

Active Living Research

Building Evidence to Prevent Childhood Obesity and Support Active Communities
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RESEARCH SYNTHESIS | *October 2011*



School Policies on Physical Education and Physical Activity

INTRODUCTION

By all estimates, obesity is the most serious health problem facing American children today, with the percentage of obese children and adolescents more than tripling over the past 40 years.¹ Currently, almost one-third of all U.S. children and adolescents are overweight or obese, and the rates among Black and Hispanic children, as well as children living in lower-income households, are even higher.² Obesity is associated with many serious health problems during childhood,³ and excess body fat in childhood creates lifetime risks for cardiovascular disease, stroke, asthma and some cancers.⁴



Being inactive or having a sedentary lifestyle is one of the major causes of obesity, so there is clearly a need to increase physical activity among children.⁵ Today, fewer than half of U.S. children and adolescents meet the recommended guidelines of at least 60 minutes of daily moderate-to-vigorous physical activity. Children's participation in regular physical activity is associated with improved cardiovascular and musculoskeletal health, better mental health and emotional well-being, as well as prevention of such chronic diseases as obesity, hypertension and type 2 diabetes.⁶ There also is substantial evidence showing that children who are physically fit and active tend to perform better in the classroom.^{7,8}

Because most children are enrolled, schools are excellent places to increase young people's physical activity.⁹ This synthesis summarizes the substantial and growing body of evidence about a range of effective approaches for engaging children in physical activity through the school setting—inside as well as outside of regular classes. Research shows that schools can provide important opportunities for physical activity to children across all grade levels, but the evidence also indicates that the power of the school setting could be better used.

Increasing Physical Activity in Our Nation's Schools

National recommendations call for children and adolescents to be active for 60 minutes a day,¹⁰ and the public health community is united in its support for promoting physical activity through schools.¹¹⁻¹³

The U.S. Department of Health and Human Services recently released national health objectives for 2020 with recommendations that underscore the importance of physical activity in schools, including daily physical education, regular recess, and access to physical play and exercise spaces during non-school hours and in the summer (Figure 1).¹⁴ In May 2010, a diverse committee of national organizations working on public health and physical activity issues launched the National Physical Activity Plan—a comprehensive set of policies, programs and initiatives designed to increase physical activity in all segments of the American population, including schools.¹⁵

FIGURE 1. **Healthy People 2020—Physical Activity Recommendations for Schools**



- PA-4** Increase the proportion of the Nation's public and private schools that required daily physical education for all students
- PA-6** Increase regularly scheduled elementary school recess in the United States
- PA-10** Increase the proportion of the Nation's public and private schools that provide access to their physical activity spaces and facilities for all persons outside of normal school hours (that is, before and after the school day, on weekends, and during summer and other vacations)

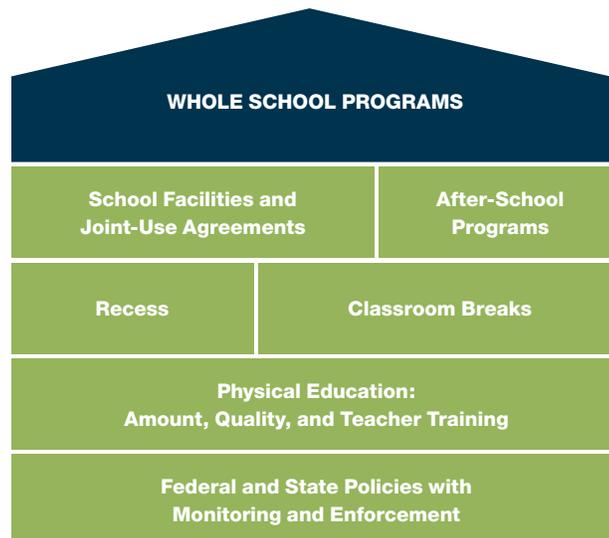
These national guidelines and initiatives recognize the need to involve policymakers, school officials, community organizations, health researchers, teachers and parents to help insure that our children engage in adequate amounts of daily physical activity and develop physically active lifestyles that improve their chances of growing into healthy adults.¹⁶ Research has shown that there are many actions that schools can take to increase students' physical activity.

Key Research Results

- **Children who attend regularly scheduled physical education (PE) classes get significantly more physical activity than those who attend PE less often.**¹⁷⁻¹⁹ A nationally representative study of U.S. high school students found that a binding PE requirement increased levels of both regular physical activity and vigorous exercise.²⁰
- **Physical education programs that include the use of standardized curricula, goals for active classes and staff development result in children who are more physically active.**²¹⁻²⁴ A study involving more than 5,000 elementary school students found that children in such programs obtained 12 more minutes of vigorous activity each day than other students.²⁵
- **Quality in-service training for teachers, either for PE specialists or for classroom teachers, increases students' levels of physical activity at school.**²⁶⁻²⁸ However, PE specialists produce greater physical activity levels in children. In a study conducted in seven schools with more than 100 teachers, children in classes taught by PE specialists received on average, more than 22 additional minutes of health-promoting activity per week, compared with students taught by untrained classroom teachers.²⁹
- **Whole school programs that provide additional opportunities for physical activity across the school day—through recess, in-class breaks and after-school events—increase children's physical activity levels.**³⁰⁻³⁴ In a large, well-designed study of U.S. middle schools that employed such whole school programs, researchers found a 24 percent increase in active participation among girls, and a 12 percent increase among boys.³⁵
- **Schools that provide ample time for supervised recess and access to equipment, as well as those that make low-cost modifications to improve play spaces, have more physically active students.**³⁶⁻³⁹ For example, children who were provided access to game equipment during recess spent 30 percent more time in moderate physical activity than did children who were not provided such access.⁴⁰
- **Additional activity breaks during classes not only increase physical activity, they also help children focus better on academic tasks⁴¹ and enhance academic achievement.**⁴² Research has shown that academic achievement improved over a three-year period for students who participated in activity breaks during classes.⁴³ Additionally, elementary school students who were given active classroom breaks improved their ability to stay on task during academic work by 20 percent, but use of inactive classroom breaks had no effect.⁴⁴

- **School environments with well-designed playgrounds, open spaces, facilities and equipment that are available, accessible, and inviting to children encourage more physical activity, both during and after school.**⁴⁵⁻⁵⁰ Based on a study of more than 16,000 children, students were nearly three times as likely to be active when there were greater numbers of outdoor facilities at their school.⁵¹
- **After-school programs may contribute additional physical activity beyond that which children obtain during school hours, but more research is needed.**⁵²⁻⁵⁵ A 2008 study of seven after-school programs in the Midwest found that students in these programs engaged in moderate-to-vigorous physical activity for an average of 20 minutes per day, or nearly one-third of the daily requirement.⁵⁶
- **Joint-use agreements between schools and communities encourage physical activity after school and on weekends by opening school grounds so children have places to play.**⁵⁷ Joint-use agreements are especially important in low-income, inner-city and rural settings that lack other recreation facilities.⁵⁸ Resources for developing joint-use agreements are already available.⁵⁹
- **State policies requiring that children engage in a specific amount of physical activity at school each day have the potential to affect large numbers of children and are an effective strategy for promoting regular activity.**⁶⁰⁻⁶² In Texas, implementation of a state law requiring 30 minutes of daily structured physical activity resulted in middle school children participating in 50 percent more than the required minimum or about 240 minutes of physical activity each week.

FIGURE 2. Policy Areas to Support Physical Activity at School



Policy Implications

Based on the evidence presented in this synthesis, there are many opportunities to change policies at the federal, state and local levels to better support physical activity in schools.

Implement and monitor local school wellness policies that include a physical activity component. The previous two federal child nutrition reauthorizations called for local school districts to develop or strengthen wellness policies. These wellness policies should include strong physical activity components that require moderate-to-vigorous activity or play, and the physical activity components should be complementary to, not in lieu of, stronger physical education standards.

Implement and monitor federal standards for physical education. The upcoming reauthorization of the Elementary and Secondary Education Act (ESEA reauthorization) should set a physical education mandate for enhanced standards at either the federal or state level. These standards should include strong minimum physical activity requirements as recommended by the National Association for Sport and Physical Education.

Improve state requirements and local standards for physical activity and physical education. Regardless of the outcome of ESEA reauthorization, state and local educational decision makers (i.e., school boards, departments of education, superintendents) should work more actively to increase physical activity among students and strengthen physical education programs in their schools. They should use nationally recognized standards and evidence-based approaches, and also should ensure that physical education is taught by certified and trained professionals. Recess and physical activity breaks should be a regular part of the daily curriculum at all schools.

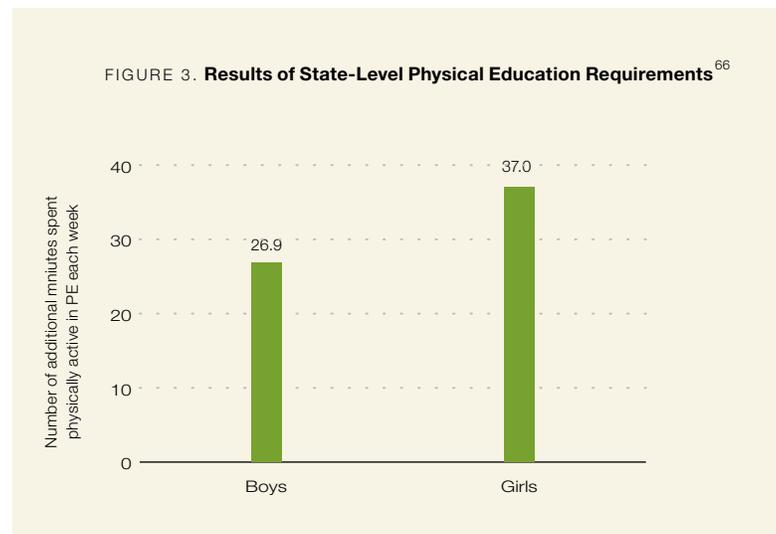
Implement joint-use agreements for community-school usage. Local educational decision makers should actively pursue joint-use agreements that provide opportunities for community groups and residents to use available facilities for physical activity. In many lower-income, urban and rural communities, school facilities are the only available and/or only safe locations that offer residents opportunities for physical activity.

Expand physical activity opportunities beyond the school day. Policymakers at all levels should work proactively to extend the school day by enhancing physical activity opportunities through various programs, including after-school programs. An extended school day that includes physical activity can be arranged in partnership with communities and businesses, and would take advantage of joint-use agreements.

Details of Key Research Findings

Children who attend regularly scheduled physical education (PE) classes get significantly more physical activity than those who attend PE less often.

■ Comparisons of state PE requirements and nationwide data from the Youth Risk Behavior Surveillance System (for 1999, 2001, 2003) show that high school students with required PE enrollment reported participating in 31 additional minutes per week of physical activity.⁶³ Girls who attended schools with PE requirements reported spending more days per week in vigorous or strength-building activity.⁶⁴ (Figure 3) These data underscore the importance of state policies, especially given that attendance in daily PE has declined among U.S. students since the early 1990s. In 2006, only 3.8 percent of elementary schools offered daily PE.⁶⁵



■ The importance of PE enrollment to girls was further noted in a large study of eighth, ninth and twelfth grade girls from 31 middle schools and 24 high schools in South Carolina.⁶⁷ Girls who were enrolled in PE classes were more physically active than girls who were not enrolled. Moreover, the intensity of their activity was greater: girls who were enrolled in PE classes spent 12 percent to 32 percent more time in moderate-to-vigorous physical activity, and 33 percent to 60 percent more time in vigorous physical activity.⁶⁸

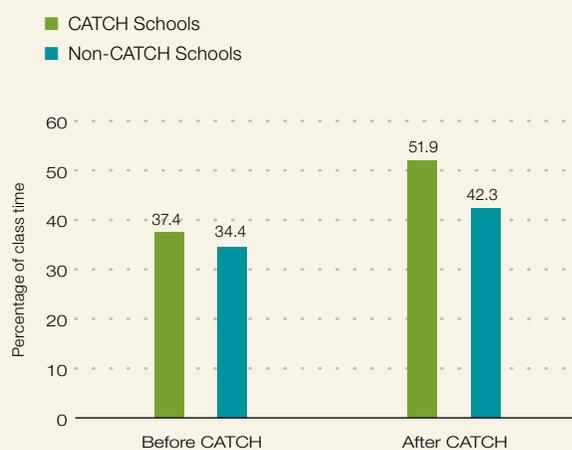
■ A large survey of more than 17,000 middle and high school students in the United States confirmed that attending PE classes was associated with increased moderate-to-vigorous physical activity. However, the study also noted that relatively few adolescents (21.3%), especially Black and Hispanic teens, participated in secondary school PE classes.⁶⁹

Physical education programs that include the use of standardized curricula, goals for active classes and staff development result in children who are more physically active.

■ While scheduling sufficient time for PE is a key to helping children engage in more physical activity, the quality of PE instruction also is critical for ensuring that children engage in recommended levels of physical activity. Multiple controlled intervention studies have shown that quality physical education programs—those that use standard curricula, set goals for more active classes and provide in-service training for staff—benefit children at all levels—elementary, middle and high school.⁷⁰ Based on a systematic review of 16 intervention studies, the U.S. Community Preventive Services group concluded that there is strong evidence that enhanced school-based physical education is effective.⁷¹

■ A study conducted in more than 96 public schools in California, Louisiana, Minnesota and Texas by the Child and Adolescent Trial for Cardiovascular Health (CATCH) program found that children who participated in an enhanced PE program increased their moderate-to-vigorous physical activity in PE class from more than 13 minutes each week, with intervention classes meeting the Healthy People objective of spending 50 percent of class time in moderate-to-vigorous physical activity.^{72, 73} (Figure 4) For the study, CATCH provided a standardized PE curriculum, three 30-minute lessons weekly that included skill and fitness instruction, goals for active class time, and staff development. Although some increase from baseline to follow-up was noted in control school students, students in the intervention schools participated in significantly more moderate-to-vigorous physical activity than did students in the control schools.

FIGURE 4. **Percentage of Time Spent in Moderate-to-Vigorous Physical Activity during CATCH-Enhanced PE Classes**⁷⁴



*The difference in the percentage of time spent in moderate-to-vigorous physical activity before and after schools participated in the CATCH program was significant at $p < 0.002$.

■ Results from the Sports, Play, and Active Recreation for Kids (SPARK) program, which was implemented in seven elementary schools in southern California over a two-year period, also demonstrated that enriched PE programs produce more active PE classes. The SPARK program provided an organized curriculum with defined health-fitness and skill-fitness units, active classes, and training for teachers. During a single school year, students in SPARK schools spent about 13 more hours in moderate-to-vigorous physical activity than students in control schools.⁷⁵

■ Similar results also have been demonstrated among middle school students. A major part of the M-SPAN (Middle School Physical Activity and Nutrition) study was a PE intervention which focused on the provision of curricular materials, staff development and follow-up technical assistance. These efforts resulted in 20 percent more physical activity without increasing the amount of time provided for PE.⁷⁶ Further, a PE-based intervention, conducted with 221 ninth grade girls in a predominately African-American high school where the program was redesigned to focus on the development of such life skills as goal setting, problem-solving and role-modeling, resulted in classes where students were 50 percent more active than those in traditionally-taught PE classes.⁷⁷

Quality in-service training for teachers, either for PE specialists or for classroom teachers, increases students' levels of physical activity at school. However, PE specialists produce greater physical activity levels in children.

■ As noted earlier, strong evidence exists that shows the effectiveness of PE enrollment and program quality on overall physical activity.⁷⁸ However, even when PE is provided, the optimal PE classroom environment is provided by teachers who have been well-trained to provide leadership that engages students in physical activity. As previously described, the CATCH program brought specialized in-service training to both classroom teachers and PE specialists in several schools in four states.⁷⁹ As a result, both groups of teachers increased the amount of physical activity in their classes by more than 30 percent, but students taught by trained PE specialists engaged in the most activity (classes taught by PE specialists obtained two additional minutes of moderate-to-vigorous physical activity and 1.5 minutes of vigorous physical activity per lesson compared with trained classroom teachers). This project and others show that school administrators should provide the best training possible for teachers, tailored to meet local needs and conditions, including indoor and/or outdoor lessons. The training also should accommodate instructors who are PE specialists and/or those who are classroom teachers.^{80, 81}

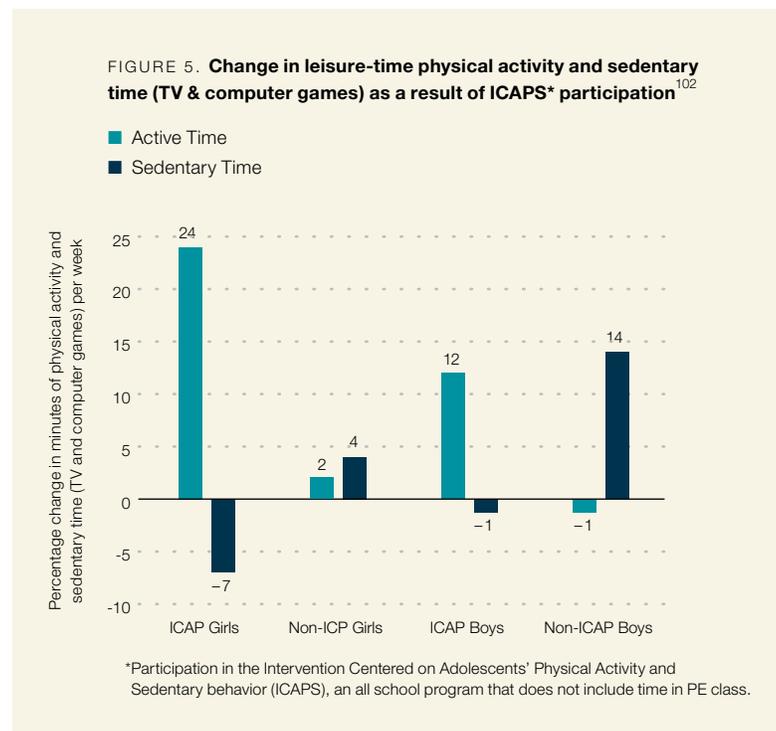
■ A four-year study of the SPARK program in seven elementary schools compared the physical activity levels of students taught by PE specialists and trained classroom teachers with those of students taught by non-trained classroom teachers.⁸² It found that students of PE specialists were the most physically active, and that students with trained classroom teachers had significantly higher levels of physical activity when compared with those taught by non-trained teachers. Following the study, PE specialists were withdrawn from the classrooms, and student physical activity levels declined by about 50 percent overall. Yet schools that retained trained classroom teachers were able to maintain nearly 90 percent of their students' activity levels. These results suggest that, when possible, schools should hire specialists to teach PE, but providing extensive professional development for classroom teachers who teach PE also is effective.⁸³

Whole school programs that provide additional opportunities for physical activity across the school day—through recess, in-class breaks and after-school events—increase children’s physical activity levels.

- Nationally and internationally, children are much more physically active if they attend schools that schedule, promote and supervise additional opportunities for students to be active beyond PE classes. For example, such whole school programs incorporate opportunities for physical activity before, during and after school via supervised recess, short classroom-based activity breaks and after-school activities. A systematic review of 57 studies, including school-based programs with multiple components, concluded that there is “Strong evidence... that school based interventions with involvement of the family or community and multicomponent interventions can increase physical activity in adolescents.”⁸⁴
- Evidence has that shown children and teens who attend schools that form school activity teams,^{85, 86} include community partnerships,^{87, 88} and provide for a strong PE program and activity opportunities across the school day⁸⁹⁻⁹¹ are more active. Promoting walking and bicycling to and from school is another strategy supported by many whole school programs that is noted for its impact on children’s levels of activity and physical fitness.^{92, 93}
- Although evaluations of whole school programs have consistently shown that these approaches are effective, some programs have had greater impact on boys, while others have been more successful with girls.^{94, 95} Such results show that the needs of both boys and girls should be considered when whole school programs are designed and implemented. For example, boys who participated in the M-SPAN (Middle School Physical Activity and Nutrition) program, which included an active PE curriculum, more efficient use of PE equipment and space, as well as training for PE staff, increased their physical activity levels more than three times as much as boys in the non-intervention classes. The increase was measured over a two-year period, both during PE classes and during leisure time. However, the M-SPAN program was less effective for girls.⁹⁶ Similar improvements for boys were observed in a whole school program conducted in 10 elementary schools in British Columbia.⁹⁷
- Physical activity often decreases as children age into adolescents. Yet the Lifestyle Education for Activity Program (LEAP), which includes a “program champion”^a and physical activity team; improvements to PE; staff wellness programs; before- and after-school activities; and community outreach efforts, has shown promising results among teens. An evaluation of LEAP that involved nearly 3,000 ninth grade girls in 24 schools showed that levels of vigorous physical activity among students at participating schools were higher than those from the other schools.⁹⁸ In schools that fully implemented LEAP, sustained effects were still measurable in the twelfth grade, demonstrating that a multicomponent physical activity program can encourage girls to maintain higher levels of vigorous physical activity through high school.⁹⁹

^aA “program champion” is a staff member at the local school who voluntarily took special interest in seeing that the intervention was implemented and who provided leadership to the school physical activity team.

■ The Intervention Centered on Adolescents' Physical Activity and Sedentary behavior (ICAPS) was conducted in eight randomly selected schools in eastern France.¹⁰⁰ ICAPS included partnerships among school board members, teachers, recreation professionals, medical staff and others. It also consisted of an educational component, additional opportunities for physical activity during school hours and reduction of barriers for after-school participation. After only six months, time spent in physical activity outside of PE class increased by 16 minutes per week among adolescent students in ICAPS schools and ICAP participants experienced declines in time spent watching television and playing computer games.¹⁰¹ (Figure 5)



Schools that provide ample time for supervised recess and access to equipment, as well as those that make low-cost modifications to improve play spaces, have more physically active students.

■ There is growing concern that not enough curriculum time is allocated to physical education, so the activity children get at play time—or recess—may be even more important.¹⁰³ National recommendations suggest that grade school students be provided at least one 20-minute supervised recess period per day,¹⁰⁴ and studies show that recess time is associated with better classroom behavior.¹⁰⁵ Yet, in 2006, fewer than 75 percent of U.S. elementary schools provided regularly scheduled recess for all elementary school students.¹⁰⁶ Recent analyses also indicate that the amount of recess children receive has declined as a result of No Child Left Behind, which was implemented in 2001).¹⁰⁷

■ When children are provided with recess opportunities, especially with adult supervision, they engage in active play for more than 60 percent of the time allocated, as shown in a 2002–04 study of nearly 37,000 child-observations at 13 low-income elementary schools with mainly Latino students.¹⁰⁸ Further, a review of 18 studies that examined children’s physical activity levels during school play times concluded that recess can contribute up to one-third of the moderate-to-vigorous physical activity recommended for children each day.¹⁰⁹

■ Although providing students with time for free play is necessary, it may be insufficient by itself to promote physical activity. For example, evidence shows that providing game equipment and playground markings can increase the amount of physical activity children engage in during recess. Researchers conducting a study of 249 fifth and sixth grade students in Belgium gave one group of students a set of game equipment and activity cards describing how to use it, while the second group received neither.¹¹⁰ Although the students had previously been active for about 50 percent of their recess period, the activity level among students in the intervention group increased by 13 percent. Among the group with no access to equipment, physical activity levels fell by 10 percent.¹¹¹

■ Other helpful low-cost enhancements to outdoor play spaces, such as colorful playground markings, can facilitate children’s activity during recess. Evidence of this was seen in a study that found multicolor playground markings to significantly increase the amount of time children spent in physical activity during recess.¹¹² Further, when schools in Northeast Wales installed new equipment and marked their playgrounds, the time their students spent in moderate-to-vigorous physical activity increased by nearly 14 percent, while it declined by more than 6 percent among students at comparison schools in Northwest England without those modifications.¹¹³ In a similar study, schools were provided funds for playground re-design that included both colorful markings and such structures as hoops, goals and fencing.¹¹⁴ Short-term (six week) and long-term (six month) assessments showed students were between 2 percent and 5 percent more active in these schools than in comparison schools.

■ Providing access to portable equipment, (sometimes called “loose” equipment) and enhancing outdoor spaces with colorful markings may be a cost-effective way to increase children’s physical activity levels, especially among low-income children. In a study of 23 elementary schools in a low socioeconomic area of Melbourne, Australia, a larger percentage of students participated in vigorous physical activity when loose equipment and supervision were provided (60% vs. 52%).¹¹⁵ Children at schools with court and playground markings also were more active than children at schools without such enhancements (34% vs. 20%). These findings suggest that such simple changes as equipment, painted markings and teacher presence can contribute to increased physical activity among students.

Additional activity breaks during classes not only increase physical activity, they also help children focus better on academic tasks and enhance academic achievement.

- Research has shown that academic achievement improved over a three-year period among students who participated in activity breaks during classes.¹¹⁶ Additionally, elementary school students who were given active classroom breaks improved their ability to stay on task during academic work by 20 percent, but inactive classroom breaks had no effect.¹¹⁷
- Exercise breaks in classes have been shown to increase students' physical activity levels, and they also appear to improve children's attention and concentration during academic instruction. Third and fourth grade students in North Carolina, who participated in *Energizers*, a classroom-based program that included physical activity breaks, took nearly 1,000 more steps during the school day than children who were not in the program. The participating children also paid better attention during academic instruction following those breaks.¹¹⁸
- Classroom breaks also influence academic performance and may benefit students' health and fitness levels. Results from a pilot study demonstrated that students' academic achievement improved over three years, especially their composite reading, math and spelling scores, when classroom teachers implemented moderate-to-vigorous breaks during class.¹¹⁹ Another study found that classroom activity breaks increased students' fitness levels and reduced their use of asthma and/or attention-deficit hyperactivity disorder medications.¹²⁰ Evidence suggests that pre-recorded DVDs or videos can be used as an alternative to teacher-led activities to provide effective, active classroom breaks.^{121, 122}

School environments with well-designed playgrounds, open spaces, facilities and equipment that are available, accessible and inviting to children encourage more physical activity, both during and after school.

- Making improvements in the physical spaces around schools is consistently associated with increased physical activity levels in children and adolescents, so it should be considered a fundamental strategy for helping children become, and remain, physically active. In a study of 7,638 Canadian students in grades six through ten, adolescents were observed to be more active, both during and after school, in school settings that had a greater number of recreational facilities. Boys benefitted most during school, and girls benefitted most during free time after school.¹²³ Other studies confirm the importance of the number of activity spaces¹²⁴ and such amenities as lighting and restrooms¹²⁵ to both middle school and high school girls. Girls in rural areas were 12 percent more physically active when they attended schools with more places for activity.¹²⁶
- Researchers studying more than 1,000 students in 24 San Diego middle schools found that students were more likely to use outdoor spaces with such permanent improvements as courts, diamonds, hoops and goals and less likely to use or be active in open spaces. Also, supervision was important, for both boys and girls, especially in indoor spaces.¹²⁷ Similar results were seen in elementary school students when neglected schoolyards in diverse communities in Denver were renovated.¹²⁸ More students used the renovated schoolyards than the non-modified playgrounds.

■ Even in areas with colder climates, such outdoor facilities as soccer fields, hopscotch and jump rope areas, and sledding hills, were found to be associated with increased physical activity among middle and high school students.¹²⁹ A study of 16,471 students in Norway indicated that boys and girls were nearly three times more likely to be active at secondary schools that had larger numbers of outdoor facilities.¹³⁰

■ The availability of facilities even affects activity levels in physical education classes. In a nationally representative study of 8,935 fifth grade students, facility availability was associated with children's physical activity levels.¹³¹ For children living in humid and hot-humid regions of the United States, gymnasium availability was associated additional minutes of physical activity per week (more than 17 minutes in humid, and an additional 25 minutes in hot-humid regions.) Importantly, children from low-income families who are at greater risk for overweight and inactivity¹³² were more likely to attend schools with poorer gymnasium and playground provisions than were other children. Such research shows that failure to provide adequate indoor space limits children's physical activity levels.

After-school programs may contribute additional physical activity beyond that which children obtain during school hours, but more research is needed.

■ After-school programs come in many different forms, including after-school child care, special tutoring programs, such extracurricular activities as clubs, and programs that specifically focus on youth sports. Researchers in Kansas found that boys and girls enrolled in after-school programs engaged in about 20 minutes of moderate-to-vigorous physical activity during the program, and that boys were more active than girls. However, more than 40 percent of the children's time was spent in sedentary activities. These findings demonstrate that after-school programs may provide untapped opportunities for increasing children's physical activity.¹³³

■ Results from a Georgia study provide more encouraging evidence.¹³⁴ Georgia *Fitkids* involved children from 18 schools in an afternoon program of academic enrichment, healthy snacks and moderate-to-vigorous physical activity. During the program, third, fourth and fifth grade students participated in more than one hour of physical activity each day, half of which was at a vigorous level. Following the three-year program, children in schools using the program were more physically fit than students in schools not using the program.¹³⁵

■ Children whose activity levels are low may benefit more from after-school programs. Students in three secondary schools in New South Wales, Australia participated in a study that compared two types of after-school programs—the Learning to Enjoy Activity with Friends (LEAF) program and an exercise-only program.¹³⁶ A group of 50 students were assigned to the LEAF program, which involved structured activities and such behavioral training as activity monitoring with pedometers and goal-setting. A comparison group of 66 students was offered an exercise-only program. Adolescents who had low levels of physical activity in the intervention group increased their activity levels by more than 30 percent, or approximately 25 minutes a day, while there was no change in the activity levels of students in the exercise-only group.

■ Promising results also have been noted in pilot studies targeting low-income minority children and overweight children in after-school programs.^{137, 138} One study included 61 African-American girls who either participated in an after-school school dance program that included additional parent activities, or received newsletters and health education.¹³⁹ Girls in the dance program were measurably more active than were the girls in the other group. Another study examined an after-school program targeting overweight fourth and fifth graders.¹⁴⁰ Children in the intervention group participated three to four days per week for six months in a soccer program, while those in the comparison group attended weekly after-school meetings on nutrition and health education. Students in the soccer group had greater activity levels compared with children in the health education program.

■ Despite these findings, there also is a body of evidence showing that the impact of after-school programs on physical activity is inconclusive. Two review papers that addressed the impact of after-school programs on physical activity noted that such programs have good potential for increasing children's levels of physical activity, yet found the evidence about the impact of the programs to be inconclusive, most likely due to the variety of types of programs.^{141, 142} More research with greater attention to program specifics, such as type and location, and how often the programs are implemented is needed. Existing studies primarily include children ages 12 or younger, so the impact of such programs on adolescents also should be studied. Further, there is limited research on how school sports, including intramural, club-level and interscholastic programs, affect children's and adolescents' physical activity levels.

■ A current look at policies that govern physical activity in schools reveals some negative but also some positive circumstances related to after-school events. In a review of state policies for after-school programs, researchers found an absence of nationally recognized quality standards or policies for promoting physical activity in after-school settings.¹⁴³ Yet it also was noted that 14 states had developed and implemented specific standards for promoting physical activity in after-school programs, including five states that require specific amounts of activity time.¹⁴⁴ These vanguard states and the policies they have developed may lead the way for other states and communities that are seeking opportunities to support and encourage physical activity through after-school programs.

Joint-use agreements between schools and communities encourage physical activity after school and on weekends by opening school grounds so children have places to play.

■ The *Guide to Community Preventive Services*, based on a systematic review of the research literature, confirms that initiatives that create or provide access to places designed or equipped for physical activity—combined with educational programs—can increase physical activity.¹⁴⁵ For example, a joint-use agreement between an urban high school and the city of Honolulu allowed the creation of a recreational program that provided physical activity for students, teachers and staff, as well as community residents.¹⁴⁶

■ Schoolchildren, as well as other residents, can become—and remain—more physically active after school and on weekends when schools and communities enter into joint-use agreements about school property and equipment. Arrangements between schools and communities to share activity facilities may be even more important in areas where children have fewer facilities outside of school, such as low-income, inner-city and rural settings. Schools, especially those in low-income neighborhoods, have been shown to be important sites where children can participate in active play.¹⁴⁷ However, when such schools are closed or locked, children living in low-income communities may have few other locations where they can be active. Researchers visited schools and parks near the residences of adolescent girls in six states and found that schools represented nearly half (44%) the available sites for physical activity for these girls.¹⁴⁸ On the day of observation, however, a third of the schools were locked. Although many factors contribute to inactivity among low-income children and adolescents, having accessible school facilities may be an important strategy for supporting physical activity at the community level.¹⁴⁹

■ A study in a low-income, African-American inner-city neighborhood in New Orleans found that having schoolyards available for free play was associated with increased physical activity among children.¹⁵⁰ Researchers found that opening schoolyards after school and on weekends resulted in an 84 percent increase in the number of children who were outdoors and active, compared with those in a school where the play areas were unavailable.

State policies requiring that children engage in a specific amount of physical activity at school each day have the potential to affect large numbers of children and are an effective strategy for promoting regular physical activity.

■ Efforts by states to create laws or make policies requiring schools to provide the minimum amount of physical activity children must receive, such as 30 minutes daily, have resulted in successful implementation and increased amounts of physical activity in children.^{151–153} The Texas legislature passed a law requiring that students in public elementary schools engage in 30 minutes of physical activity daily, or 135 minutes per week. Following implementation of the law, students participated in about 30 percent more physical activity than the minimum requirement.¹⁵⁴ An even stronger impact was observed at the middle school level, where children participated in physical education four days per week and 58 minutes per class, compared with just two days of participation before implementation.¹⁵⁵ Successful implementation of a similar regulation was observed in North Carolina K–8 schools.¹⁵⁶

■ Federal efforts to increase children's physical activity levels have not produced similar success. According to The Child Nutrition and WIC Reauthorization Act of 2004, school districts were required to develop local wellness policies with the purpose of creating healthier school environments. A review of the implementation of this policy found that most districts addressed physical activity in their wellness policies, but few offered specific requirements.¹⁵⁷ It was concluded that the tendency to set standards that were not well-developed and lacked plans for implementation and monitoring may have caused the poor outcomes. As noted in an evaluation of Texas legislation for elementary school students, the impact of statewide physical activity legislation may be enhanced by concurrently supporting the implementation of coordinated school health programs that include a teacher training component.¹⁵⁸ More rigorous policies are needed, along with additional financial resources, to increase physical activity opportunities for children in school.¹⁵⁹

Conclusions and Implications

■ **Schools, especially physical education classes, are the source of much of our children's physical activity.** However, changes are needed to help maximize the potential of schools to promote physical activity. Policymakers at all levels, school faculty, parents and community leaders should advocate the adoption and implementation of policies and programs that closely align with evidence-based guidelines for physical education and physical activity.

■ **There are several evidence-based strategies for enhancing physical education, long the bedrock of school physical activity.** Among these are scheduling more frequent PE classes at all grade levels. Another recommendation is for programs to use standard curricula, and for classes to ensure that children engage in health-benefiting (moderate-to-vigorous) physical activity at least half the time. Research also strongly suggests that anyone who teaches PE should receive specialized in-service training, and whenever possible, PE specialists should be engaged for that purpose.

■ **Schools can help increase students' activity levels outside of PE classes.** Schools should provide supervised physical activity at several times across the school day in addition to PE classes, in class breaks, recess and after-school programs. Providing activity breaks during academic classes not only increases the amount of time students are active, evolving evidence indicates that academic performance, focus on academic tasks and classroom behavior also improve. Providing recess time is especially important for children in grade school, and adult supervision and access to loose equipment have been shown to increase students' activity levels. After-school programs, especially for children who have low levels of physical activity, can add significantly to these students' daily activity levels. One strategy schools should consider is integrating these additional opportunities through whole school or multicomponent programs. Whole school programs that offer multiple opportunities throughout the school day, enhance the quality of PE classes, and create school-community partnerships are optimal for increasing physical activity.

■ **School environments should include safe equipment and multiple supervised facilities that encourage children to be physically active.** When after-school programs are held, sufficient activity time should be provided and supervised. The adoption of joint-use agreements for schools and communities is highly recommended, especially in low-income, inner-city and rural settings. These agreements make school grounds accessible to community residents after school and on weekends and help form school-community partnerships to make parks and recreational spaces available for schoolchildren whose schools lack adequate facilities.

■ **States should place a higher priority on implementing specific school policies that require children to participate in a minimum of 30 minutes of physical activity daily.** Such up-stream approaches have strong potential to reach large groups of children. Existing federal requirements for school district wellness policies also need to be strengthened to include more specific goals and/or requirements for physical activity and physical education to help more students meet national recommendations for physical activity.

Areas Where Additional Research is Needed

Research into promoting children's physical activity at school is a large and growing endeavor throughout the world. Much of the current research in the areas covered by this synthesis further confirms many of these findings and improves our understanding of numerous effective approaches for increasing students' physical activity levels at school. However, additional research is needed in the following areas:

- Physical education requirements have declined over the past years but may be reinstated in response to demonstrated need, including high rates of childhood obesity. Studies are needed to assess the impact of physical education requirements on child activity both during school and across the day.
- Broad-scale surveillance systems could be implemented to provide accountability for meeting federal, state and district-level physical activity policies. Ongoing surveillance also could assess the impact of increased quantity and quality of physical activity (and physical education) programs on overall activity levels and health outcomes among children and adolescents.
- Cost-effectiveness studies are needed to determine the implication of increased PE requirements, especially for schools with limited resources.
- More studies would help us understand the kinds of programs and settings that will make physical activity more appealing to girls, boys, and certain racial and ethnic groups who have low levels of physical activity. They also are needed to help us determine if there are potential benefits of special programming for such other special populations as Spanish-speaking children.
- Whole school programs implemented throughout the school day have shown success, but it is not known whether any one aspect of a program is more important, or whether it is the synergy of two or more parts of such a program that results in greater levels of physical activity.
- It is unclear, based on very limited research, how the physical activity needs of children with physical and other handicaps are being met.
- Research is needed to help determine whether schools should invest in intramural sports that are open to all students instead of interscholastic sports designed only for elite athletes.
- After-school programs show promise, but additional research should be conducted to determine whether existing programs, such as those in schools or YMCAs, meet new after-school standards for physical activity provisions.
- Many promising practices have been identified through research, but strategies for disseminating the results of such studies are poorly understood. Efforts to create dissemination mechanisms should be explored.

Additional Resources and References

Active & Healthy Schools™: www.activeandhealthyschools.com

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Let's Move: America's Move to Raise a Healthier Generation of Kids: www.letsmove.gov/about

Let's Move in School: www.aahperd.org/letsmoveinschool

Promoting Nutrition and Physical Activity in Afterschool Settings: Strategies for Program Leaders and Policy Makers, 2006: http://nccic.acf.hhs.gov/afterschool/fitness_nutrition.pdf

The National Physical Activity Plan: www.physicalactivityplan.org

Energizers for Elementary and Middle School: www.eatsmartmovemorenc.com/Energizers/Elementary.html and www.eatsmartmovemorenc.com/Energizers/Middle.html

Move More North Carolina Recommended Standards for After-School Physical Activity Programs: www.eatsmartmovemorenc.com/AfterSchoolStandards/Texts/AfterSchool0409-NoCost.pdf

Opening Schools Grounds to the Community After-Hours: A tool-kit: www.phlpnet.org/healthy-planning/products/joint_use_toolkit

Checklist for Developing Joint-use Agreements: www.nplanonline.org/sites/phlpnet.org/files/nplan/JointUse_checklist_FINAL_web_090318.pdf

Unlocking the playgrounds: Achieving Equity in Play Spaces: www.cpehn.org/pdfs/Joint%20Use%20Brief.pdf

Promoting Healthier After School Environments: Opportunities and Challenges: www.partnershipph.org/sites/default/files/90077_CAE_HealthierAfterSchool_FINAL.pdf

National Association for Sports and Physical Education: www.aahperd.org/naspe

Physical Education Curriculum Analysis Tool (PECAT): www.cdc.gov/HealthyYouth/PECAT/pdf/PECAT.pdf

Physical Activity Guidelines for American: Children and Adolescents: www.cdc.gov/HealthyYouth/PhysicalActivity/guidelines.htm

Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People: www.cdc.gov/healthyouth/npao/strategies.htm

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Active Living Research, a national program of the Robert Wood Johnson Foundation, stimulates and supports research to identify environmental factors and policies that influence physical activity for children and families to inform effective childhood obesity prevention strategies, particularly in low-income and racial and ethnic communities at highest risk. Active Living Research wants solid research to be part of the public debate about active living.

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Table of Studies

The following table provides brief summaries of the studies cited in this synthesis, including sample characteristics, methods, and strengths and weaknesses.

TABLE 1. Studies Cited in this Synthesis

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Barroso et al., 2009	Key informant interviews with staff in 112 Texas middle schools, observations in 17 PE classes and key informant interviews at Texas–Mexico border schools	Used statewide probability sampling to select 112 middle schools for interviews. In the 17 border schools, SOFIT observations observations were conducted in PE classes, with up to three observations per school with one observation for 6th, 7th and 8th grades	<p>+ Used key informant, student-report and observational data to confirm number of days of PE, minutes per class, and percent of MVPA per class</p> <p>– Self-reported data is subject to some bias</p>
Beets et al., 2009	Literature review of peer-reviewed articles between 1980–2008 using three major search engines (PubMed, Science Direct, EBSCOhost)	Descriptive comparison of study results providing study characteristics and standardized mean difference effect size	<p>+ Comprehensive assessment linking after-school programs with outcomes across six domains</p> <p>– Heterogeneity in program structure among the programs</p>
Brink et al., 2010	16,505 students in nine schools in Denver, Colorado	Used observational assessment system, SOPLAY, for four days prior to and following renovations to measure children’s physical activity and effect of surface area	<p>+ Monitored activity levels of students in recently renovated, established and control (not modified) schoolyards; schools were predominately lower-income and diverse</p> <p>– Quasi-experimental design and only school-level data collected (no individual patterns assessed)</p>
Cawley et al., 2007	Pooled sample of 36,884 adolescents in grades 9–12 in national sample of U.S. states	Cross-sectional analysis using YRBS data (1999, 2001, 2003) merged with data on state minimum PE requirements from the 2001 Shape of the Nation Report	<p>+ National sample with large number of students and states participating; controlled for important covariates</p> <p>– Assessed only high school students and policies; did not include elementary or middle school</p>
Choy et al., 2008	Pilot study of one urban high school in Honolulu, Hawaii with a student population primarily from low-income and ethnic minority backgrounds	In-Motion project developed and implemented a joint use agreement. Physical activity preferences of students, staff, and community members were assessed to guide recreational program offerings. Various recreational classes were offered free to the school community. Surveys were completed by students, teachers/staff and community members.	<p>+ Focused on joint-use agreement</p> <p>+ Program extended over one year</p> <p>– Small pilot program</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Donnelly et al., 2009	Sample included students (n=1,527) from 24 elementary schools in Kansas	Randomized school-based study to measure the contribution of regular activity in classrooms. Effect on physical activity assessed in sub-sample (n=167) using accelerometers	<p>+ Used accelerometers to assess physical activity over four days (two weekends); assessed academic achievement; good process measures</p> <p>– Smaller sub-sample, but randomly selected</p>
Evenson et al., 2009	Online survey of all North Carolina school districts (n=115 districts serving 2,484 schools)	50-item survey to assess implementation of state policy for 30 min. of physical activity daily	<p>+ 96% response rate</p> <p>– Self-report data subject to bias; no confirmation using observation or personal interviews</p>
Farley et al., 2008	Sample included two matched neighborhoods in low-income neighborhoods in New Orleans and children in grades 2–8.	One schoolyard was open after school and on weekends over two years. SOPLAY observations of children’s physical activity levels over a four-week period before and every quarter during the two-year period. Observations occurred in five distinct play areas.	<p>+ Intervention period was two years in length</p> <p>+ Systematic observation was used to measure physical activity at multiple points in time</p> <p>– Only two schools were included</p>
Fernandes & Sturm, 2010	Data are from nationally representative Early Childhood Longitudinal Survey Kindergarten Cohort obtained in 2004. The sample included 8,935 5th graders. School teachers and administrators were surveyed about facility provision, PE, and recess time.	School administrators reported on availability and adequacy of school facilities. Classroom teachers reported on PE and recess time. Multivariate linear and logistic regressions accounted for the nesting of children within schools	<p>+ Large number of participants</p> <p>+ Nationally representative sample</p> <p>– Self-reported data without observational confirmation</p> <p>– Reading and math teachers reported amount of PE and recess without external validation</p>
Gordon-Larsen et al., 2000	17,766 U.S. adolescents in middle and high schools (including 3,933 non-Hispanic blacks, 3,148 Hispanics, and 1,337 Asians)	Cross-sectional study comparing self-reported physical activity with PE enrollment, obtained by telephone survey. PE enrollment compared in low and high physical activity groups; included sex and race and ethnic comparisons	<p>+ Nationally representative sample</p> <p>+ Large number of adolescents</p> <p>– Self-reported physical activity and PE enrollment</p>
Gutin et al., 2008	206 youths (grades 3–5) who remained in the same 18 Augusta, GA, schools for the three-year period	Measurements at beginning and end of the grades 3–5. Fitness measured with heart rate response to bench-stepping task. Percent body fat and bone density were measured with dual-energy x-ray absorptiometry	<p>+ Intervention provided strong dose of physical activity (five days a week for three school years)</p> <p>+ HR was measured during activity sessions</p> <p>– Only a minority of youths (206 out of 617) met attendance policy for this analysis</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Hannon et al., 2006	Project focused on development of open-door community advisory board to focus on access to after-school activity programs for inner-city youth	“Play Across Boston” developed and implemented a needs assessment for future sports and recreation planning	<p>+ Comprehensive needs assessment in large metropolitan area</p> <p>– Preliminary activity prior to intervention</p>
Haug et al., 2010	Sample of 16,471 students (grades 4–10) in 130 schools in Norway	Data on facilities and activity obtained by self-report from administrators and students	<p>+ Large representation of schools and adolescents</p> <p>– Self-reported facility data without confirmation</p> <p>– Used self-reported physical activity data based on responses to three questions</p>
Kelder et al., 2009	Used a prior probability sampling model representing Texas elementary schools and health districts (n=171 schools). Also, surveyed schools in two border regions (all 12 schools from Region 10, and eight out of 20 schools from Region 11).	Used a structured phone interview to collect data from administrators. Questionnaire included 28 items about Texas State Senate bills. Also, collected teacher-reported minutes of physical activity in schools (4th grade teachers key log of child activity). PE assessments using SOFIT conducted in third, fourth, and fifth grade PE classes.	<p>+ Study included 20 schools on the Texas–Mexico border that represent high obesity, diabetes and poverty levels</p> <p>+ Used administrator, teacher, and direct observation data</p> <p>– Self-report data is subject to recall and social desirability</p>
Leatherdale et al., 2010	Sample included 2,379 students from 30 elementary schools in Canada	Cross-sectional study of school and school-level characteristics associated with children’s physical activity. Physical activity assessed by self-report and school data by School Health survey completed by school administrator	<p>+ Used self-reported measure of child physical activity</p> <p>+ School level instrument aligned with physical activity components of healthy schools</p> <p>– Did not measure the impact of ethnic group or socioeconomic status</p>
Lubans & Morgan, 2008	Sample included 116 adolescents from three schools in Wales	Within school randomization by grade level (8th and 9th). Program was an extra-curricular, weekly school sport option for secondary students that included pedometers and workbooks for goal-setting and monitoring. Comparison group students participated in a health-related fitness program. Both programs were of similar length (once per week for eight weeks). Physical activity measured by pedometers.	<p>+ Program components well-described</p> <p>– Quasi-experimental (within school) randomization</p> <p>– Pedometer measures often subject to bias (feedback to participant)</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Luepker et al., 1996	Sample included 5,106 students from 96 schools in four U.S. states	Randomized clinical trial (CATCH) over two and a half years to test health behavior interventions (enhanced PE, food service modifications, classroom health curricula); overall physical activity assessed by objective monitor and activity checklist; PE class activity assessed by direct observation	<p>+ Large, multi-site study with strong research methods</p> <p>+ Careful documentation of PE intervention component</p> <p>+ Systematic observation of PE with multiple observations</p> <p>– Overall physical activity assessed at post-test only</p>
Mahar et al., 2006	Sample included 243 elementary school students	Compared the use of a classroom break program (Energizers) to usual classroom activities. Physical activity was assessed by pedometers.	<p>+ Assessed physical activity multiple times before and during intervention; also assessed on-task behavior following intervention period using systematic protocol</p> <p>– Pedometers were used to assess physical activity (only steps recorded)</p>
McKenzie et al., 1993	Sample included all fourth grade classes from seven elementary schools in one California school district	Schools were matched and randomized into PE specialist (PES), trained classroom teacher (TT), and control (CO). In the TT group, teachers received 23 hours of in-service training using standard PE curriculum (SPARK) and weekly follow-up consultation. PES classes were taught by a certified PE teacher trained in the curriculum. Classroom observations conducted using SOFIT.	<p>+ Large number of schools and students included</p> <p>+ Used systematic observation system to determine impact</p> <p>– PE teachers hired specifically for study; optimal dissemination depends upon availability of PE teachers, although training classroom teachers was better than no training</p>
McKenzie et al., 1996	Sample same as Luepker et al., 1996	Randomized intervention over two and a half years as part of a large health behavior study (CATCH) that included a PE intervention; assessed impact of curriculum and staff development. PE class activity assessed by direct observation.	<p>+ Large, multi-site study with strong research methods</p> <p>+ Careful documentation of PE intervention component</p> <p>+ Systematic observation of PE with multiple observations</p> <p>– Optimal dissemination depends upon availability of PE teachers</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
McKenzie et al., 1997	Sample included two separate groups of fourth grade students from seven elementary schools in one California school district	Randomized intervention (SPARK) that compared one of three PE interventions: 1) PE specialists (PES) were employed and trained with standard curriculum; 2) classroom teachers were trained; and 3) usual PE taught by classroom teachers. Activity levels in PE class assessed by direct observation. Study expands original SPARK study for two additional years and another grade level. Also tested effects of withdrawing PES. SOFIT used to assess activity in PE class.	<p>+ Two separate replications of the intervention; used systematic observational protocol</p> <p>– Schools all from one district; no baseline measures of overall physical activity</p>
McKenzie et al., 2001	Sample same as Luepker et al., 1996	Part of a large randomized multi-state school-based intervention to increase cardiovascular health. CATCH PE focused on improving the quality and quantity of PE delivered. CATCH PE intervention compared standard curriculum and professional development over a two and a half year period. Classroom activity assessed by direct observation.	<p>+ Strong research design and implementation</p> <p>+ Systematic observational protocol used to assess physical activity level within PE class</p> <p>+ PE taught by existing PE teachers and classroom teachers in indoor and outdoor settings</p> <p>– Only in-school activity assessed regularly</p>
McKenzie et al., 2010	Sample included data from 2,349 visits to 13 elementary schools in from low-income neighborhoods in southern California	Cross-sectional study using SOPLAY observational system; physical activity levels in 137 target areas assessed	<p>+ Used direct observation to assess physical activity</p> <p>+ Included a large number of observations</p> <p>– Study did not control for analysis by school</p>
Naylor et al., 2008	Sample included 515 students (ages 9–11) from 10 schools in British Columbia, Canada	Randomized school-based intervention (Action Schools! BC) implemented over 16 months. Compared use of training and support provided by external liaisons, internal champions compared with usual conditions. Physical activity was measured using pedometers.	<p>+ Used novel, customized intervention model suitable for teachers to implement</p> <p>– Pedometer is a weak outcome measure</p> <p>– Results were found only for boys</p>
Nichols et al., 2009	Sample included data from 7,638 sixth to tenth grade students who participated in the Canadian Health Behaviour Survey (2005–06)	Cross-sectional analysis based on adolescents' self-reported physical activity. School administrator completed survey about school facilities.	<p>+ Large sample of adolescents</p> <p>+ Used national surveillance data</p> <p>– Self-report of activity</p> <p>– Facilities survey data were not validated</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Pate et al., 2005	Sample included 2,744 girls with large number of African-American students assessed in spring of eighth grade and followed over one year	Randomized school-based intervention (LEAP) based on the Coordinated School Health Model. Components included enhanced PE, school environment, health education, staff wellness and home/community, and used a program champion model. Physical activity assessed by self-report (3DayPAR).	<ul style="list-style-type: none"> + One of the few studies of high school girls + Large number of participants, including African-American girls + Intervention implementation could be modified to accommodate local school setting – Self-report assessment of physical activity used
Pate et al., 2007	Sample included 2,154 eighth and 1,888 ninth and 1,402 twelfth grade girls from 22 high schools in South Carolina	Cross-sectional study of physical activity assessed (three days) by self-report and PE enrollment by questionnaire	<ul style="list-style-type: none"> + Large sample of girls in three different grades – Significant population of African-American girls – Self-reported physical activity – Only 10% of 12th grade girls were enrolled in PE
Pate et al., 2007	Sample included 1,594 adolescent girls in 22 high schools in South Carolina	Longitudinal observation three years following LEAP intervention. Physical activity assessed by self-report (3DayPAR).	<ul style="list-style-type: none"> + Long-time follow-up of girls in high school + Considered full implementation to partial implementation – Self-report used to assess physical activity – Maintenance depended upon the level of implementation of original LEAP intervention
Pate & O'Neill, 2008	Literature review of peer-reviewed articles using two major search engines (Medline, Psy-Info).	Descriptive comparison of study results providing study characteristics and outcomes	<ul style="list-style-type: none"> + Grouped study outcomes by objective and self-report measures – Search criteria (including scope of search) was not defined
Robinson et al., 2003	Pilot study included 61 eight- to 10-year-old African-American girls and their families	Randomized control design. Intervention consisted of 12-week program of after-school dance classes at community centers and lesson delivered at home. Controls received newsletters and health talks. Physical activity accessed by accelerometry.	<ul style="list-style-type: none"> + Innovative approach for after-school program – Small pilot study
Ridgers et al., 2006	Literature review of peer-reviewed articles between 1970 and 2004	Descriptive comparison of key findings giving a variety of outcomes	<ul style="list-style-type: none"> + First review of recess-based interventions – Most studies were of low quality, reflecting the state of the research – Search strategies were unclear, including number of databases searched

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Ridgers et al., 2007	Sample included 26 schools located in areas of high deprivation in one large city in England	15 schools each received £20,000 for redesign of playgrounds, including color-coding and such additional physical structures as goal post, and fencing. Eleven schools served as matched socioeconomic controls. Physical activity during recess was assessed by heart rate and activity monitoring. Children were assessed at baseline, six weeks and six months following the playground redesign intervention.	<p>+ Study included a large number of schools and significant funds for redesign</p> <p>+ Assessed short-term and long-term effects</p> <p>– Used non-standard measure of activity that integrated accelerometer and heart rate monitoring</p>
Sallis et al., 1997	Sample of 955 fourth- and fifth-grade students from seven schools in one California school district	Randomized intervention (SPARK) that compared one of three PE interventions: 1) PE specialists trained using SPARK curriculum; 2) classroom teachers trained to use SPARK curriculum; and 3) PE taught by classroom teachers (control). Activity levels in PE class assessed by direct observation. Methods same as McKenzie et al. (1997). Overall physical activity assessed by accelerometers.	<p>+ Used systematic observational protocol for PE observations</p> <p>+ Accelerometers used to assess physical activity</p> <p>– Small number of schools in one district</p> <p>– Quasi-experimental research design</p> <p>– No baseline measures of overall physical activity</p>
Sallis et al. 2001	Sample included 24 middle schools in San Diego, CA	School physical activity areas were assessed by observation. Adolescents' physical activity, teacher supervision, and equipment assessed by direct observation using SOPLAY instrument on three randomly scheduled days	<p>+ Large number of middle schools included</p> <p>+ Facilities determined by observation</p> <p>+ Activity levels by observation</p> <p>– Very small number of students who were physically active during free time</p>
Sallis et al., 2003	Sample included 1,109 middle school students from 24 schools in San Diego, CA	Randomized school-based intervention that included school-level planning, enhanced PE, social marketing and increased opportunities for physical activity. Physical activity at school was assessed by observation in different places (PE classes, and before, during, and after school) using direct observation. Individual physical activity assessed by activity checklist.	<p>+ Used systematic observation protocol and assessed activity in a variety of school locations</p> <p>+ Effective approach for increasing boys' physical activity</p> <p>– Used only in-school group-level observation of physical activity; no individual assessments conducted</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Scott et al., 2007	Study used baseline data (n=1,603) from girls participating in the Trial of Activity for Adolescent Girls (TAAG) study with usable accelerometer data. Girls were randomly selected from 36 schools in six states. Residences for 1,556 of the girls were geocoded.	All schools and parks within one-half mile were geocoded and visited. Amenities and accessibility were documented on Saturdays. Accelerometers data from TAAG study were used to measure girls' physical activity levels.	<p>+ Large, multi-site research study</p> <p>+ Data represents multiple states and racial and ethnic diversity</p> <p>+ On-site observation of facilities and objective physical activity data</p> <p>– Did not provide qualitative data on school facilities</p> <p>– One-day visitation</p>
Simon et al., 2004	Sample included eight randomly selected middle schools of the 77 in one district in eastern France, and included 954 adolescents	Schools were matched by income and randomized into intervention or control groups. The ICAPS program includes multiple partnerships with community groups, and targets knowledge, attitudes, beliefs and motivation for physical activity. Provided increased physical activity opportunities during school (lunch, recess and after-school). Also, included sporting events and active transportation. Physical activity measured by self-report.	<p>+ Strong research design</p> <p>+ Promising results in initial six months</p> <p>– Physical activity measured by self-report</p> <p>– Longer study results not yet available</p>
Stratton et al., 2005	Sample included 120 students from eight elementary schools: four from low-income areas and four from comparison schools in Wales	Schools received a health promotion grant to paint playground. Children (boys and girls) were randomly selected to wear heart rate monitors to assess physical activity levels.	<p>+ Study included lower-income schools</p> <p>+ All schools received similar funding £800</p> <p>– Pre-post design; no control group</p> <p>– No measure of marking quality</p>
Trost et al., 2008	Participants (n=147) were children recruited from seven ethnically diverse after-school programs in one school district in Kansas	Physical activity was assessed by accelerometers. Students wore monitors six times during the program.	<p>+ Multiple assessments of after-school activity level</p> <p>+ Data from seven different programs</p> <p>– Only one school district represented</p>
Verstraete et al., 2006	Sample included seven elementary schools randomly assigned to intervention and control groups. Intervention schools (four) included 122 children, while the control group (three schools), included 113 children	Children's activity levels were measured before and three months after providing game equipment. Physical activity assessed using accelerometers.	<p>+ Unique study with focus on equipment usage</p> <p>+ Randomized at school level</p> <p>– Unable to control amount of recess time provided</p>

TABLE 1. continued

Study	Sample Characteristics	Methods	+ Strengths / – Weaknesses
Weintraub et al., 2008	Sample included 21 fourth and fifth grade students with BMI levels at or above the 85th percentile	Study was a 6-month, randomized controlled pilot study. Soccer team was the focus of the after-school program. Control group received an active placebo; 25 sessions of nutrition and physical activity. Physical activity measured by accelerometers.	<ul style="list-style-type: none"> + Use of team sport innovative + Program length (six months) – Limited to overweight/obese children – Very small number of participants
Willenberg et al., 2010	Sample included 23 elementary schools in Melbourne, Australia. Twelve were randomly assigned to the intervention group.	Study part of a large school-based intervention (Fun 'n Healthy in Moreland!). Children's activity levels assessed by direct observation (SOPLAY). Assessment occurred with and without access to loose equipment and teacher supervision.	<ul style="list-style-type: none"> + Large number of schools involved + Large number of students observed (6,182) + Observations conducted in multiple school-yard settings (e.g. courts, equipment areas, grassy fields, etc.) – No quantification of loose equipment
Young et al., 2006	Participants included 221 ninth grade girls (83% African-American) enrolled in one urban high school	Recruited girls were randomized into life skills or standard physical education class which last for one school year. Intervention classes focused on having maximum classroom activity, behavior skills training and parent information. Physical activity assessed by self-report of previous week, and Fitnessgram was used.	<ul style="list-style-type: none"> + Addressed high-risk group of African-American, inner city girls + Alternative PA program lasted two semesters + Intervention delivered by teacher, making it more generalizable – Only conducted in one high school – PA measured by self-report