

Physical Education, Physical Activity, and Academic Performance in Youth

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Introduction

The teaching of physical education in public schools is an educational practice that dates back to the mid 1800s (Welch, 1996). The goals of school physical education go beyond the simple promotion of physical activity and fitness and include development of the cognitive knowledge and the physical, social, and emotional skills necessary for participation in life-long physical activity. However, with school systems facing budgetary constraints and pressure to improve academic test scores as part of “No Child Left Behind,” teachers and administrators are increasingly questioning the contribution of physical education and other physical activity programs to the central academic mission of schools. This concern has led to a substantial reduction in the time available for physical activity instruction during the school day, and in some cases, school-based physical activity programs have been completely eliminated. In 2006, only 3.8% of elementary schools, 7.9% of middle schools, and 2.1% of high schools provided daily physical education or its equivalent for the entire school year in all grades in the school (Lee, Burgeson, Fulton, & Spain, 2007).



The decision to downsize or eliminate physical education or other school-based physical activity programs to increase classroom instructional time is the focus of this review. A review of peer-reviewed scientific literature on this topic will demonstrate that increasing time for physical education or other school-based physical activity programs does not adversely affect academic performance. The review will also provide evidence that health-related outcomes associated with school physical education, higher levels of physical activity and physical fitness, are positively associated with improved academic performance in youth.

Physical Education and Academic Performance

To date, four controlled experimental studies have evaluated the effects on academic performance of allocating additional instructional time for physical education. The results from all four studies clearly demonstrate that physical activity does not need to be sacrificed for academic performance.

Shephard and colleagues (Shephard et al., 1984; Shephard, 1997) examined the effects on academic performance of adding one hour per day of physical education in a cohort of 546 elementary school students. Control students received only the standard single period of physical education per week. Each student’s academic performance was calculated as the average of classroom grades for French, mathematics, English, and natural science. From grades 2 through 6 (ages 8–12 years), the experimental classrooms exhibited significantly higher levels of academic performance than controls, despite receiving, on average, 14% less classroom time. Yearly differences

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Research Digest

ranged from 9.4% in grade 4 to 28% in grade 2. Across all grade levels, the average difference in academic performance was 15.5%.

Dwyer et al. (Dwyer, Coonan, Leitch, Hetzel, & Baghurst, 1983; Dwyer, Blizzard, & Dean, 1996) examined the impact of an extended physical education curriculum on academic performance in fifth-grade children (mean age = 10 years) in South Australia. At each of the seven participating schools, class groups were randomly assigned to one of three 14-week programs: fitness, motor skill, or control. Classes assigned to the fitness and skill conditions received 75 min of moderate-to-vigorous physical activity per day, 15 min before school and 60 min in normal class time. Classes assigned to the control condition received the usual three 30-min periods of physical education. Despite a substantial reduction in classroom time for the fitness and skills groups (210 min per week), there were no significant group differences in arithmetic performance or reading skills over the 14-week study period.

Sallis et al. (1999) investigated the effects of an intensive 2-year health-related physical education program on academic achievement in elementary school children. Seven participating primary schools were randomly assigned to one of three experimental conditions. Two schools adopted a modified physical education curriculum taught by physical education specialists. An additional two schools adopted the same curriculum, but the program was taught by classroom teachers and not physical education specialists. The three remaining schools served as controls that maintained their usual physical education program taught by classroom teachers. The modified physical education program called for a minimum of three 30-min lessons per week for 36 weeks. Academic achievement before and after the 2-year physical education program was measured via school district administered standardized tests. Scores in all conditions declined over the 2 years. Although the teacher-led physical education program significantly attenuated the declines in overall achievement and achievement in language and reading, the intensive physical education program did not adversely affect academic achievement, despite a doubling of the amount of time devoted to physical education.

A recently published study involving fourth- and fifth-grade students from British Columbia evaluated the effects on academic performance of introducing daily 15-min classroom physical activity sessions (Ahamed et al., 2007). Ten elementary schools, stratified by size and geographical location, were randomly assigned to one of three conditions: (1) liaison schools, (2) champion schools, and (3) usual practice schools. Liaison schools implemented the daily activity program with the help of external consultants, whereas champion schools received minimal outside assistance and established a program facilitator or "school champion" within the school. Classroom teachers in both the liaison and champion schools completed single-day training sessions on implementing the classroom activity program and were provided with additional resources and equipment for physical activity. Throughout the study, students continued participation in their regularly scheduled physical education program (80 min/wk). For the evaluation of increased physical activity instructional time on academic performance, the liaison and champion conditions were combined and compared with the usual-care control schools. Academic performance was measured using the Canadian Achievement Test (CAT-3), which evaluated knowledge and skills related to math, reading, and language arts. Despite increasing in-school physical activity time by approximately 50 min per week, students attending intervention schools had equivalent standardized test scores in mathematics, reading, and language arts as controls.

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A number of investigations employing either observational or quasi-experimental study designs have evaluated the relationship between physical education instructional time and academic performance. The results of these studies show that increasing or decreasing time for physical education does not help or hurt academic performance.

Coe, Pivarnik, Womack, Reeves, and Malina (2006) studied the effects of enrollment in physical education on the academic achievement of 214 sixth-grade students at one middle school. In this year-long study, students were enrolled in physical education in either the first or second semester. The authors sought to determine whether students' grades and standardized test scores in reading/language arts, math, science, and social studies would be significantly different between the two semesters. They found that enrollment in physical education did not adversely affect students' grades or standardized test scores, despite receiving 55 min less classroom instructional time daily.

Dollman, Boshoff, and Dodd (2006) completed a retrospective analysis of 117 elementary schools in South Australia by collecting data on the average time spent in physical education, the students' academic achievement for years 3, 5, 7, and 9 for mathematics and literacy, the percentage of students in the school with a non-English speaking background (as an indicator of ethnicity), and the percentage of students at the school receiving government assistance (an indicator of socioeconomic status). After controlling for demographic factors, time in physical education was unrelated to achievement in mathematics and literacy.

Tremarche, Robinson, and Graham (2007) compared standardized test scores in mathematics and English/language arts (Massachusetts Comprehensive Assessment System) among fourth-grade students exposed to either a high or low amount of physical education programming. Students receiving 56 hours per school year of physical education exhibited significantly higher test scores in English/language arts than students receiving 28 hours per school year of physical education. There were no significant differences on mathematics test scores.

Most recently, Carlson et al. (2008) analyzed data from the Early Childhood Longitudinal Study (ECLS) to evaluate the association between time spent in physical education and academic achievement in a nationally representative cohort of children from kindergarten through to fifth grade (N = 5,316). The weekly frequency (<1, 1–2, 3–4, daily) and average lesson duration (1–15 min, 16–30 min, 31–60 min, >60 min) of school physical education, as reported by classroom teachers, were combined to form physical education exposure categories labeled low (0–35 min per week), medium (36–69 min per week), and high (70–300 min per week). Academic achievement in mathematics and reading were measured using item response theory (IRT) scores developed for the ECLS by the National Center for Educational Statistics. Exposure to physical education and achievement in mathematics and reading were measured at five time points: fall of kindergarten, spring of kindergarten, spring of first grade, spring of second grade, and spring of fifth grade. In cross-sectional analyses, after controlling for family income, race ethnicity, maternal education, and kindergarten type (half vs. full day), girls receiving 70 min or more of physical education weekly exhibited higher achievement in mathematics and reading than students receiving lower amounts of physical education. However, these differences were only statistically significant in kindergarten and grades 1 and 5. In the longitudinal analysis, after controlling for grade level gains, baseline scores, kindergarten type, and demographic variables, girls receiving 70 min or more of physical education weekly exhibited

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significantly higher achievement scores in mathematics and reading than girls receiving physical education for 35 min or less weekly. In both the cross-sectional and longitudinal analyses, greater exposure to physical education was neither positively or negatively associated with academic achievement in boys.

To further delineate the relationship between time in physical education and academic performance, we calculated effect sizes (Cohen's *d*) from six experimental studies in which exposure to additional physical education served as an independent variable. The six studies provided a total of 28 effect sizes, ranging in magnitude from -1.4 to 1.2. The distribution of effect sizes is show in Figure 1. The mean effect size was 0.02 (95% CI = -0.15 to 0.20), indicating that, on average, increasing time in physical education had little or no effect on academic performance.

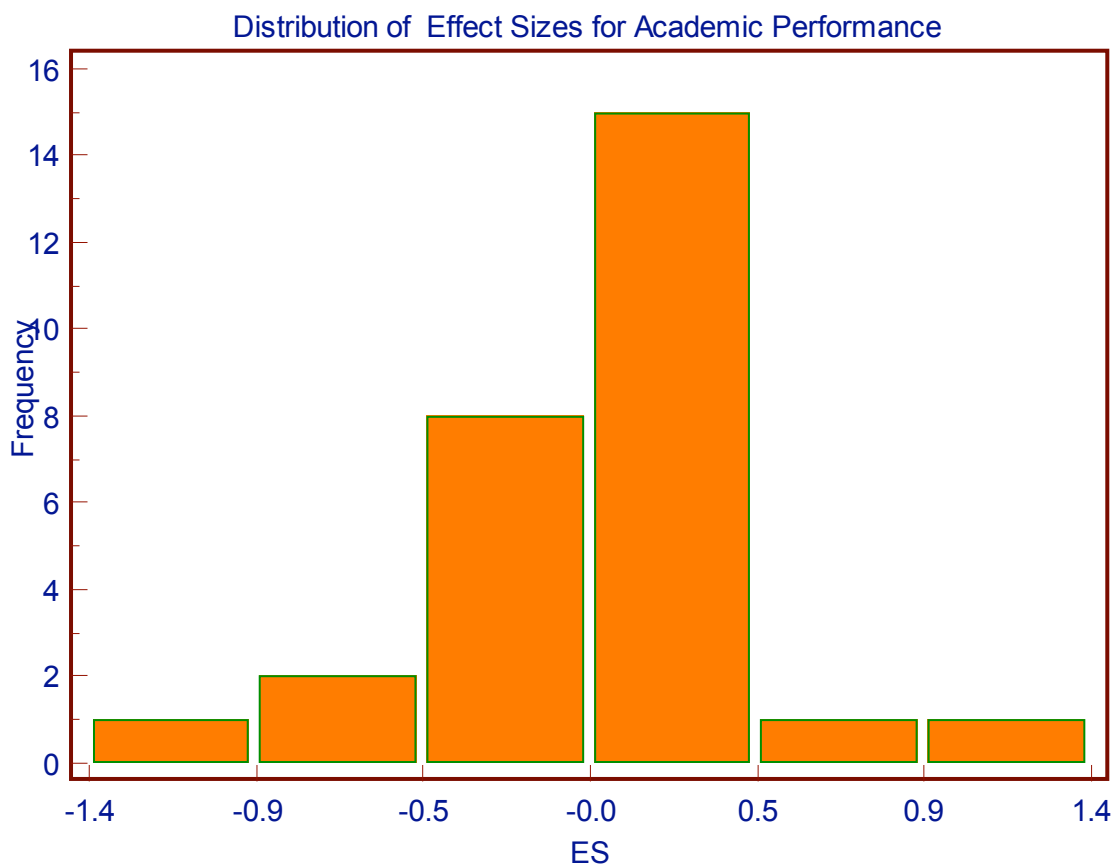


Figure 1 — Distribution of effect sizes (Cohen's *d*) from studies investigating the impact of additional school physical education on academic performance.

Physical Activity and Academic Achievement

The case for inclusion of physical education programs and other opportunities for physical activity during the school day is strengthened considerably by a substantial body of scientific evidence linking regular participation in physical activity to higher levels of academic performance.

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Studies conducted by McIntosh (1966) and Start (1967) in the United Kingdom during the 1960s suggested that students of higher academic standing were significantly more likely than students of lower academic ability to participate in school and extracurricular sports. However, none of these early studies controlled for socioeconomic status or other potentially confounding factors. More recent studies conducted in the UK confirm the results of earlier studies. Williams (1988) studied the sport and physical activity behaviors of 14,350 students from 15 schools in London. Sports participation was positively associated with academic attainment. The effect was evident in both boys and girls, but was particularly strong among adolescent girls.

Lindner (1999) investigated the relationship between sports participation and perceived academic performance in 4,690 Hong Kong children age 9 to 18 years. A sports participation index was derived from the self-reported frequency, duration, and months of participation for up to five sports or physical activities. Student participants rated their academic performance as good, average, below average, or poor. The sports participation index was significantly higher among students with high self-rated academic performance than for students with less satisfactory self-rated academic performance. The association was stronger in girls than in boys.

Dwyer, Sallis, Blizzard, Lazarus, and Dean (2001) assessed the relationship between physical activity and academic performance in a national sample of Australian children age 7 to 15 years ($N = 7,961$). Academic performance for each participant was measured using a 5-point rating scale completed by a school representative (principal). Physical activity was assessed by questionnaire. Students reported the frequency, duration, and intensity with which they cycled or walked to school, engaged in physical education class, engaged in school sport, and engaged in other physical activities. A further item asked students to report their usual level of activity during lunchtime. Among girls aged 7, 8, 9, and 14 years, small but statistically significant positive associations ($r = .11-.19$) were observed between rating of academic performance and physical activity. Among boys, physical activity was weakly associated with academic performance in all age groups, with the exception of 11-year-olds. Correlations ranged from .08 to .18.

Sigfusdottir, Kristjansson, and Allegrante (2007) evaluated the association between physical activity and academic performance in a nationally representative sample of Icelandic ninth- and tenth-grade students ($N = 5,810$). Physical activity was measured via four self-report questions related to frequency of physical activity outside of school, participation in sports clubs or teams, participation in nonorganized physical activities, and frequency of vigorous-intensity activities. Self-reported grades in Icelandic, mathematics, English, and Danish were used as indicators of academic performance. After controlling for absenteeism, parental education, family structure, and gender, physical activity was found to be a weak but significant positive predictor of academic performance.

Tremblay, Inman, and Willms (2000) examined the relationship between physical activity and academic performance in approximately 7,000 sixth-grade students residing in New Brunswick, Canada. Physical activity was based on four questions assessing the weekly frequency of sustained moderate physical activity, sustained vigorous physical activity, and participation in strength and flexibility enhancing activities. Academic performance was measured by standardized scores on reading and mathematics tests administered by the Department of Education. After adjusting for socioeconomic status, family structure, and BMI, physical activity was negatively associated with math and reading scores; however, the magnitude of the associations were trivial and close to zero.

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In the United States, Fejgin (1994) analyzed data from the National Educational Longitudinal Study (N = 22,696) to track the effects of participation in competitive school sports on academic performance from the eighth through the tenth grade. After controlling for gender, race/ethnicity, family income, parental education, and academic performance in the eighth grade, sports participation was associated with higher levels of academic performance, although its explanatory contribution was weak. Using data from the 1990 Centers for Disease Control and Prevention's Youth Risk Behavior Survey some two years later, Pate, Heath, Dowda, and Trost (1996) assessed the relationship between physical activity and academic performance in a population-representative sample of U.S. high school students. After controlling for age, sex, and race/ethnicity, low active youth were found to be 1.9 times more likely than active students to have low levels of academic performance. Most recently, Nelson and Gordon-Larsen (2006) analyzed data from the U.S. National Longitudinal Study of Adolescent Health to examine the association between physical activity and academic performance. Adolescents who reported either participating in school activities, such as physical education and team sports, or playing sports with their parents were 20% more likely than their sedentary peers to earn an "A" in math or English.

Physical Fitness and Academic Performance

Several population-level investigations have assessed the relationship between physical fitness and academic performance in school-age youth. These studies have consistently reported significant positive associations between physical fitness and academic achievement.

Dwyer et al. (2001) assessed the relationship between physical fitness and academic performance in a national sample of Australian children age 7 to 15 years. Academic performance was measured using a 5-point rating scale completed by a school administrator, usually the principal. Measures of physical fitness included the PWC 170 cycle ergometer test for cardiorespiratory fitness, 1-mile run, 50-m shuttle run, timed sit-up test, timed push-up test, sit and reach, and standing long jump. Although the magnitude of the association varied by sex and grade level, ratings of academic performance were significantly correlated with performance on the 1-mile run, timed sit-up test, and timed push-up test. However, none of the fitness parameters accounted for more than 10% of the variability in academic performance.

Kim et al. (2003) evaluated the association between physical fitness and academic performance in a representative sample of just under 6,500 Korean boys and girls in grades 5, 8, and 11. Standardized fitness scores based on performance in sprinting, long distance running, standing long jump, chin-ups, and throwing were positively correlated with student grade point average. The squared multiple correlation for the fitness parameters ranged from 1.3% in grade-11 boys to 9.3% in grade-5 boys. In comparison, socioeconomic status explained between 2.3% and 13% of the variance in grade point average.

Grissom (2005) evaluated the relationship between physical fitness and academic achievement in fifth-, seventh-, and ninth-grade Californian schoolchildren (N = 884,715). Academic achievement was based on test scores on the Stanford Achievement Test 9th edition. Physical fitness was measured using the Fitnessgram test battery. Standardized test scores in reading and mathematics increased significantly with the number of fitness standards achieved. Across grade levels, Fitnessgram test scores accounted for 4–5% of the variability in test scores.

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Most recently, Castelli, Hillman, Buck, and Erwin (2007) evaluated the relationship between components of health-related physical fitness and academic achievement in 259 third- and fifth-grade public school students. Academic achievement was measured using the Illinois Academic Standards Achievement Test for mathematics and reading. The different components of physical fitness, including aerobic fitness, body mass index, muscular strength, and flexibility were assessed using the Fitnessgram test battery. After controlling for age, sex, and school, aerobic fitness and BMI were significantly associated with general academic achievement and achievement in reading and mathematics. Standardized betas for cardiorespiratory fitness ranged from 0.40 to 0.43, indicating that a 1 standard deviation increase in aerobic fitness was associated with an increase of just over 0.4 standard deviations in academic achievement. A 1 standard deviation increase in BMI was associated with a 0.13–0.16 decrease in academic achievement.

Conclusions

The research examining the relationship between physical activity and academic performance in youth clearly shows that physical education and other school-based physical activity programs do not adversely affect academic performance. Furthermore, health-related outcomes associated with school physical education such as regular participation in physical activity and higher levels of aerobic fitness are related to improved academic performance. Therefore, on the basis of this evidence, the position that these school-based physical activity programs should be eliminated or significantly reduced to provide more classroom instructional time cannot be justified. There is no need to sacrifice students' health to achieve academic goals.

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