Physical Activity and Student Performance at School

Howard Taras

ABSTRACT: *To review the state of research on the association between physical activity among school-aged children and academic outcomes, the author reviewed published studies on this topic. A table includes brief descriptions of each study's research methodology and outcomes. A review of the research demonstrates that there may be some short-term improvements of physical activity (such as on concentration) but that long-term improvement of academic achievement as a result of more vigorous physical activity is not well substantiated. The relationship between physical activity in children and academic outcomes requires further elucidation.* (J Sch Health. 2005;75(6):214-218)

An understanding of the impact of student health on educational outcomes has major implications. Among them are ramifications for how schools address health concerns. The National Coordinating Committee on School Health and Safety (NCCSHS), comprising representatives of federal departments and national nongovernmental organizations, encourages school districts to respond to evolving challenges by developing coordinated school health programs. To enhance awareness of existing evidence linking health and school performance and to identify gaps in knowledge, the NCCSHS has begun a project designed to ascertain the status of research in these areas. The project involves a literature search of peer-reviewed published research reporting on the relationship between students' health and their performance in school. Compilations of research articles exploring the association between academic performance and health include those on chronic conditions. This article summarizes findings on the association between physical activity and academic outcomes among school-aged children.

BACKGROUND ON PHYSICAL ACTIVITY IN THE ACADEMIC SETTING

Few teachers, administrators, and parents would argue with the assumption that physical activity is likely to help children perform better in school. Physical activity improves general circulation, increases blood flow to the brain, and raises levels of norepinephrine and endorphins—all of which may reduce stress, improve mood, induce a calming effect after exercise, and perhaps as a result improve achievement.[1,2] The structure of physical activity in schools also provides social benefits that could result in academic outcomes. Children who learn to cooperate, share, and abide by rules of group physical activities and those who learn to discover and test their physical abilities even in individual activities are likely to feel more connected to their school and community and want to challenge themselves. Physically active adolescents are less likely to attempt suicide, adopt risk-taking behaviors, and become pregnant—all of which may be associated with better academic outcomes.[3,4]

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Nevertheless, daily physical education among elementary and secondary school students is not common in US schools and may be becoming less so[5], despite the recommendations from the federal government and professional education associations. The National Association for Sport and Physical Education has recommended standards for physical education and developed sound sequential curricula that build student knowledge and skills from year to year in developmentally appropriate ways.[6] Healthy People 2010 objectives include increasing the proportion of adolescents who participate in daily school physical education and the proportion of the nation's public and private schools that require daily physical education for all students.[7]

SELECTION OF PHYSICAL ACTIVITY ARTICLES

Only articles meeting the following criteria were selected for review. (1) Study subjects were school-aged children (5 to 18 years), (2) article was published later than 1984 (20 years) in a peer-reviewed journal, and (3) research included at least one of the following outcomes: school attendance, academic achievement, a measure of cognitive ability (such as general intelligence, memory), and attention. If a full article could not be retrieved, studies with detailed abstracts were included. Many studies cited here had major outcome measures other than those pertinent to the objectives of this project. These alternative outcomes may not be described at all or are briefly mentioned.

LITERATURE REVIEW

There were 14 articles published since 1984 that examined the association between physical activity in school-aged children and academic performance (Table 1). Most were descriptive retrospective studies that compared reports on physical activity levels with reported academic achievement in a defined population. Some studies addressed the impact of physical education programs, others involvement in sports and other extracurricular activities. For the most part, the studies showed either significant but weak associations between activity level and better academic performance or no correlation at all. It is difficult from these studies to know if the association is causal and if so, the direction of the cause-effect.

Five articles (Caterino and Polak 1999, MacMahon and Gross 1987, Raviv 1990, Sallis et al 1999, Shephard 1996 in Table 1) had prospective, controlled experimental designs. A physical activity regimen was instituted to a portion of a population, and outcomes were measured in both control and intervention groups. Conclusions are

Table 1
Published Research Articles that Address Childhood Physical Activity and School Performance *(Continued on next page)*

Reference	Experimental Design	Outcomes Related to School Performance
Caterino MC, Polak ED. Effects of 2 types of activity on the performance of 2nd-, 3rd-, and 4th-grade students on a test of concentration. *Percept Mot Skills.* 1999;89:245-248. (United States)	54 children (second to fourth graders) were divided into 2 groups: "no physical activity" or "physical activity" (15 minutes of stretching and aerobic walking). All children were then given Woodcock-Johnson Test of Concentration.	Fourth graders showed significantly better performance on Woodcock-Johnson Tests of Concentration if they had participated in physical activity prior to the test. No differences associated with physical activity were found on test performance among second and third graders.
Daley AJ, Ryan J. Academic performance and participation in physical activity by secondary school adolescents. *Percept Mot Skills.* 2000;91:531-534. (United Kingdom)	232 students in a private school (in grades 8-11; ages 13-16) were randomly selected and asked about sports-based physical activities. Academic performance assessed using most recent examination scores in English, Math, and Science.	Various correlations between academic performance and physical activity (minutes and frequency) were not significant.
Dexter T. Relationship between sport knowledge, sport performance and academic ability: empirical evidence from GCSE Physical Education. General Certificate of Secondary Education. *J Sport Sci.* 1999;17:283-295. (United Kingdom)	Sports knowledge and achievement in English and Math were determined by looking at graduation examinations of 517 16-year-old students from 17 different schools. All students had chosen Physical Education as an elective. Performance in physical activities was assessed using teacher scores.	A weak but positive correlation was found between academic ability in Math and in English and sport performance.
Field T, Diego M, Sanders CE. Exercise is positively related to adolescents' relationships and academics. *Adolescence.* 2001; 36(141):106-110. (United States)	89 high school seniors were given questionnaire on exercise habits, academic performance, and other questions. For exercise, the median was found and the group divided into high- and low-exercise groups. Grade point averages (GPAs) were scored on a 4-point scale (from A to D).	Adolescents in high-exercise group engaged in sports more hours per week and statistically had significantly higher GPAs.
Fisher M, Juszczak L, Friedman SB. Sports participation in an urban high school: academic and psychologic correlates. *J Adolesc Health.* 1996;18:329-334. (United States)	Anonymous questionnaires were given to 838 students in high school gym classes. Demographics, academic performance, sports involvement, leisure time, substance use, and other questions were given.	Sports involvement was not statistically associated with academic performance.
Harrison PA, Gopalakrishnan N. Differences in behavior, psychological factors, and environmental factors associated with participation in school sports and other activities in adolescence. *J Sch Health.* 2003;73(3):113-120. (United States)	Data taken from statewide multiyear surveillance. Over 50,000 ninth graders were surveyed for extracurricular activities, sports participation, and other habits/ attitudes.	Students involved in both sports and other extracurricular activities had the highest chances of doing more than 3 hours homework per week (58% for those in sports and other extracurricular; 52% for those in extracurricular; 38% for those in sports only; 30% in neither).

Table 1
Published Research Articles that Address Childhood Physical Activity and School Performance *(Continued from previous page)*

Reference	Experimental Design	Outcomes Related to School Performance
Oh SY, Kim WK, Jang YA, Won HS, Lee HS, Kim SH. Academic performance of Korean children is associated with dietary behaviours and physical status. *Asia Pac J Clin Nutr.* 2003;12(2):186-192. (Korea)	More than 6000 students (grades 5, 8, and 11) were given a questionnaire that included food frequency. GPAs, height, weight, and physical fitness scores were recorded from school records.	Small positive association of physical fitness to academic performance was found.
Knight D, Rizzuto T. Relations for children in grades 2, 3, and 4 between balance skills and academic achievement. *Percept Mot Skills.* 1993; 76:1296-1298. (USA)	122 students (second to fourth grades; ages 7-11) were assessed on 10 balance skills (eg, balance beam walking, 1 foot hop). Children either passed or failed each, giving a score from 0 to 10. Iowa Test of Basic Skills scores for mathematics and reading subtests were ascertained.	Reading and mathematics achievement scores increase as balance skills scores increased.
MacMahon JR, Gross RT. Physical and psychological effects of aerobic exercise in boys with learning disabilities. *Dev Behav Pediatr.* 1987;8(5):274-277. (United States)	54 boys (ages 7-12) from a private school were randomly assigned to an aerobic exercise program or to a less vigorous exercise program—each lasting 20 weeks. All boys had average or higher Wechsler Intelligence Scale for Children-Revised (WISC-R) intelligence test scores and had been diagnosed as learning disabled (Wide Range Achievement Test [WRAT] test of achievement greater than 1.5 standard deviations below mean). WRAT was used to measure academic achievement prior to and after the 20 weeks. The Bruininks-Oseretsly Test of Motor Proficiency, physical measures, and self-concept were also measured.	Prior to initiating the exercise programs, no significant differences existed between the 2 groups for all measures. After the 20 weeks, the aerobic group demonstrated significantly better self-concept and physical fitness. No significant differences were found for motor proficiency or academic achievement.
Oja L, Jurimae T. Physical activity, motor ability, and school readiness of 6-year-old children. *Percept Mot Skills.* 2002;95(2):407-415. (Estonia)	Parent and teacher reports collected for 294 6-year-old children, using history; also a motor ability test and endurance test were given. Controlled drawing test was used as predictor of school readiness and development of mental abilities.	Outdoor activities on weekdays and weekends did not influence scores on the Control Draw Test. Various physical activities account for up to 25% of children's ability on the Control Draw Test. Motor ability tests, which demand children's total attention and concentration account for up to 20% of ability, reflected on this school readiness test. Children with highest physical activity tended to have the better scores on the subtest of fine motor control.
Raviv S, Low M. Influence of physical activity on concentration among junior high-school students. *Percept Mot Skills.* 1990;70(1):67-74. (Israel)	96 students (ages 11-12) divided into 4 groups: 1 received physical education at 8 AM, the other at 2 PM. The 2 remaining groups received science, not physical education, at 8 AM and 2 PM. A standardized measure of concentration was given at the beginning and end of each lesson.	Receiving physical education or science class had no bearing on education. Concentration scores were better at the end of each lesson, compared to the beginning.

Table 1
Published Research Articles that Address Childhood Physical Activity and School Performance *(Continued from previous page)*

Reference	Experimental Design	Outcomes Related to School Performance
Sallis JF, McKenzie TL, Kolody B, Lewis M, Marshall S, Rosengard P. Effects of health-related physical education on academic achievement: project SPARK. *Res Q Exerc Sport.* 1999;(2): 127-134. (United States)	Students in 7 schools in an affluent school district were followed from fourth through sixth grades. Two schools were assigned to having a certified physical education specialist and an activity program. In another 2 schools, regular classroom teachers were taught how to deliver the activity program. One school was a control where classroom teachers taught physical activity in their usual way. Metropolitan Achievement Test was used to measure academic achievement.	Achievement scores were higher than national averages at baseline; nevertheless, significant differences occurred among those receiving the intervention. Spending more time in physical education did not have harmful effects on standardized achievement. Favorable effects were found on 4 of 8 academic achievement measures. Those receiving physical education experienced smaller declines in test scores over the 3 years, compared to controls. In only 1 of 8 subtests, controls had an advantage over those receiving physical education.
Sanders CE, Field TM, Diego M, Kaplan M. Moderate involvement in sports is related to lower depression levels among adolescents. *Adolescence.* 2000; 35(140): 793-797. (United States)	89 high school seniors were given questionnaire on exercise habits, academic performance, and other questions. Three categories of exercise were determined from responses low (2 hours/week or less), moderate (3-6 hours/week), and high (>7 hours/week). GPA was assessed based on students' estimates.	Although moderate exercise was associated with less depression, low, moderate, and high exercise levels were not associated with GPAs.
Shephard RJ. Habitual physical activity and academic performance. *Nutr Rev.* 1996;54(4): S32-S36. (Canada, France)	Review of 2 studies. (1) 546 students (followed from grades 1 through 6) from 2 schools; intervention: 1 hour/day physical activity; control from preceding and succeeding classes in same schools received 14% more academic instruction; academic performance reported by homeroom teacher. (2) Half of each school day was assigned to physical activities with 26% less teaching.	Study 1: Prior to intervention at first grade, students in intervention group had significantly poorer grades than control. From grades 2 to 6, "intervention students" scored significantly better in math grades than control but had poorer performance in languages and "overall intelligence." Intervention benefited girls more than boys. Study 2: There was no difference in academic progress, despite curtailed instruction time. Conclusion of Studies 1 and 2: Do not expect academic improvement from physical activity, but expect improved rate of academic learning per unit of class time.

difficult to reach from such a small number of studies. Concentration appears to improve in the immediate period after children are physically active, but this improved level of concentration is not necessarily sufficient to influence improvement in school achievement (Caterino and Polak 1999, Raviv 1990 in Table 1). Shephard (Table 1) concluded that although academic improvement may not improve because of a physical activity program, there is an improved rate of academic learning per unit of class time. This should help thwart concerns that time devoted to physical activity draws from academic advancement in other subjects. Other studies demonstrated mixed results; for example, studies showed positive effects of physical activity (for example, on physical fitness and self-concept)

but little effect (Sallis et al 1999 in Table 1) or no effect (MacMahon and Gross 1987 in Table 1) on academic performance in the long term.

Clearly, more investigation into the benefits of physical activity on school performance is warranted before drawing conclusions. In adults, a meta-analysis of numerous studies found that the influence of exercise on cognition was inconsequential when small and temporary changes were implemented. However, exercise administered over a long period of time to produce fitness gains was more likely to enhance cognitive abilities.[8] One unpublished study demonstrated a significant difference in academic performance among low-achieving children who participated in aerobic activity during the school day.[9] It may be that the beneficial effects of high child physical activity levels on school achievement only exists in certain subpopulations of students. Alternatively, it is possible that the benefits of physical activity on academics are subtle and can only be detected when extremely large populations of students are studied, when physical activity programs are sufficiently aerobic, or when they have become part of children and youth's lives after many years.

CONCLUSION

Physical activity is well associated with improved overall health. Among school-aged children, physical activities programs help children develop social skills, improve mental health, and reduce risk-taking behaviors. Relatively few studies have explored the relationship between physical activity and academic outcome, and more investigation is warranted before researchers can better understand the effect of physical activity on student performance. This paucity of evidence should not be considered justification to limit school physical education programs because they may detract from time better spent on other subject areas. There is evidence to suggest that short-term cognitive benefits of physical activity during the school day adequately compensate for time spent away from other academic areas. ■

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