls for 3 years as they rose from 2nd or 3rd to 4th or 5th grades. Changes in academic achievement, fitness, and blood screening were considered secondary outcomes. During a 3-year period, students who engaged in physically active lessons, on average, improved their academic achievement by 6 percent, while the control groups exhibited a 1 percent decrease. In students who experienced at least 75 minutes of PAAC lessons per week, BMI remained stable (see Figure-3).

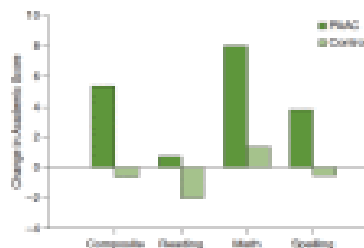


FIGURE 3

Change in academic scores from baseline after physically active classroom lessons in elementary schools in northeast Kansas (2003–2006). NOTE: All differences between the Physical Activity Across the Curriculum (PAAC) group ($N = 117$) and control

THE DEVELOPING BRAIN, PHYSICAL ACTIVITY, AND BRAIN HEALTH. The study of brain health has grown beyond simply measuring behavioral outcomes such as task performance and reaction time (e.g., cognitive processing speed). New technology has emerged that has allowed scientists to understand the impact of lifestyle factors on the brain from the body systems level down to the molecular level. A greater understanding of the cognitive components that subserve academic performance and may be amenable to intervention has thereby been gained. Research conducted in both laboratory and field settings has helped define this line of inquiry and identify some preliminary underlying mechanisms. Despite the current focus on the relationship of physical activity to cognitive development, the evidence base is larger on the association of physical activity with brain health and cognition during aging. Much can be learned about how physical activity affects childhood cognition and scholastic achievement through this work. Despite earlier investigations into the relationship of physical activity to cognitive aging, for a review), the field was shaped

by the findings of who examined the effects of aerobic fitness training on older adults using a randomized controlled design. Specifically, 124 older adults aged 60 and 75 were randomly assigned to a 6-month intervention of either walking (i.e., aerobic training) or flexibility (i.e., nonaerobic) training. The walking group but not the flexibility group showed improved cognitive performance, measured as a shorter response time to the presented stimulus. Results from a series of tasks that tapped different aspects of cognitive control indicated that engagement in physical activity is a beneficial means of combating cognitive aging

Child Development, Brain Structure, and Function. Certain aspects of development have been linked with experience, indicating an intricate interplay between genetic programming and environmental influences. Gray matter, and the organization of synaptic connections in particular, appears to be at least partially dependent on experience (NRC/IOM, 2000; Taylor, 2006), with the brain exhibiting a remarkable ability to reorganize itself in response to input from sensory systems, other cortical systems, or insult (Huttenlocher and Dabholkar, 1997). During typical development, experience shapes the pruning process through the strengthening of neural networks that support relevant thoughts and actions and the elimination of unnecessary or redundant connections. Accordingly, the brain responds to experience in an adaptive or “plastic” manner, resulting in the efficient and effective adoption of thoughts, skills, and actions relevant to one's interactions within one's environmental surroundings. Examples of neural plasticity in response to unique environmental interaction have been demonstrated in human neuroimaging

Effects of Regular Engagement in Physical Activity and Physical Fitness on Brain Function

Other research has attempted to characterize fitness-related differences in brain function using fMRI and event-related brain potentials (ERPs), which are neuroelectric indices of functional brain activation in the electro-encephalographic time series. To date, few randomized controlled interventions have been conducted. Notably, conducted one such intervention lasting approximately 14 weeks that randomized 20 sedentary overweight preadolescent children into an after-school physical activity intervention or a nonactivity control group. The fMRI data collected during an antisaccade task, which requires inhibitory control, indicated increased bilateral activation of the prefrontal cortex and decreased bilateral activation of the posterior parietal cortex following the physical activity intervention relative to the control group. Such findings illustrate some of the neural substrates influenced by participation in physical activity. Two additional correlational studies compared higher- and lower-fit preadolescent children and found differential brain activation and superior task performance as a function of fitness. That is, observed increased activation in prefrontal and parietal brain regions during early task blocks and decreased activation during later task blocks in higher-fit relative to lower-fit children. Given that higher-fit children outperformed lower-fit children on the aspects of the task requiring the greatest amount of cognitive control,

LIMITATIONS. Despite the promising findings described in this chapter, it should be noted that the study of the relationship of childhood physical activity, aerobic fitness, and adiposity to cognitive and brain health and academic performance is in its early stages. Accordingly, most studies have used designs that afford correlation rather than causation. To date, in fact, only two randomized controlled trials on this relationship have been published. However, several others are currently ongoing, and it was necessary to provide evidence through correlational studies before investing the effort, time, and funding required for more demanding causal studies. Given that the evidence base in this area has grown exponentially in the past 10 years through correlational studies and that causal evidence has accumulated through adult and nonhuman animal studies, the next step will be to increase the amount of causal evidence available on school-age children.

Conclusion. From an authentic and practical to a mechanistic perspective, physically active and aerobically fit children consistently outperform their inactive and unfit peers academically on both a short- and a long-term basis. Time spent engaged in physical activity is related not only to a healthier body but also to enriched cognitive development and lifelong brain health. Collectively, the findings across the body of literature in this area suggest that increases in aerobic fitness, derived from physical activity, are related to improvements in the integrity of brain structure and function that underlie academic performance. The strongest relationships have been found between aerobic fitness and performance in mathematics, reading, and English. For children in a school setting, regular participation in physical activity is particularly beneficial with respect to tasks that require working memory and problem solving. These findings are corroborated by the results of both authentic correlational studies and experimental randomized controlled trials. Overall, the benefits of additional time dedicated to physical education and other physical activity opportunities before, during, and after school outweigh the benefits of exclusive utilization of school time for academic learning, as physical activity opportunities offered across the curriculum do not inhibit academic good performance.

REFERENCES

- Sturm R. (2020) Physical education in elementary school and body mass index: Evidence from the Early Childhood Longitudinal Study. *Journal Information*. pp. 23.
- Sturm R. (2017) Childhood overweight and elementary school outcomes. *International Journal of Obesity*. pp. 172
- Magnabosco JL. (2016) Childhood overweight and academic performance: National study of kindergartners and first-graders. *Obesity Research*. pp. 189
- Davidson MC, (2019) Diamond A. Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*. pp. 21.
- Naglieri JA. (2018) Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology*. pp. 48
- Dawson P, Guare R. (2020) Executive skills in children and adolescents: A practical guide to assessment and intervention. New York: Guilford Press; pp. 89
- CS, Seshadri S. (2020) Visceral fat is associated with lower brain volume in healthy middle-aged adults. *Annals of Neurology* pp. 123
- Dexter TT. (2022) Relationships between sport knowledge, sport performance and academic ability: Empirical evidence from GCSE physical education. *Journal of Sports Sciences*. pp. 45