

Physical Activity, Fitness, and Cognitive Processes in School-Aged Children

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Time spent in physical education addressing health-related content and performance based outcomes of the national standards may actually contribute to enhanced academic achievement (van der Mars, 2006). The importance of the mind-body connection is not a new idea, as many learning theorists have assumed interdependence between cognitive and physical health. Intuitively, physical education teachers have held fast to the belief that children do better in school when they have health-enhancing levels of physical fitness, most often observed as normal body weight and regular engagement in moderate to vigorous physical activity (i.e., running, jumping rope, playing basketball).

Today, teachers aspire to having children move freely, like they themselves did during their childhood, as the advent of the 21st century has led to alarming increases in sedentary behaviors (U.S. Department of Health and Human Services [USDHHS], 2000). Traditionally children have participated in physical education, recess, and walked or rode bicycles to schools, yet many of these opportunities are being reduced or eliminated. Over the past ten years enrollment in physical education classes has held steady (National Association for Sport and Physical Education [NASPE], 2006); however, closer scrutiny of physical education lessons has suggested that low percentages of time are spent in moderate to vigorous physical activity engagement (Coe, Pivarnik, Womack, Reeves, & Malina, 2006). Despite general consensus regarding the expectations of student performance, as reflected by the NASPE physical education standards (2004), many physical education programs particularly on the high school

level are considered to be poor performing (Castelli & Rink, 2003). These programs are inhibited by a lack of accountability, marginalization, and little administrative support.

Because of time, safety, and other educational issues such as school of choice (where a child elects not to attend a neighborhood school, but instead enrolls in one across town), the frequency of walking or riding a bicycle to school has declined (USDHHS, 2000). Additionally, public policy such as the No Child Left Behind mandate (The No Child Left Behind Act, 2002), has placed external pressures on schools and teachers to enhanced student performance in reading, mathematics, and science. As an attempt to increase academic learning time, particularly in these subjects, some schools have reduced or eliminated recess (Skrupskelis, 2000).

Increased sedentary behaviors stemming from societal changes, policies, or ineffective curricula, have been directly linked to public health issues such as childhood obesity. Approximately one-third of all children are overweight or at risk for overweight (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004); a drastic increase from just a decade ago. Additionally, increased incidence of juvenile or type II diabetes formally thought of as adult onset disease have been recorded (USDHHS, 2000). The American Heart Association (AHA) and the Center for Disease Control (CDC) are presently reconsidering the role of schools in addressing these public health issues. The purpose of this article is to inform educational personnel of the physical and cognitive health benefits associated with physical activity and fitness. Particularly, this article will focus on the mechanisms by which a school can expand its role in addressing public health issues while concomitantly enhancing cognitive performance through the modification of present practice.

Cognitive Processes and Physical Attributes in the Educational Context

In school-age children, common measures of cognitive performance are standardized testing, grade point average, grades as well as measures of concentration, memory, and other overt behaviors. Longitudinal studies conducted in the late 1970's (Shepard, JeQuier, LaValle, LeBarre, & Rajic, 1980) and 1980's (Shepard, 1984) brought some initial positive associations between academic achievement and enrollment in physical education. A study by Issacs, Anderson, Alcantara, Black, & Greenough (1992) confirmed the associations between physical activity, motor skill, and cognitive processing by using animals and a rigorous experimental design. Specifically, Issacs et al. (1992) discovered that rats who were trained both aerobically (i.e., running on a wheel) and participated in activities with a complex motor demand (i.e., climbing ropes, seesaws, and rope bridges) had more efficient cognitive function because of increased blood flow to the brain.

Since that time, findings related to increased cognitive performance have been established in older adults (Kramer, Sowon, Cohen, Banich, McAuley, Harrison, et al., 1999) as well as in children (Hillman, Castelli, & Buck, 2005). Specifically, work by Hillman et al. (2005) has suggested that enhanced neurocognitive function is associated with aerobic fitness, as high fit children exhibited greater reaction time, accuracy, and better attention than low fit children on a computer generated stimulus-response task. Yet, another study suggested that fitness effects are not exclusive to aerobic capacity but more a result of overall fitness that is influenced by an individual's genetics and nutritional habits (Etnier, Nowell, Landers, & Sibley, 2006). As such, it is difficult to quantify these effects into specific recommendations for behavioral change or curriculum reform.

Studies have equated small, positive gains in cognitive performance with high fitness (CDE, 2001; Castelli, Hillman, Buck, & Erwin, *in press*) and regularity of physical activity (Coe,

Pivarnik, Womack, Reeves, & Malina, 2006; Sibley & Etnier, 2003). Additionally, increased physical education and reduced academic subject matter time was determined not to be harmful to academic performance (Dwyer, Coonan, Leitch, Hetzel, & Baghurst, 1983; Sallis, McKenzie, Kolodyt, Lewis, Marshall, & Rosengard, 1999; van der Mars, 2006).

Utilizing a random control design, students in three different conditions (health-fitness, sport-fitness, and self-management) were examined to determine the influence of physical activity on academic performance (Sallis et al., 1999). Sports, Play, and Active Recreation for Kids [SPARK] used a comprehensive curriculum to educate students in health-related fitness content and promote cardiovascular activity within and beyond school. Although academic achievement scores did not significantly increase it was concluded that the additional time spent in physical education did not detract from academic performance. More specifically, those students who participated in the health-fitness curriculum had improvements in academic achievement, though not significant from the other conditions.

The California Department of Education (CDE, 2001) conducted a study individually matching student scores from the Stanford Achievement Test with results of the state-mandated physical fitness test, known as the *FITNESSGRAM* (Welk, Morrow, & Falls, 2002). In this study, reading and mathematics scores were matched with fitness scores of 353,000 fifth graders, 322,000 seventh graders, and 279,000 ninth graders. A positive relationship was observed for physical fitness and the Stanford Achievement Test across all grades, as a higher level of fitness was associated with higher academic achievement in both mathematics and reading.

In a similar study examining the relationship of physical fitness to academic achievement on standardized tests in 3rd and 5th grade students, Castelli, Hillman, Buck & Erwin, (*in press*) found that overall physical fitness was positively related to academic performance. Findings

identified that performance in mathematics was most closely related to aerobic fitness.

Additionally, children with lower BMI also performed better academically, thus corroborating the CDE and SPARK studies on children. Unlike the previous studies, children from both high and low poverty circumstance were just as likely to benefit from attainment of physical fitness.

Despite these positive associations, researchers are not yet able to prescribe recommendations beyond that of increasing physical activity to 60 or more minutes per day for children (NASPE, 2004). A recent study examining the relationship between physical education enrollment and academic performance in sixth grade students discovered that some physical education classes may not offer a long or hard enough amount of physical activity to make a difference in cognitive performance (Coe et al., 2006). Only those students who did meet the physical activity guidelines and displayed vigorous activity during engagement had higher grades than their inactive counterparts. In no way does this literature suggest that an individual who runs a single lap at a higher intensity than his/her peers will likely become smarter as a result. Instead, these data suggest that regular physical activity engagement at a moderate to vigorous level can help many individuals reap cognitive benefits when compared to their inactive peers, even from early stages of child development.

Findings from these studies indicate that positive contributors to cognitive performance such as physical activity and fitness can be increased by key school personnel in order to improve physical health and potentially academic performance in students. Federal mandates have increased pressure to achieve basic levels of competency in reading, mathematics, and science and have resulted in diminished opportunities for physical activity during the school day (The No Child Left Behind Act, 2002). Counter to this practice, national organizations such as AHA, CDC, and NASPE have suggested that schools provide enjoyable, lifetime physical

activities, and promote motor skills development. Several elements of the educational context, such as policies, teacher and student attitudes, may influence the relationship between physical fitness and academic performance (Shephard, 1997). Therefore, it is timely for schools to take necessary action.

Comprehensive Provision of Physical Activity

Increasing the frequency and intensity of physical activity engagement is a delicate and complex process requiring a change in behavior. A comprehensive commitment by the schools and the communities in which they are nested is required, as physical activity opportunities are contextually based and vary substantially by situation (Barnett, O'Loughlin, Gauvin, Paradis, & Hanley, 2006). Within the school day an elementary-aged child should participate in 30 minutes of daily physical education and an additional 30 minutes of recess (Pate et al., 2006). Students in secondary education should participate in at least 50 minutes of physical education each day and be offered physical activity opportunities during breaks in academics (i.e., walking during lunch hour, open gym during study hall).

Given the findings in the literature as well as variation by setting, several recent developments warrant consideration in educational programming: (a) reform of the physical education curriculum, (b) physical activity as part of the school curriculum, and (c) connectedness with community programming. If schools are to play a pivotal role in changing the physical activity behaviors of children it must be a comprehensive effort, laden throughout the formal as well as hidden curriculum.

Reform of the physical education curriculum. An administrator and physical education teacher(s) should conduct an evaluation of the effectiveness of the present physical education curriculum. The administrator should observe at least one physical education lesson and begin

that observation by asking the teacher how the lesson relates to the NASPE national and state standards. Each activity within a lesson should be structured to address health-related content identified by the NASPE national standards (2004), as enactment of these recommendations will enable children to enjoy physical activity throughout the lifespan. Specifically, the administrator needs to quantify the amount of student physical activity time provided during the lesson. Students should be physically active more than 50% of the time in each lesson in order to target behavioral change.

Through this evaluation process, the teacher should also conduct a self-reflection, in writing based upon the same criteria suggested for use by the administrator: (a) the attempt to put standards into practice, and (b) the amount of physical activity time provided during the lesson. It is important to realize that physical activity time may be reduced when the teacher is introducing a new unit, there are high safety demands, or the tasks are complex in nature. The teacher and administrator should consider these factors when scheduling the observation date. After reflection by the physical education teacher and evaluation by the administrator, if the physical education lessons are not structured in this manner, then reform should take place.

The physical education curriculum should also have a predominantly health-related content base with additional attention given to the promotion of social responsibility and refinement of motor skills. Specifically, during physical education instruction teachers should address ways in which students can be physically active beyond the school day or increase physical demands of the activities in which they are currently engaged. As suggested in an article by Castelli & Beighle (*in press*), one simple way to increase physical activity during recess time is by taking one or two physical education lessons to teach students how to modify traditional

playground games to increase the amount of engagement in activity. Teachers should explain what it means to have active recess, where there is “no parking on the playground.”

The integration of easy to use technology such as pedometers can also help a physical education teacher extend his/her curriculum beyond the individual lessons. Children could wear pedometers throughout the school day, recording steps counts during recess or activity break times. The promotion of physical activity begins within the formal physical education instruction and should be supported throughout the entire school curriculum.

Physical activity as part of the school curriculum. Nearly half of young people are not active on a regular basis (USDHHS, 2000) and the school environment may be the only place in which some young people have an opportunity to do so. The positive effects of physical activity come from accumulated amounts and therefore can result from several short bouts provided throughout the school day. Given the brevity of classes, time required for instruction and management, physical activity should not exclusively come from physical education classes during the school day. School-wide events, active recess, and brief bouts of physical activity in the classroom setting are mechanisms that can be utilized to endorse engagement throughout the school curriculum.

The Child Nutrition and WIC Reauthorization Act of 2004 required each school to develop a wellness policy for this academic year. In many situations, the physical education teacher has likely already collaborated in the policy development. The physical education teacher who is a member of the wellness team may want to establish a physical activity committee (PAC) (Castelli & Beighle, *in press*). This committee, comprised of subject matter teachers, administrators, parents, recess supervisors, coaches, students, and other community members, can plan events that promote healthy choices. For example, on national walk to school day, this

committee could promote school-wide participation. A recent feasibility study examining the integration of events created by a PAC have valuable potential for increasing physical activity in elementary-aged students (Oliver, Schofield, & McEvoy, 2006).

According to Pellegrini and Bohn (2005) recess plays an important role in the cognitive development of children. In combination with the health benefits, children can also improve social responsibility and motor performance during recess. It is important for the PAC to provide opportunities and incentives for active, not passive recess. Active recess involves gross motor movements requiring an individual to increase his/her breathing and heart rate. Whether briskly walking while talking to a friend or intensely engaged in a competitive game of football, students are choosing their own level of engagement.

Recently, the classroom has been considered as another possible outlet for physical activity. For example, a new program entitled *TAKE 10!* has successfully introduced physical activity opportunities into classroom instruction (Stewart, Dennison, Kohl, & Doyle, 2004). Some teachers have already embraced this notion and have children physically act out poems or dance to increase comprehension of content. In class, during an activity breaks, or through a school-wide event, the PAC can promote engagement in many different forums.

Connectedness with community programming. A responsibility of the PAC can be to promote physical activity beyond the school day. Before and after school programs as well as those conducted in the community on the weekends are other places in which children can be physically active. The PAC endorsing these types of events is more likely to impact engagement. For example, a community may want to encourage young children to have a positive experience with running, so they host a one-mile fun run. A child and parent could run in an event prior to a larger competition on the same course. Children can train during physical education programs,

but also keep physical activity logs of their efforts with parents outside of school and subsequently be rewarded with beads for their shoelaces or rubber wrist bracelets for their continued participation. The largest incentive however would be to run down the middle of main street on race day. The community that embraces physical activity as an important element in public health can create an environment conducive to its continuation.

Because of the uniqueness of each community, it is difficult to suggest particular events. What the PAC needs to do is investigate all of the physical activity possibilities within the community and unite with the key promoters of those events. In all likelihood, the event sponsors would be thrilled at the chance to increase participation. The sponsors may even be willing to wave registration fees, provide t-shirts, or conduct a school demonstration. The PAC may choose to start small, like taking students to a local bowling alley as a field trip, or may wish to create their own physical activity event, but whatever the decision of the PAC, school-community linkages are an important factor in addressing public health issues (Pate et al., 2006).

In Summary

Schools and teachers should play an instrumental role in changing the physical activity behaviors of children (Pate et al., 2006). The school wellness team provides an ideal unit to increase physical activity engagement during physical education, academic breaks, as well as in the classroom setting. The formation of a PAC provides a more comprehensive endorsement of physical activity across the curriculum and into the community setting. If school and community leaders can successfully increase physical activity engagement of children there are numerous physical and cognitive health benefits. One positive outcome of direct importance to teachers and administrators is the likelihood of increased academic performance, as physical activity and fitness are associated with greater cognitive function.

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