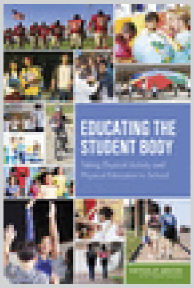

Educating the Student Body: Taking Physical Activity and Physical Education to School

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Harold W. Kohl III and Heather D. Cook, Editors; Committee on Physical Activity and Physical Education in the School Environment; Food and Nutrition Board; Institute of Medicine

Educating the Student Body: Taking Physical Activity and Physical Education to School

Committee on Physical Activity and Physical Education in the School Environment
Food and Nutrition Board

Harold W. Kohl III and Heather D. Cook, *Editors*

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

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Willing is not enough; we must do."
—Goethe

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This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Andy Bindman, University of California, San Francisco
James F. Bogden, National School Boards Association
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Katherine T. Thomas, University of North Texas, Denton

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by **Connie M. Weaver,** Purdue University, and **Caswell A. Evans, Jr.,** University of Illinois at Chicago. Appointed by the Institute of Medicine and National Research Council, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

PREFACE

Physical activity is central to health, and its importance clearly extends beyond its role in achieving energy balance to prevent and treat obesity and overweight. Adequate daily physical activity improves cardiovascular health, metabolic health, brain and mental health, and musculoskeletal health, benefits that recent research shows are gained across the life span. Important emerging research in youth has further focused on the association between physical activity in youth and academic achievement.

Clinical and public health guidelines indicate that youth need a minimum of 60 minutes per day of vigorous or moderate-intensity physical activity to optimize health and development. Because many youth spend a substantial amount of time in school, this report focuses specifically on the role schools can play in increasing physical activity among youth and providing opportunities to meet these guidelines. This role falls squarely within schools' long standing tradition of providing access to health services such as health screenings, nutrition programs, and immunizations.

The assumption that school-based physical education can provide enough physical activity for children and adolescents has recently been challenged on a variety of fronts. First, the 60 minutes per day of physical activity that is health-enhancing is nearly impossible to achieve through physical education, even with the highest-quality physical education curriculum. Second, quality physical education must include time for teaching activities and lessons that may not be physically active. Third, political and economic pressures on education systems to improve standardized test scores have had the unintended consequences of reducing or eliminating physical education curricula and thus students' opportunities for physical activity. Therefore, the purpose of this report is to highlight the central need not only to provide quality physical education for all youth, but also to implement other evidence-informed methods schools can use to help all children and adolescents attain a minimum of 60 minutes of vigorous or moderate-intensity physical activity per day to improve health, development, and academic performance. Many different constituents—including federal, state, district, and school administrators; teachers; parents; and all those interested in the health, development, and academic achievement of youth—must be reached with the message that such a whole-of-school approach to physical activity is needed.

Many people contributed to the successful completion of this project. First, the committee thanks Tina Kauh and the Robert Wood Johnson Foundation for supporting the study and the development of this report. The committee also wishes to thank participants in a public workshop held in September 2012 to gather expert opinion on this topic from leaders in the field: Michael Beets, Ph.D.; Becky Ciminillo; Don Disney, M.S., M.A.; Erin Donoghue, M.Ed.; Joseph Donnelly, Ed.D.; David Dzewaltowski, Ph.D.; Dolly Lambdin, Ed.D.; Gillian Hotz, Ph.D.; Melissa Maitin-Shepard, M.P.P.; Noreen McDonald, Ph.D.; Thomas McKenzie, Ph.D.; Lisa Perry, M.Ed; Shellie Pfohl, M.S.; Abby Rose, M.Ed., M.A.; and Jennifer A. Weber, M.P.H., R.D. In addition, in December 2012, Katrina L. Butner, Ph.D., spoke with the committee during an open session and we would like to thank her for her time.

I am most grateful to the volunteer expert committee members who so graciously gave time from their busy schedules to contribute to the completion of this task over such a short time period. The efforts of each member were extraordinary. Further, I appreciate the extensive consultative guidance from Terry Huang, Ph.D., M.P.H., C.P.H., of the University of Nebraska Medical Center. Dr. Huang's understanding of systems thinking helped shape the committee's approach and this report in an innovative way.

This work could not have been completed without the outstanding support and guidance of the dedicated Institute of Medicine (IOM) staff, Heather Del Valle Cook, study director; Lynn Parker, scholar; Emily Ann Miller, program officer; Sarah Ziegenhorn, research assistant; Allison Berger, senior program assistant; Sarah Sliwa, Christine Mirzayan Science and Technology Policy Fellow; and Linda Meyers, director of the IOM Food and Nutrition Board. Finally, the report greatly benefited from the copyediting skills of Rona Briere. I am grateful to each of these individuals for their patience and focus during the study process.

Harold W. Kohl III, *Chair*
Committee on Physical Activity and Physical Education in the School Environment

Contents

Summary

Physical inactivity is a key determinant of health outcomes across the life span. A lack of activity increases the risk of heart disease, colon and breast cancer, diabetes mellitus, hypertension, osteoporosis, anxiety and depression, and other diseases. Recent studies have found that in terms of mortality, the global population health burden of physical inactivity approaches that of cigarette smoking and obesity. Indeed, the prevalence of physical inactivity, along with this substantial associated disease risk, has been described as a pandemic.

Although complete data are lacking, the best estimate in the United States is that only about half of youth meet the current and evidence-based guideline of at least 60 minutes of vigorous or moderate-intensity physical activity daily. Moreover, the proportion of youth who meet this guideline declines with advancing age, so that younger children are more likely to do so than adolescents. Further, daily opportunities for incidental physical activity have declined for children and adolescents, as they have for adults, as a result of such factors as increased reliance on nonactive transportation, automation of activities of daily living, and greater opportunities for sedentary behavior. Finally, substantial disparities in opportunities for physical activity exist across racial, ethnic, and socioeconomic lines.

Perhaps it should not be surprising, then, that over the past 30 years, the United States has experienced a dramatic increase in the prevalence of noncommunicable diseases, including obesity, many of which have their origins in childhood and persist as health burdens throughout adulthood. In examining this critical national health challenge, it becomes clear that increased physical activity should be an essential part of any solution.

The prevalence and health impacts of physical inactivity, together with evidence indicating its susceptibility to change, have resulted in calls for action aimed at increasing physical activity across the life span. Clearly, the earlier in life this important health behavior can be ingrained, the greater the impact will be on life-long health. The question becomes, then, how physical activity among children and adolescents can be increased feasibly, effectively, and sustainably to improve their health, both acutely and throughout life. A recent report of the Institute of Medicine (IOM), *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation*, singles out schools as “a focal point for obesity prevention among children and adolescents,” stating: “Children spend up to half their waking hours in school. In an increasingly sedentary world, schools therefore provide the best opportunity for a population-based approach for increasing physical activity among the nation’s youth.”

STUDY APPROACH

In this context, the IOM's Committee on Physical Activity and Physical Education in the School Environment was formed to review the current status of physical activity and physical education in the school environment (including before, during, and after school), and to examine the influences of physical activity and physical education on the short- and long-term physical, cognitive and brain, and psychosocial health and development of children and adolescents. The committee's statement of task is provided in Box S-1.

BOX S-1
Statement of Task

An ad hoc committee of the Institute of Medicine (IOM) will review the current status of physical activity and physical education in the school environment. The committee will also review influences of physical activity and physical education on the short- and long-term physical, cognitive and brain, and psychosocial health and development of children and adolescents. The committee will then, as appropriate, make recommendations regarding approaches for strengthening and improving programs and policies for physical activity and physical education in the school environment, including before, during, and after school.

In carrying out its task, the committee will

- Review the current status of physical activity and physical education in the school environment.
- Review evidence on the relationship between physical activity, physical education, or physical fitness and physical, cognitive and brain, and psychosocial health and development.
- Within a life-stage framework, consider the role of physical activity and physical education-related programs and policies offered in the school environment in contributing to short- and long-term health, health behaviors, and development (e.g., motor and cognitive development).
- Recommend, as appropriate, strategic programmatic, environmental, and policy approaches for providing, strengthening, and improving physical activity and physical education opportunities and programs in the school environment, including before, during, and after school.
- As evidence is reviewed, identify major gaps in knowledge and recommend key topic areas in need of research.

The committee recognized that although schools are a necessary part of any solution to the problem of inadequate physical activity among the nation's youth, schools alone cannot implement the vast changes across systems required to achieve a healthy and educated future generation. Many more institutional players and supports will be necessary to make and sustain these changes. In approaching this study, therefore, the committee employed systems thinking to delineate the elements of the overall system of policies and regulations at multiple levels that influence physical activity and physical education in the school environment.

THE EVIDENCE BASE

Extensive scientific evidence demonstrates that regular physical activity promotes growth and development in youth and has multiple benefits for physical, mental, and cognitive health. Quality physical education, whereby students have an opportunity to learn meaningful content with appropriate instruction and assessments, is an evidence-based recommended strategy for increasing physical activity.

Much of the evidence to date relating physical activity to health comes from cross-sectional studies showing associations between physical activity and aspects of physical health; nonetheless, the available observational prospective data support what the cross-sectional evidence shows. Conducting exercise training studies with young children is very challenging, so experimental evidence for the effects of physical activity on biological, behavioral, and psychosocial outcomes is limited for this population. It has been shown, however, that older children, especially adolescents, derive much the same health benefits from physical activity as young adults.

In addition to long-term health benefits, an emerging literature supports acute health benefits of physical activity for children and adolescents. Physical activity in children is related to lower adiposity, higher muscular strength, improved markers of cardiovascular and metabolic health, and higher bone mineral content and density. Physical activity in youth also can improve mental health by decreasing and preventing conditions such as anxiety and depression and enhancing self-esteem and physical self-concept.

Although evidence is less well developed for children than adults, a growing body of scientific literature indicates a relationship between vigorous and moderate-intensity physical activity and the structure and functioning of the brain. Both acute bouts and steady behavior of vigorous and moderate-intensity physical activity have positive effects on brain health. More physically active children demonstrate greater attentional resources, have faster cognitive processing speed, and perform better on standardized academic tests. Of course, academic performance is influenced by other factors as well, such as socioeconomic status, and understanding of the dose-response relationship among vigorous and moderate-intensity physical activity, academic performance, and classroom behavior is not well developed. Nevertheless, the evidence warrants the expectation that ensuring that children and adolescents achieve at least the recommended amount of vigorous and moderate-intensity physical activity may improve overall academic performance.

THE ROLE OF SCHOOLS

The evidence base summarized above supports the need to place greater emphasis on physical activity and physical education for children and adolescents, particularly on the role schools can play in helping youth meet physical activity guidelines.

Physical education has traditionally been the primary role played by schools in promoting physical activity. Despite the effectiveness of quality physical education in increasing physical activity, however, challenges exist to its equitable and effective delivery. Fiscal pressures, resulting in teacher layoffs or reassignments and a lack of equipment and other resources, can inhibit the offering of quality physical education in some schools and districts. Schools may lack trained physical educators, and safety issues are associated with allowing children to play. Policy pressures, such as a demand for raising standardized test scores through increased classroom contact time, further challenge the role of school physical education in providing physical activity for youth. Nearly half (44 percent) of school administrators report cutting significant amounts of time from physical education, arts, and recess to increase time in reading and mathematics since passage of the No Child Left Behind legislation in 2001. These challenges have been cited as the reasons why the percentage of schools offering physical education daily or at least 3 days each week declined dramatically in U.S. schools between 2000 and 2006.

Children and adolescents engage in different types and patterns of physical activity as the result of a variety of factors, including age and access to resources. Exercise capacity in children and the activities in which they can successfully engage change in a predictable way across developmental periods. Young children are active in short bursts of free play, and their capacity for continuous activity increases as they grow and mature. In adults and likely also adolescents, improved complex motor skills allow for more continuous physical activity, although intermittent exercise offers much the same benefit as continuous exercise when the type of activity and energy expenditure are the same. Although the health benefits of sporadic physical activity at younger ages are not well established, children require frequent opportunities for practice to develop the skills and confidence that promote ongoing engagement in physical activity. Physical education curricula are structured to provide developmentally appropriate experiences that build the motor skills and self-efficacy that underlie lifelong participation in health-enhancing physical activity, and trained physical education specialists are uniquely qualified to deliver them.

In the best possible scenario, however, physical education classes are likely to provide only 10-20 minutes of vigorous or moderate-intensity physical activity per session. Physical education, then, although important, cannot be the sole source of the at least 60 minutes per day of vigorous or moderate-intensity physical activity recommended to enhance the health of children and adolescents. Other ways to promote physical activity in youth must therefore be systematically exploited to provide physical activity opportunities. Family, neighborhood, and community programs can be a source of such additional opportunities. Moreover, other school-based opportunities, including intramural and extramural sports programs, active transport to and from school, classroom physical activity breaks, recess, and before- and after-school programming, all can help youth accumulate the recommended 60 or more minutes per day of physical activity while in the school environment. Yet educators and policy makers may lack awareness and understanding of how effective physical activity may improve academic achievement and the many ways in which physical activity can and has been successfully incorporated into the school environment.

Traditionally, schools have been central in supporting the health of their students by providing immunizations, health examinations and screening, and nutrition programs such as school breakfasts and lunches, in addition to opportunities for physical activity. They also have acted as socioeconomic equalizers, offering all students the same opportunities for improved health through these services and programs. Moreover, local, state, and national policies have been able to influence what schools do. Given that children spend up to 7 hours each school day in school and many attend after-school programs, it is important to examine the role schools can play in promoting physical activity in youth. Although more physical activity at home and in the community is an important goal as well, the opportunity to influence so many children at once makes schools an extremely attractive option for increasing physical activity in youth.

RECOMMENDATIONS

The committee formulated recommendations in six areas: taking a whole-of-school approach, considering physical activity in all school-related policy decisions, incorporating physical education as part of the core curriculum, monitoring physical education and opportunities for physical activity in schools, providing preservice training and professional development for physical education teachers, and ensuring equity in access to physical activity and physical education.

Taking a Whole-of-School Approach

Recommendation 1: District and school administrators, teachers, and parents should advocate for and create a whole-of-school approach to physical activity that fosters and provides access in the school environment to at least 60 minutes per day of vigorous or moderate-intensity physical activity more than half (>50 percent) of which should be accomplished during regular school hours.

- **School districts should provide high-quality curricular physical education during which the students should spend at least half (≥50 percent) of the class-time engaged in vigorous or moderate-intensity physical activity. All elementary school students should spend an average of 30 minutes per day and all middle and high school students an average of 45 minutes per day in physical education class. To allow for flexibility in curriculum scheduling, this recommendation is equivalent to 150 minutes per week for elementary school students and 225 minutes per week for middle and high school students.**
- **Students should engage in additional vigorous or moderate-intensity physical activity throughout the school day through recess, dedicated classroom physical activity time, and other opportunities.**
- **Additional opportunities for physical activity before and after school hours, including but not limited to active transport, before- and after-school programming, and intramural and extramural sports, should be made accessible to all students.**

Because the vast majority of youth are in school for many hours, because schools are critical to the education and health of children and adolescents, and because physical activity promotes health and learning, it follows that physical activity should be a priority for all schools, particularly if there is an opportunity to affect academic achievement. As noted earlier, schools have for years been the center for other key health-related programming, including screening, immunizations, and nutrition and substance abuse programs. Unfortunately, school-related physical activity has been fragmented and varies greatly across the United States, within states, within districts, and even within schools. Physical education typically has been relied upon to provide physical activity as well as curricular instruction for youth; as discussed above, however, physical education alone will not allow children to meet the guideline of at least 60 minutes per day of vigorous or moderate-intensity physical activity. Interscholastic and intramural sports are another traditional opportunity for physical activity, but they are unavailable to a sizable proportion of youth. Clearly schools are being underutilized in the ways in which they provide opportunities for physical activity for children and adolescents. A whole-of-school approach that makes the school a resource to enable each child to attain the recommended 60 minutes or more per day of vigorous or moderate-intensity physical activity can change this situation.

The committee therefore recommends a whole-of-school approach to physical activity promotion. Under such an approach, all of a school's components and resources operate in a coordinated and dynamic manner to provide access, encouragement, and programs that enable all students to engage in vigorous or moderate-intensity physical activity 60 minutes or more each day. A whole-of-school approach encompasses all segments of the school day, including travel to and from school, school-sponsored before- and after-school activities, recess and lunchtime breaks, physical education, and classroom instructional time. Beyond the resources devoted to quality daily physical education for all students, other school resources, such as classroom teachers, staff, administrators, and aspects of the physical environment, are oriented toward physical activity. Intramural and extramural sports programs are available to all who wish to participate, active transport is used by substantial numbers of children to move from home to school and back again, recess and other types of breaks offer additional opportunities for physical activity, and lesson plans integrate physical activity as an experiential approach to instruction. Figure S-1 illustrates the breadth of opportunities available for physical activity in the school environment.

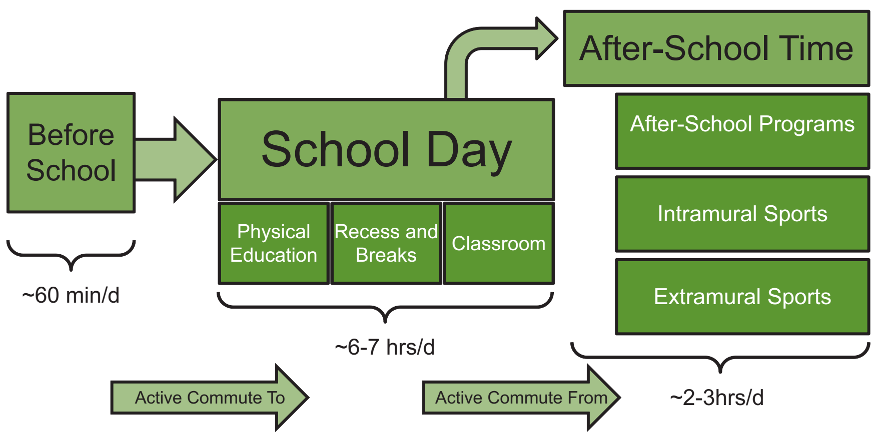

FIGURE S-1 A whole-of-school approach.
SOURCE: Beets, 2012. Reprinted with permission from Michael Beets.

A whole-of-school approach encompasses all people involved in the day-to-day functioning of the school, including students, faculty, staff, and parents. It creates an atmosphere in which physical activity is appreciated and encouraged by all these groups. School buildings, outdoor grounds and playgrounds, indoor and outdoor equipment, and streets and pathways leading to the school from the surrounding neighborhood encourage and enable all persons to be more physically active. Moreover, the school is part of a larger system that encompasses community partnerships outside the school to help these goals be realized.

Considering Physical Activity in All School-Related Policy Decisions

Recommendation 2: Federal and state governments, school systems at all levels (state, district, and local), city governments and city planners, and parent–teacher organizations should systematically consider access to and provision of physical activity in all policy decisions related to the school environment as a contributing factor to improving academic performance, health, and development for all children.

Many examples exist of effective and promising strategies for increasing vigorous and moderate-intensity physical activity in schools. The most thorough, yet often most difficult to implement, are multi-component interventions based on a systems approach that encompasses both school and community strategies. For strategies with a singular focus, the evidence is most robust for interventions involving physical education. Although physical education curricula should not focus only on physical activity, those curricula that do emphasize fitness activities result in more physical activity. Quality physical education curricula increase overall physical activity, increase the intensity of physical activity, and potentially influence body mass index (BMI)/weight status in youth. However, the lack of consistent monitoring of physical activity levels during physical education classes in schools (especially elementary and middle schools) impedes monitoring and evaluation of progress toward increasing physical activity during physical education in schools across the nation (see Recommendation 4).

Beyond physical education, opportunities for increasing physical activity are present in both the classroom and for elementary and middle schools, during recess. Classroom physical activity and strategies to reduce sedentary time in the school setting hold promise for increasing overall physical activity among children and adolescents, yet isolating the impact of these strategies is complex, and they are often met with resistance from key stakeholders. With respect to recess, its use to increase physical activity is a nationally recommended strategy, and there is evidence that participating in recess can increase physical activity and improve classroom behavior. However, implementation of recess across school districts and states is not currently at a sufficient level to increase physical activity.

Effective and promising strategies beyond the school day include after-school programming and sports, as well as active transport to and from school. After-school programming and participation in sports are important physical activity opportunities in the school setting, but implementation of and access to these opportunities vary greatly. Moreover, formal policies adopting physical activity standards for after-school programs are needed. Finally, evidence shows that children who walk or bike to school are more physically active than those who do not. Successful active-transport interventions address policy and infrastructure barriers.

Also associated with the school environment are agreements between schools and communities to share facilities as places to be physically active. Although this is a relatively new research topic, these joint use agreements can be a way to give youth additional opportunities for physical activity outside of school. Further research is needed on the utilization of facilities due to these agreements and the impact they have on physical activity.

Designating Physical Education as a Core Subject

Recommendation 3: Because physical education is foundational for lifelong health and learning, the U.S. Department of Education should designate physical education as a core subject.

Physical education in school is the only sure opportunity for all school-aged students to access health-enhancing physical activity and the only school subject area that provides education to ensure that students develop knowledge, skills, and motivation to engage in health-enhancing physical activity for life. Yet, states vary greatly in their mandates with respect to time allocated for and access to physical education. As stated previously, 44 percent of school administrators report having cut significant time from physical education and recess to increase time devoted to reading and mathematics in response to the No Child Left Behind Act. Moreover, while the literature on disparities in physical education by race/ethnicity and socioeconomic status is limited and not always as straightforward, disparities have been documented in access to physical education for students of Hispanic ethnicity and lower socioeconomic status.

Currently, despite growing concern about the negative consequences of physical inactivity, physical education is not considered or treated as a core subject. Several national studies and reports have pointed to the importance of implementing state laws and regulations mandating both time requirements for physical education and monitoring of compliance with those requirements. Although a number of national governmental, nongovernmental, private industry, and public health organizations and agencies have offered specific recommendations for the number of days and minutes per day of physical education, no policy that is consistent from state to state has emerged. If treated as a core academic subject, physical education would receive much-needed resources and attention that would enhance its overall quality in terms of content offerings, instruction, and accountability. The enactment of this recommendation also would likely result in downstream accountability that would assist in policy implementation.

Monitoring Physical Education and Opportunities for Physical Activity in School

Recommendation 4: Education and public health agencies at all government levels (federal, state, and local) should develop and systematically deploy data systems to monitor policies and behaviors pertaining to physical activity and physical education in the school setting, so as to provide a foundation for policy and program planning, development, implementation, and assessment.

The intent of this recommendation is to give citizens and officials concerned with the education of children in the United States—including parents and teachers plus education and public health officials at local, state, and federal levels—the information they need to make decisions about future actions. Principals, teachers, and parents who know that regular vigorous and moderate-intensity physical activity is an essential part of the health and potentially the academic performance of students and who have adopted a “whole-of-school” approach to physical activity will want and need this information. This information also is important to support the development of strategies for accountability for strengthening physical activity and physical education in schools.

Aside from a few good one-time surveys of physical activity during physical education classes, remarkably little information is available on the physical activity behaviors of students during school hours or school-related activities. Even the best public health monitoring systems do not obtain this information. This dearth of information is surprising given that school-related physical activity accounts for such a large portion of the overall volume of physical activity among youth and that vigorous and moderate-intensity physical activity is vital to students' healthy growth and development and may also influence academic performance, and classroom behavior.

The few existing monitoring systems for school-related physical activity behaviors need to be augmented. Information is needed not only on the amount of vigorous or moderate-intensity physical activity in which youth are engaged but also on its distribution across segments of the school day (i.e., physical education, recess, classroom, travel to and from school, school-related before- and after-school activities). Existing national surveys are not designed to provide local or even state estimates of these student behaviors. State departments of education, local school districts, and state and local health departments will need to collaborate to provide adequate monitoring. Also needed is augmented monitoring of physical activity–related guidelines, policies, and practices at the federal, state, and local levels.

Evidence is emerging that laws and policies at the state and district levels have not just potential but actual influence on the physical activity behaviors of large numbers of children and adolescents. Also emerging is evidence of a gap between the intent and implementation of policies, so that their final impact is commonly less, sometimes appreciably so, than expected. The factors that create an effective policy are still being elucidated. Policies that entail required reporting of outcomes, provision of adequate funding, and easing of competing priorities appear to be more likely to be implemented and more effective. Further evaluation of physical activity and physical education policies is needed to fully understand their impact in changing health behavior.

Monitoring of state and district laws and policies has improved over the past decade. In general, the number of states and districts with laws and policies pertaining to physical education has increased, although many such policies remain weak. For example, most states and districts have policies regarding physical education, but few require that it be provided daily or for a minimum number of minutes per week. Those that do have such requirements rarely have an accountability system in place. Although some comprehensive national guidelines exist, more are needed to define quality standards for policies on school-based physical activity and create more uniform programs and practices across states, school districts, and ultimately schools.

Providing Preservice Training and Professional Development for Teachers

Recommendation 5: Colleges and universities and continuing education programs should provide preservice training and ongoing professional development opportunities for K-12 classroom and physical education teachers to enable them to embrace and promote physical activity across the curriculum.

Teaching physical education effectively and safely to youth requires specific knowledge about their physical/mental development, body composition (morphology) and functions (physiology and biomechanics), and motor skill development and acquisition. Teaching physical education also requires substantial knowledge and skill in pedagogy, the science and art of teaching, which is required for any subject. In addition, because health is associated with academic performance, priority should be given to educating both classroom and physical education teachers regarding the importance of physical activity for the present and future physical and mental health of children.

The current wave of effort to curb childhood physical inactivity has begun to influence teacher education programs. Data appear to suggest that training programs for physical education teachers are beginning to evolve from a traditionally sport- and skill-centered model to a more comprehensive physical activity- and health-centered model. However, education programs for physical education teachers are facing a dramatic decrease in the number of kinesiology doctoral programs offering training to future teacher educators, in the number of doctoral students receiving this training, and in the number of professors (including part-time) offering the training. Additional data suggest a shortage of educators in higher education institutions equipped to train future physical education teachers. With unfilled positions, these teacher education programs are subject to assuming a marginal status in higher education and even to elimination.

Professional development—including credit and noncredit courses, classroom and online venues, workshops, seminars, teleconferences, and webinars—improves classroom instruction and student achievement, and data suggest a strong link among professional development, teacher learning and practice, and student achievement. The most impactful statement of government policy on the preparation and professional development of teachers was the 2002 reauthorization of the Elementary and Secondary Education Act. Although Title I of the act places highly qualified teachers in the classroom, Title II addresses the same goal by funding professional development for teachers. According to the No Child Left Behind Act, professional development should be offered to improve teachers' knowledge of the subject matter they teach, strengthen their classroom management skills, advance their understanding and implementation of effective teaching strategies, and build their capabilities to address disparities in education. This professional development should be extended to include physical education instructors as well.

Ensuring Equity in Access to Physical Activity and Physical Education

> **Recommendation 6: Federal, state, district, and local education administrators should ensure that programs and policies at all levels address existing disparities in physical activity and that all students at all schools have equal access to appropriate facilities and opportunities for physical activity and quality physical education.**

All children should engage in physical education and meet the recommendation of at least 60 minutes per day of vigorous or moderate-intensity physical activity regardless of their region, school attended, grade level, or individual characteristics. However, a number of studies have documented social disparities in access to physical education and other opportunities for physical activity by race/ethnicity, socioeconomic status, gender, and immigrant generation. Moreover, because not every child has the means or opportunity to participate in before- and after-school activities and intramural/extramural sports, curriculum-based physical education programs often provide the only opportunity for *all* school-aged children to access health-enhancing physical activity.

FUTURE RESEARCH NEEDS AND AREAS FOR ADDITIONAL INVESTIGATION

As stated at the beginning of this summary, an extensive scientific literature demonstrates that regular physical activity promotes growth and development in children and adolescents and has multiple benefits for physical, mental, and cognitive health. Looking forward, gaps remain in knowledge about physical activity and physical education in the school environment and key areas in which research would be useful to those who are implementing programs and policies designed to improve children's health, development, and academic achievement. These research needs are covered in greater detail throughout the report and especially in the final chapter. They include such topics as

- the effects of varying doses, frequency, timing, intermittency, and types of physical activity in the school environment;
- the relationship between motor skills and participation in physical activity;
- baseline estimates of physical activity behaviors in school;
- standardized data on participation in physical education, including the degree of vigorous or moderate-intensity physical activity in these classes;
- the extent and impact of sedentary behavior in school;
- the influence of school design elements;
- the impact of school–community physical activity partnerships;
- the impact of physical activity–related policies, laws, and regulations for schools; and
- the effectiveness of various physical activity–enhancing strategies in schools in addressing the needs of students who typically have not had equal access to opportunities for physical activity.

1
Introduction

Physical inactivity is a key determinant of health outcomes across the life span. A lack of activity increases the risk of heart disease, colon and breast cancer, diabetes mellitus, hypertension, osteoporosis, anxiety and depression, and other diseases. Recent studies have found that, in terms of mortality, the global population health burden of physical inactivity approaches that of cigarette smoking and obesity (Lee et al., 2012). Indeed, the prevalence of physical inactivity, along with this substantial associated disease risk, has been described as a pandemic (Kohl et al., 2012). Further, higher educational achievement and years of schooling are both markers and determinants of better health status, mainly as a result of to education's correlation with improved work and economic conditions, enhanced social psychological resources, and the ability to pursue a healthful lifestyle (Ross and Mirowsky, 1999). There is a long-held belief that health is an important determinant of educational performance, yet, only recently has evidence begun to accumulate on a plausible physiologic pathway explaining the influence of one important health behavior—physical activity—on brain function and cognitive processes (see Chapter 4). These data increase confidence that improving physical activity and fitness may result in better school achievement and performance.

Although complete data are lacking, the best estimate in the United States is that only about half of youth meet the current evidence-based guideline of at least 60 minutes of vigorous or moderate-intensity physical activity daily. Moreover, the proportion of youth who meet this guideline declines with advancing age, so that younger children are more likely to do so than adolescents. Daily opportunities for incidental physical activity also have declined for children and adolescents, as they have for adults, as the result of such factors as increased reliance on nonactive transportation, automation of activities of daily living, and greater opportunities for sedentary behavior. In addition, significant disparities in physical activity exist across racial/ethnic and socioeconomic lines.

The prevalence and health impacts of physical inactivity, together with evidence indicating its susceptibility to change, have resulted in calls for action aimed at increasing physical activity across the life span. A common belief is that the earlier in life this important health behavior can be ingrained, the greater the impact will be on lifelong health. The question becomes, then, how physical activity among children and adolescents can be increased feasibly, effectively, and sustainably to improve their health, both acutely and throughout life. A recent report of the Institute of Medicine (IOM), *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation*, singles out schools as "a focal point for obesity prevention among children and adolescents," stating: "Children spend up to half their waking hours in school. In an increasingly sedentary world, schools therefore provide the best opportunity for a population-based approach for increasing physical activity among the nation's youth" (IOM, 2012, p. 333).

PURPOSE OF THIS STUDY

Given the importance of physical activity to health in youth and increasing attention to its role in educational performance coupled with the potential of schools to provide opportunities to be physically active, a 14-member ad hoc committee of the IOM was convened and charged to review the current status of physical activity and physical education in the school environment. The committee was also tasked with reviewing influences of physical activity and physical education on the short- and long-term physical health, cognition and brain health, and psychosocial health and development of children and adolescents. The committee was asked to make recommendations, as appropriate, regarding approaches for strengthening and improving programs and policies for physical activity and physical education in the school environment, including before, during, and after school. In doing so, the committee was expected to review the current status of physical activity and physical education in the school environment; review evidence on the relationship between physical activity, physical education, or physical fitness and physical, cognitive and brain, and psychosocial health and development; within a life-stage framework, consider the role of physical activity- and physical education-related programs and policies in the school environment in contributing to short- and long-term health, health behaviors, and development (e.g., motor and cognitive development); recommend, as appropriate, strategic programmatic, environmental, and policy approaches for providing, strengthening, and improving physical activity and physical education opportunities and programs in the school environment, including before, during, and after school; and, as evidence was reviewed, identify major gaps in knowledge and recommend key topic areas in need of research.

Key Terms Used in This Report

Academic Learning Time (ALT)-physical education (PE): A measure used to assess quality physical education instruction. ALT-PE is the time in physical education class during which children are exposed to motor skill development, understanding of movement principles, attainment of health-enhancing levels of fitness, regular engagement in physical activity, socially responsible behaviors in physical activity settings, and an appreciation of the importance of engagement in physical activity.

Active transport: Modes of transportation to and from school that involve physical activity; includes primarily walking and biking.

Classroom physical activity: Opportunities for physical activity integrated into classroom lessons.

Developmentally appropriate physical activity: Physical activity that meets/includes the following criteria: (1) an orderly sequence of motor skill learning, (2) provisions for individual differences, (3) appropriate goal structures, and (4) ample learning time.

Exercise: Planned, structured, and repetitive activity designed to target a particular outcome (e.g., a component of fitness).

Extramural sports: Organized and supervised sports programs sanctioned by the school system that provide opportunities for competition outside the bounds of a particular school.

Intramural sports: Organized and supervised sports programs involving within-school teams and clubs that provide opportunities for all students to participate.

Moderate-intensity physical activity: Physical exertion that is equivalent to brisk walking. Such activities are usually performed at between 3.5 and 6.0 times resting metabolic rate.

Physical activity: Bodily movement that increases energy expenditure.

Physical activity breaks: Opportunities for physical activity provided briefly throughout the day, such as during morning announcements.

Physical education: A planned sequential K-12 standards-based program of curricula and instruction designed to develop motor skills, knowledge, and behaviors of healthy active living, physical fitness, sportsmanship, self-efficacy, and emotional intelligence.

Physical fitness: A set of physiologic attributes that are either health-related or skill-related. Physical fitness is an adaptive physiologic state that varies with growth and maturity status and physical activity.

Recess: A regularly scheduled period within the school day for supervised physical activity and play.

Vigorous-intensity physical activity: Physical exertion that leads to sweating and heavy breathing, such as running, basketball, soccer, and swimming laps; usually performed at or above an intensity of 6.0 times resting metabolic rate.

BACKGROUND AND STUDY CONTEXT

Since before the early 1900s, schools have had a role in providing health care for youth (IOM, 1997). From the single school nurse performing inspections and injury treatment to the provision of screening, health education, and immunizations to today's school-based health centers, schools have been important in providing health services to children. Throughout the history of school-based health care, access to children for large portions of the day has made schools practical and effective in providing these services (IOM, 1997). With the emergence of childhood obesity as a key health threat for youth, schools are yet again being called upon to take a lead role in the health of students.

As noted above, physical activity is an essential component of proximal and distal health indicators in youth (see Chapter 3). Recent efforts have led to an evidence-based guideline for physical activity in youth of at least 60 minutes per day, 7 days per week (Strong et al., 2005; Physical Activity Guidelines Advisory Committee, 2008) (see Box 1-1). Most of the 60 minutes per day should be spent in vigorous or moderate-intensity activities. Further, vigorous physical activities, bone-strengthening activities, and muscle-strengthening activities should be included at least 3 days each week. Such activities should offer variety, be enjoyable and be age-appropriate.

BOX 1-1
Physical Activity Guidelines for Americans: Active Children and Adolescents

Children and adolescents should perform 60 minutes (1 hour) or more of physical activity daily.

Aerobic: Most of the 60 or more minutes per day should be either moderate- or vigorous-intensity aerobic physical activity, and should include vigorous-intensity physical activity at least 3 days per week.

Muscle-strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week.

Bone-strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days of the week.

It is important to encourage young people to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.

SOURCE: HHS, 2008.

Schools have long provided opportunities for physical activity to children and adolescents; most notably through physical education. Early school-based physical education efforts in the 19th century focused largely on hygiene, gymnastics, performance in sports and games, and (later) military readiness (IOM, 2012). A focus on physical education for health and fitness subsequently emerged, gradually taking hold in the middle of the 20th century (IOM, 1997). Quality school physical education has been recommended as an evidence-based strategy to increase physical activity among youth (Task Force on Community Preventive Services, 2005). Physical education thus has a long history of being a central foundation for health, development, and learning in schools.

Despite the effectiveness of quality physical education (whereby students have an opportunity to learn meaningful content with appropriate instruction and assessments) in increasing physical activity, challenges exist to its equitable and effective delivery. Fiscal pressures, resulting in teacher layoffs or reassignments and a lack of equipment and other resources, can inhibit the offering of quality physical education in some schools and districts. Schools may lack trained physical educators, and safety issues are associated with allowing children to play. Educators and policy makers may lack awareness and understanding of the potential for physical activity to improve academic achievement and the many ways in which physical activity can be and has been successfully incorporated into the school environment. The role of school physical education in providing physical activity for youth is further challenged by a demand for raising standardized test scores by increasing classroom contact time and the ensuing policy pressures to do so. Nearly half of school administrators report cutting significant amounts of time from physical education, arts, and recess to increase time in reading and mathematics since passage of the No Child Left Behind legislation in 2001. These challenges have been cited as the reasons why the percentage of schools offering physical education daily or at least 3 days each week declined dramatically in U.S. schools between 2000 and 2006 (GAO, 2012).

Children and adolescents engage in different types and patterns of physical activity as the result of a variety of factors, including age and access to resources. Exercise capacity in children and the activities in which they can successfully engage change in a predictable way across developmental periods. Young children are active in short bursts of free play, and their capacity for continuous activity increases as they grow and mature. In adults and likely also adolescents, improved complex motor skills allow for more continuous physical activity, although intermittent exercise offers much the same benefit as continuous exercise when the type of activity and energy expenditure are the same. While the health benefits of sporadic physical activity at younger ages are not well established, children require frequent opportunities for practice to develop the skills and confidence that promote ongoing engagement in physical activity. Physical education curricula are structured to provide developmentally appropriate experiences that build the motor skills and self-efficacy that underlie lifelong participation in health-enhancing physical activity, and trained physical education specialists are uniquely qualified to deliver them.

In the best possible scenario, however, physical education classes are likely to provide only 10-20 minutes of vigorous or moderate-intensity physical activity per session. Physical education, then, although important, cannot be the sole source of the at least 60 minutes per day of vigorous or moderate-intensity physical activity recommended to enhance the health of children and adolescents. Other ways to promote physical activity in youth must be systematically exploited to provide physical activity opportunities. Family, neighborhood, and community programs can be a source of such additional opportunities. Moreover, other school-based opportunities, including intramural and extramural sports programs, active transport to and from school, classroom physical activity breaks, recess, and before- and after-school programming, all can help youth accumulate the recommended 60 or more minutes per day of physical activity. Recent policy guidance from the National Association of State Boards of Education has suggests such an integrated approach (NASBE, 2012).

Although family and community settings are helpful, schools provide a unique framework for physical activity opportunities because of the tremendous opportunity to contact many students multiple times. According to estimates of the U.S. Census Bureau, more than 51 million children aged 5-17 were enrolled in U.S. public schools in 2010; an additional 5.5 million were enrolled in U.S. private schools. Thus, an estimated 96-98 percent of the entire population in this age group was enrolled in an institutional school. Youth spend up to 7 hours each school day in school. Moreover, recent figures suggest that 15 percent of students across all grades attend an after-school program and 38 percent of parents whose children do not attend such a program say their children would do so if they had access (Afterschool Alliance, 2009). These data, together with the role of schools in health promotion for youth, suggest that more can be done to leverage schools to help children meet the recommendation for at least 60 minutes per day of physical activity.

STUDY APPROACH

The committee recognized that although physical education and physical activity in the school setting are primarily the responsibility of the education system, schools alone cannot implement the changes across systems required to achieve a healthy and educated future generation. Accomplishing these changes will demand systems approaches influenced by the social and cultural, economic, and physical environments, as well as the drivers of local, state, and national policies (see Figure 1-1).

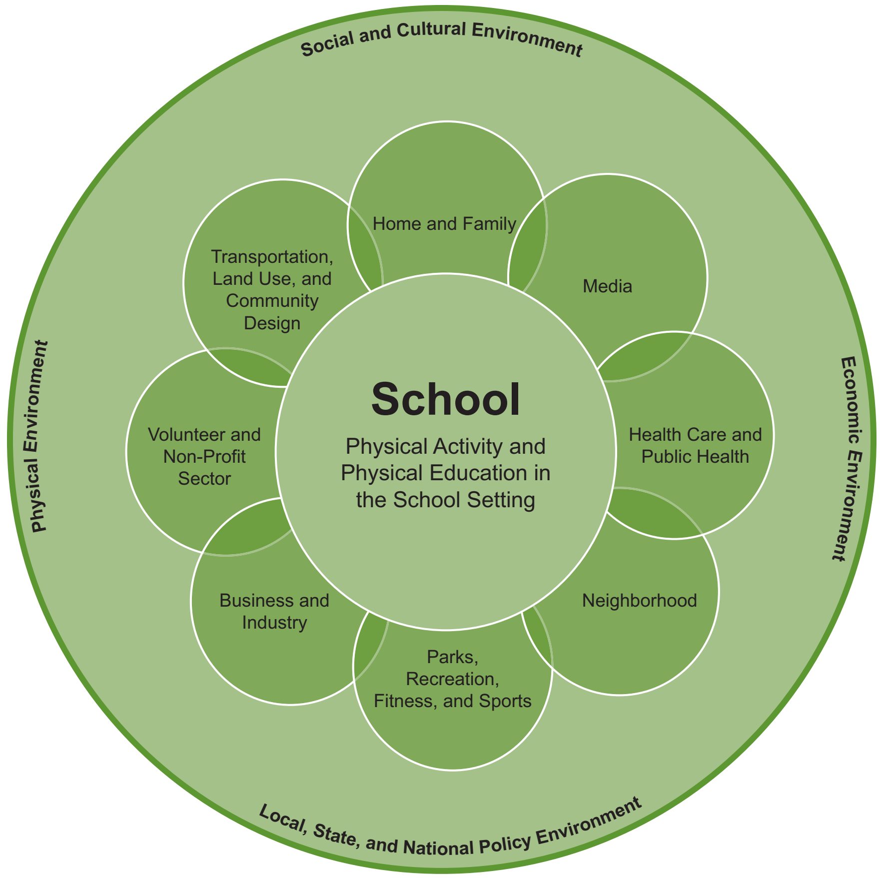

FIGURE 1-1 Context for physical activity and physical education in the school environment.

Changes in a single venue or sector or at a single level or those that are uncoordinated are unlikely to be effective and will do little to effect long-term improvement. Interactions among and between the local school or district and eight additional sectors will be required to achieve the desired outcomes: (1) the home and family; (2) transportation, land use, and community design; (3) volunteer and nonprofit community organizations; (4) business and industry; (5) parks, recreation, and sports; (6) neighborhood resources, including safety; (7) health care and public health; and (8) media and communications. These sectors traditionally have operated independently and have not communicated effectively. All, however, share a stake in and responsibility for working to change the conditions that promote the status quo of decreasing physical activity and increasing sedentary behavior among the nation's youth.

A Systems Approach

A challenge in current efforts to address the problem of physical inactivity among youth has been an unbalanced attention to individualized behavior change strategies instead of a true public health approach that requires systems thinking (Kohl et al., 2012) (see Box 1-2 for a definition of systems thinking). A systems approach posits that schools may act as a focal point but alone cannot accomplish the task of increasing and sustaining physical activity in youth because multiple systems and sectors in society influence the adoption of an active, healthy life–style. A systematic review of recent obesity prevention interventions (Krishnaswami et al., 2012) found a significant correlation between engagement with the community and intervention outcomes. Capacity building, needs assessments, dissemination of results, and durable partnerships among different sectors can improve health outcomes.

BOX 1-2
What Is Meant by Systems Thinking?

A systems approach:

- explicitly designs strategies to focus on interactions and interconnections (integration) between and among different sectors in the community and between individuals and their community environment;
- accounts for the context and characteristics of a community in planning intervention strategies in order to see the whole picture so that intended and unintended consequences of strategies can be recognized and the strategies altered if required;
- utilizes a multidisciplinary approach, including community experts, to determine the interactions among systems and sectors necessary to develop feasible interventions that will be sustainable (persistence of changes made and ongoing adoption of new ones)and scalable (capable of being brought to scale to impact many settings) and have reach across cultural and language population subgroups.

Increasing societal demand for and ingraining values that support a healthier environment and population requires direct engagement and alignment of the priorities of multiple sectors including those displayed earlier in Figure 1-1. A systems approach in public health requires identifying key actors that can effect change. Within the local education sector, the actors that can influence physical activity and physical education opportunities for children and adolescents include school board members, superintendents, principals, administrators and coordinators of curricular areas and evaluation, school physical education and pupil services, security, and transportation programs. Parent–teacher organizations and school health advisory councils also are part of a systems perspective on the problem.

To capture the systems perspective on increasing physical activity among children and adolescents, it is important to recognize that efforts must go beyond physical education curricula or physical activity programs per se (see Figure 1-2). Components of an intervention should explicitly and directly impact elements of the support infrastructure (at both the school and community levels) that enables high-quality physical education and meaningful opportunities for physical activity throughout the school day. Investments in the support infrastructure should ensure that its elements are well aligned and integrated (i.e., work synergistically) to achieve the goals of school curricula and programs. In addition, opportunities for physical activity throughout the school day should be cohesively designed to bring about a culture of active living and the value of wellness. Finally, the support infrastructure should enable accountability of physical education curricula and physical activity programs. In turn, these curricula and programs should be monitored and evaluated to inform iterative improvements to the overall system.

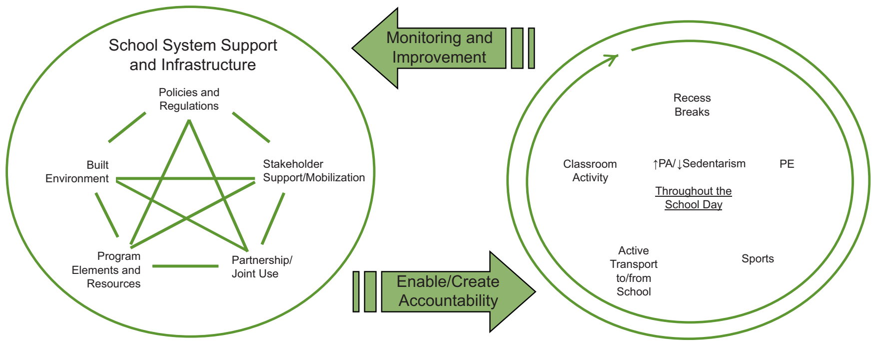

FIGURE 1-2 Integrated/coordinated approach to increasing physical activity among children and adolescents in the school environment before, during, and after-school.
NOTE: PA = physical activity; PE = physical education.

As part of its systems approach, the committee acknowledged that much of what happens in the school setting is part of an overall system of policies and regulations at multiple levels (see Figure 1-3). The center of interest is students' physical activity opportunities and experiences. Such opportunities include physical education, intramural and extramural sports, active transport to and from school, classroom physical activity, recess, before- and after-school programs, and other types of breaks. These opportunities and experiences are influenced by a series of federal guidelines, state laws, district policies, and school and classroom policies and practices. The impact of this set of guidelines, laws, policies, and practices is influenced in part by any accompanying assistance or incentives and by whether means of enforcement are in place. In other words, guidelines, laws, and policies are more likely to be properly implemented if there are aids and rewards (e.g., funding, training) for doing so and penalties (e.g., less funding, less job security) for not doing so. The varying strengths of influence are depicted in Figure 1-3 by the varying thicknesses of the arrows exiting each level of influence (i.e., federal, state, district, school, classroom). Figure 1-3 also acknowledges other influences, such as other and sometimes competing policies issuing from the same organizational level; competing interests; or a lack of funding, personnel, or space. The arrows veering toward the empty space at the edges of Figure 1-3 indicate that at every level there is likely to be slippage. One study found, for example, that seven of eight high schools in Mississippi and Tennessee had entirely avoided the implementation of new state legislation designed to increase levels of physical activity and improve the quality of physical education in high schools. The main barriers to implementation at these schools were priority given to standardized testing, the subordination of physical education to varsity sports, resource constraints, and policy overload (Amis et al., 2012).

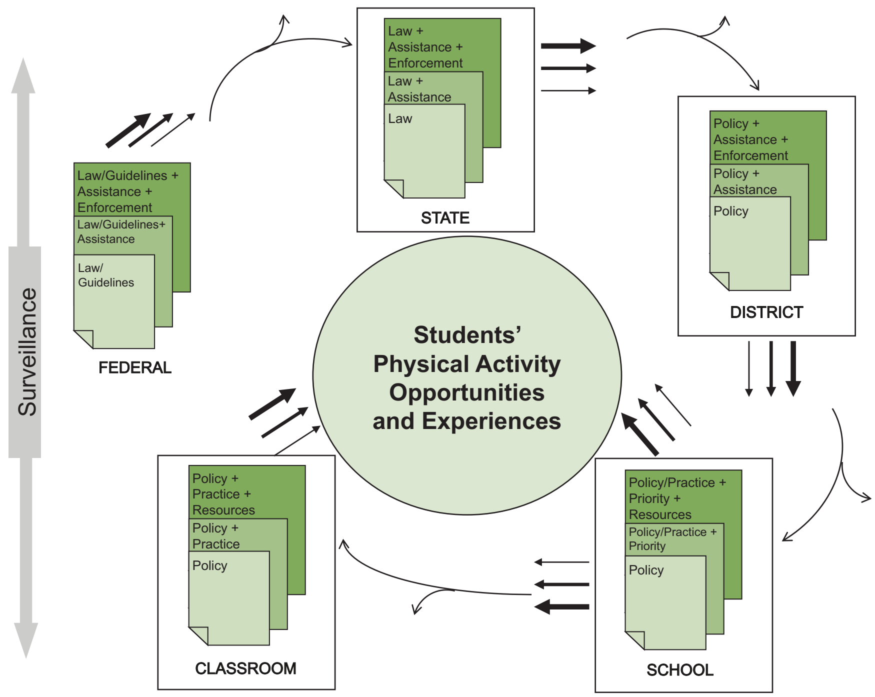

FIGURE 1-3 Influence of policy level and strength of implementation on student experience.
NOTE: Arrow weight indicates no implementation, weak implementation, and strong implementation (thin to thick); box shade indicates no law or policy, weak law or policy, and strong law or policy (light to dark).

Figure 1-3 also suggests that monitoring (surveillance) of federal guidelines, state laws, district policies, and school and classroom policies, plus related incentives and enforcements, is important. Monitoring of students' physical activity opportunities and experiences is essential because they represent the ultimate outcome of importance, and barriers may have derailed implementation (Amis et al., 2012).

A systems approach demands analysis of existing and potential practical program and policy interactions among the sectors and individuals outlined above, interactions that are necessary for the optimal impact on physical activity. A process of aligning priorities among disparate sectors should lead to new types of intersectoral interactions. These new interactions can potentially produce greater synergistic effects than independent within-sector efforts. Such synergies can in turn allow for opportunities to pool and share resources. For example, synergies that lead to combining efforts in the education and transportation sectors may be more likely to create a sustainable and effective program that promotes active transportation to and from school than such a program implemented only within the education sector. Developing these approaches in a place-based framework will allow for tailoring interventions, taking into account the strengths and constraints, cultural and demographic characteristics, and resources of each local context. The outcomes achieved must be sustainable (persistence of changes made and ongoing adoption of new ones) and scalable (diffusion across settings) and have reach across population subgroups.

Guiding Principles

Early in this study, the committee formulated a set of principles that guided its deliberations and its consideration of recommendations:

- Instilling lifelong physical activity in children and adolescents is crucial to the current and future health of the nation, and its long-term benefits should be recognized.
- Systems thinking is needed to develop recommendations for improving physical activity and physical education opportunities in schools in the context of children's and adolescents' development, family, home, culture, and community. Unintended consequences, accelerants, barriers, and other factors should be considered.
- Disparities in physical activity and physical education opportunities exist, and their elimination should be a priority in any recommendations for school-based efforts.
- The committee should consider all types of school environments in formulating its recommendations.
- The committee should consider student diversity, including gender, culture, religion, education, resources, and physical ability, in developing its recommendations.
- The committee should consider the practicality of implementation and existing school resources in making its recommendations. In addition, it should consider the challenges and barriers faced by policy makers, principals, teachers, parents/guardians, students, and other stakeholders.
- The committee should base its recommendations on the best available scientific evidence and promising approaches.

Conceptual Framework

The committee developed a conceptual framework for its work plan and its deliberations (see Figure 1-4). In this framework, the proximal and distal outcomes of most interest for this study are measures of academic performance and indicators of health and development in youth. Leading to these two ultimate outcomes of interest are several layers of determinants, programs, and intermediate outcomes reviewed by the committee. At the base of Figure 1-4 are key supports for the multiple programmatic and policy approaches to improving physical activity and physical education in schools.

Although the central programmatic approach to physical activity in schools remains the physical education curriculum, the committee conceptualized multiple additional opportunities, including intramural and extramural sports, active transport to and from school, classroom physical activity, before- and after-school programs, recess, and other types of breaks. (Although the framework applies to all opportunities for physical activity and physical education on K-12 school campuses before, during, and after school, including onsite preschool and after-school programming, summer was not considered independently.)

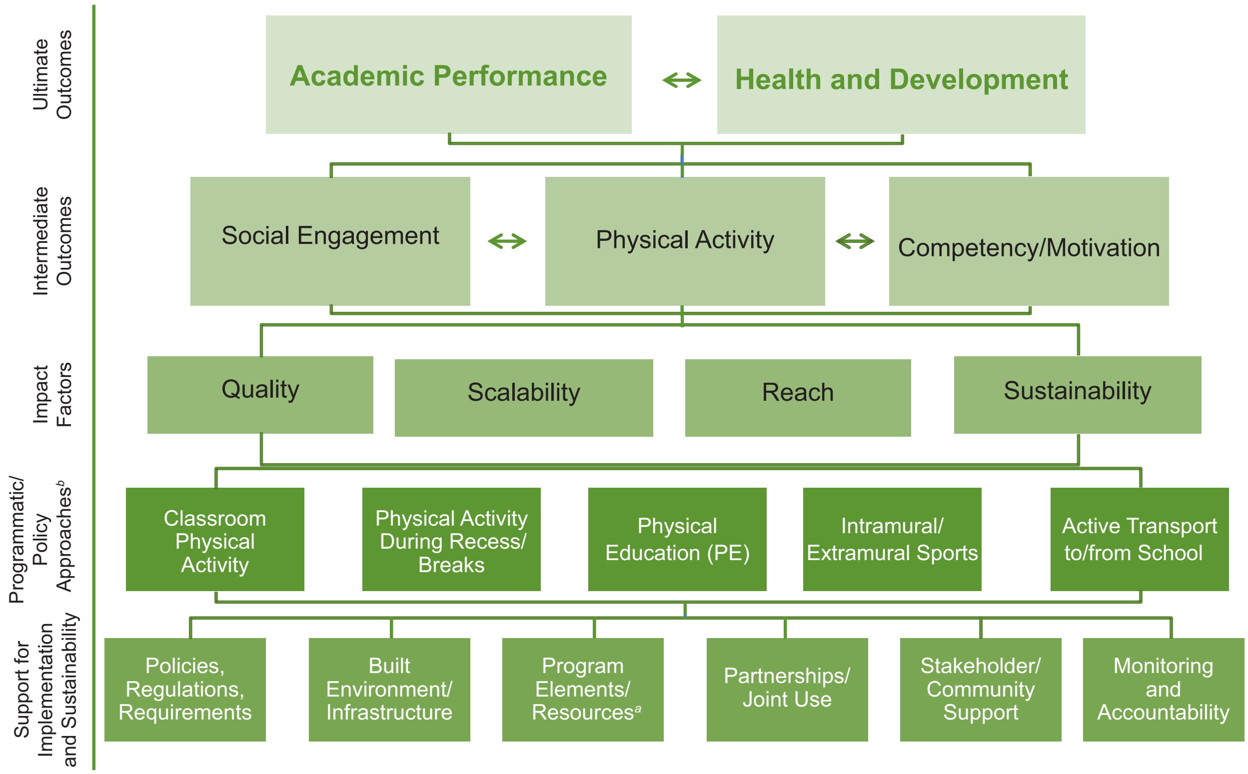

FIGURE 1-4 Conceptual framework for physical activity and physical education in the school environment.
NOTE: The framework applies to all opportunities for physical activity and physical education on K-12 school campuses before, during, and after school, including onsite preschool and after-school programming.

[a]For example, professional development/credentials, staffing, class size, class/program length and frequency, curricula/instructional materials used, equipment, supervision, use of class time (vigorous and moderate-intensity physical activity), use of technology.

[b]Each approach can occur before, during, or after school.

Factors affecting a program's impact toward achievement of the ultimate outcomes include the quality (fidelity) of implementation, the scalability of the program (its ability to move beyond an individual school or class to affect a broader population of schools and youth), and the reach of the program—whether it is available to all students and is unaffected by potential disparities. Finally, the committee believed that sustainability was a critical factor to consider, an issue that is central to the systems thinking that guided its deliberations.

Literature Review

In addressing its charge, the committee identified more than 1,000 articles and reports from the peer-reviewed published literature and from organizations relevant to physical education, physical activity, and health. The focus of the literature review was on gathering the available evidence on (1) the influences of physical activity and physical education on the short- and long-term physical, cognitive and brain, and psychosocial health and development of children and adolescents, and (2) potential physical activity and physical education policies and programs.

The literature search strategy generated search terms based on the committee's conceptual framework. The initial search strategy paired the terms *physical education* and *physical activity* with terms related to themes including *academic achievement*, *brain development*, *classrooms*, *disparities*, *fitness*, *intra- and extra-mural sports*, *joint-use agreements*, *mental health*, *out of school time*, *policy*, *psychosocial health*, *recess*, *sedentary activity*, *school financing*, *somatic growth*, *transport*, and *weight*. Searches were typically limited to U.S. populations and to children and adolescents, with the exception of studies examining the long-term and adult health benefits of childhood activity. See Appendix B and the references in Chapters 2 through 7 for more details on the methodology used and the evidence identified.

A Whole-of-School Approach

School and community policy and regulatory environments impact both the health and learning of children and youth. The "healthy schools " and "healthy communities" initiatives in various countries around the world, following guidance from the World Health Organization, have placed major emphasis on attempting to create school and community environments that support both physical and psychosocial health (Samdel and Rowling, 2013). In the United States, local "wellness policies" have been mandated for schools receiving U.S. Department of Agriculture support for school food and nutrition programs. Recently, these policies have been strengthened, leading to potential new systems of accountability for how healthy the school environment is for both children and school staff (Belansky et al., 2009; Schwartz et al., 2009).

Early in its deliberations, the committee defined a whole-of-school approach for physical activity and physical education. In this approach, each opportunity for physical activity that can be tied to the school grounds and facilities can be considered together. As seen in Figure 1-5, such an approach can realistically be expected to provide nearly the full 60 minutes or more of recommended health-enhancing physical activity on school days. Figure 1-5 also reflects the description of programmatic and policy approaches in the committee's conceptual framework (Figure 1-4).

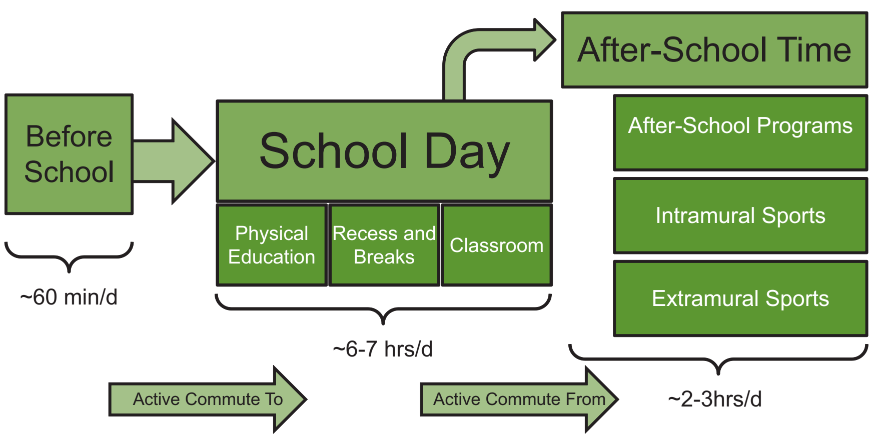

FIGURE 1-5 Comprehensive approach to school-wide physical activity promotion.
SOURCE: Beets, 2012. Reprinted with permission from Michael Beets.

The committee recommends a whole-of-school approach to physical activity promotion. Under such an approach, all of a school's components and resources operate in a coordinated and dynamic manner to provide access, encouragement, and programs that enable all students to engage in vigorous or moderate-intensity physical activity 60 minutes or more each day. A whole-of-school approach encompasses all segments of the school day, including travel to and from school, school-sponsored before- and after-school activities, recess and lunchtime breaks, physical education, and classroom instructional time. Beyond the resources devoted to quality daily physical education for all students, other school resources, such as classroom teachers, staff, administrators, and aspects of the physical environment, are oriented toward physical activity. Intramural and extramural sports programs are available to all who wish to participate, active transportation is used by substantial numbers of children to move from home to school and back again, recess and other types of breaks offer additional opportunities for physical activity, and lesson plans integrate physical activity as an experiential approach to instruction.

A whole-of-school approach encompasses all people involved in the day-to-day functioning of the school, including students, faculty, staff, and parents. It creates an atmosphere in which physical activity is appreciated and encouraged by all these groups. School buildings, outdoor grounds and playgrounds, indoor and outdoor equipment, and streets and pathways leading to the school from the surrounding neighborhood encourage and enable all persons to be more physically active. Moreover, the school is part of a larger system that encompasses community partnerships outside the school to help these goals be realized.

Development of Recommendations

The committee's approach to developing its recommendations was informed by the systems approach and guiding principles outlined above. A consensus process was used to develop and review the overarching recommendations presented in Chapter 8. In addition, committee members discussed areas for research that, if pursued would advance the field of physical activity and physical education in schools to further the evidence base.

OVERVIEW OF THE REPORT

The remainder of this report is organized into seven chapters. Chapter 2 describes the status and trends of physical activity behaviors and related school policies. Chapters 3 and 4, respectively, describe health and development outcomes and academic and cognitive outcomes associated with physical activity and physical education. Chapter 5 provides an overview and discussion of physical education programs and policies in schools, including what a quality program looks like. Chapter 6 provides an overview and discussion of physical activity programs and policies in schools. Chapter 7 summarizes the evidence for the effectiveness of physical activity and physical education programs and policies. Finally, Chapter 8 provides the committee's recommendations. Appendix A is a glossary of acronyms and terms used in the report, Appendix B provides a detailed description of the study methodology, Appendix C provides a summary of data extracted from the National Association of State Boards of Education's State School Health Policy Database, Appendix D contains the agenda for workshops held to inform the committee's deliberations, and Appendix E presents biosketches of the committee members.

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2
Status and Trends of Physical Activity Behaviors and Related School Policies

Key Messages

- Few children in the United States, probably no more than half, meet the currently recommended standard of at least 60 minutes of vigorous or moderate-intensity physical activity daily.
  - The proportion meeting the standard declines with age, with more elementary school children than middle and high school students achieving the goal. Boys are more likely than girls to meet the recommendation.
  - During the past 30-40 years, probably even longer, the volume and intensity of daily physical activity among youth have gradually declined.

- Given the large proportion of total waking hours spent at school and in school-related activities, remarkably little is known about students' physical activity behaviors during school hours and during school-related after-school activities. Despite some excellent research and a few good public health surveillance systems, current monitoring of overall and school-related physical activity behaviors among youth and school-related policies and practices that enable or impede those behaviors is inadequate.

- An adequate description of the current status and monitoring of changes in students' school-related physical activity behaviors currently are not possible. Public health and education surveillance and research need to be enhanced so the impact of efforts to increase students' physical activity can be monitored.

- Policies are and will be important in creating an atmosphere in schools that enables, facilitates, and encourages children to be more physically active. Less clear are the factors that create an effective policy. An understanding is needed of what facilitators (e.g., funding, promotions, awards) and enforcers (e.g., less funding, job security) lead to policies that are fully implemented.

As discussed in further detail throughout this chapter, few children in the United States, probably no more than half, meet the currently recommended standard of at least 60 minutes of vigorous or moderate-intensity physical activity daily. In addition, the proportion meeting the standard declines with age, with more elementary school children than middle and high school students achieving the goal. Boys are more likely than girls to meet the recommendation. Finally, one can say with reasonable certainty that during the past 30-40 years, probably even longer, the volume and intensity of daily physical activity among youth have gradually declined.

It is also known that because children and adolescents spend so many hours at school, school-related physical activity must be a large contributor to overall physical activity among youth. Not known, however, is exactly how large the overall contribution is, or the contribution of each segment of the school day—transportation to and from school, physical education, recess, classroom time, and before- and after-school activities. It is known that over the past 40-years, the proportion of children walking and biking to school has declined substantially; otherwise, there are at best rough estimates of the current physical activity behaviors, recent changes, or long-term trends associated with each of these segments of the school day.

Guidelines, recommendations, and policies from all levels of government (federal, state, district, local) and from various organizations (e.g., National Association for Sport and Physical Education, American College of Sports Medicine) are known to influence youth's school-related physical activity. Understood as well is that the strength of that influence is, in turn, affected by incentives and enforcements associated with those guidelines, recommendations, and policies (see Figure 1-2 in Chapter 1). What remains unclear is which guidelines, recommendations, policies, incentives, and enforcements are most influential in today's social milieu.

What should also be apparent is that despite some excellent research and a few good public health surveillance systems, current monitoring of overall and school-related physical activity behaviors and school-related policies and practices that enable or impede those behaviors is inadequate. These deficiencies have arisen for several reasons. First, physical activity has only recently been acknowledged as a vital public health issue, so monitoring of the volume of physical activity at the population level is a recent objective with still insufficient priority. The Physical Activity and Health Branch of the Centers for Disease Control and Prevention was not established until 1996, and the first formal federal-level physical activity guidelines were not published until 2008 (HHS, 2008). Second, physical activity is a notoriously difficult behavior to measure. Third, understanding of the types and amounts of physical activity relevant to health and health outcomes is still growing. The types and amounts of physical activity recommended for children and adolescents have changed several times in the past 20 years, frustrating efforts to monitor trends. Fourth, information is scarce on prevalence and trends for policies that may enable (or inhibit) physical activity. Examples include school- and district-level policies on recess and training for physical education teachers, as well as community or neighborhood policies on active transportation to and from school. Monitoring of policies and practices is improving, but needs expansion and maturation. Finally, schools and school districts vary greatly in size, resources, environmental setting, urbanization, population characteristics, traditions, and policies. Summary assessments and measures may capture the national gestalt but omit important differences among subgroups.

Physical Activity Versus Exercise

Physical activity is defined as all human movement; it is done at some rate of energy expenditure in all settings and for many different purposes. Exercise is a subcomponent of physical activity that is done for the purpose of increasing physical fitness. Intensity (i.e., rate of energy expenditure) is an important descriptor of physical activity because different intensities have different physiologic effects. Both physical activity and exercise encompass the full range of energy expenditure.

The purpose of this chapter is to describe the evidence supporting these general statements about the status and trends of the physical activity behaviors of school-age children and adolescents, as well as the school-related policies and practices that help determine those behaviors. Description of the status and trends of physical activity behaviors of youth requires, along the way, some discussion about the behavior itself, how it is measured, and how the current recommendations came into being.

PHYSICAL ACTIVITY

Unless they take a nap or lie down to rest, all people are physically active from the time they get up in the morning until they go to bed at night. Physical activity is a necessary part of everything people do at home, work, or school; while going from place to place; and during leisure time. Few people in the United States, whether adults or children, expend a great deal of energy during physical activity, but they are always expending some. In the still emerging field of physical activity and public health, physical activity is commonly defined as “any bodily movement produced by skeletal muscles that results in energy expenditure” (Caspersen et al., 1985, p. 126). Despite this straightforward definition, physical activity is a complex behavior with a wide variety of types and intensities. Types of physical activity may be categorized, for example, by type of movement (e.g., walking, skipping), by sport (e.g., soccer, badminton), by life context (e.g., at school, at home, during transportation), or by predominant physiologic effect (e.g., cardiorespiratory conditioning, muscle strengthening). Regardless of the categorization scheme, physical activity operates through multiple physiologic pathways to influence many health outcomes. Although physical activity can be categorized and discussed in many ways, aerobic activities are the most common and have the broadest physiologic and health effects. Aerobic activities are commonly categorized as being sedentary, light, moderate, or vigorous intensity based on the rate of energy expenditure (see Box 2-1).

BOX 2-1
Categories of Intensity of Physical Activity

Categories of Absolute Rate of Energy Expenditure

Aerobic activities are common and important and include activities such as walking, dancing, and playing soccer or basketball, involve large muscle groups in rhythmic repetitive movement. Aerobic activities are performed at a pace that can be continued for more than a few minutes, and when done at higher than usual levels, aerobic physical activities improve the efficiency and capacity of the cardiorespiratory system (Powell et al., 2011).

Aerobic activities commonly have been categorized based on the rate of energy expenditure, or intensity, at least in part because high rates of energy expenditure were known to be important for fitness training and were presumed necessary to reduce the risk of heart disease. Although energy expenditure can be measured in various units (e.g., kilocalories, milliliters of oxygen consumption), metabolic equivalents (METs), have become the method of choice in public health circles. One MET is the rate of energy expenditure while a person is sitting at rest and is equivalent to an oxygen uptake of about 3.5 ml/kg body weight × min. Because METs take a person's body weight into account, the MET rate for any given activity is similar for all individuals. For adults, for example, the MET rate for sitting at rest is 1.0, for cooking or food preparation is 2.0, for walking at 3 miles per hour is 3.5, and for running at 5 miles per hour is 8.3. Because of their smaller size, immature motor patterns, and other physiologic differences, children's energy expenditure for most activities is slightly higher than that for adults (Torun, 1983). Despite these differences, however, adult MET values provide the best approximation of energy expenditure for children for most activities. The exceptions are walking and running for which equations based on age and speed should be used (Ridley et al., 2008).

Although rate of energy expenditure is a continuous variable, splitting the range into four categories has become standard (Pate, 2008) (see the table below). This categorization scheme has facilitated conversation, epidemiologic analysis, surveillance, and public health recommendations. Although useful, the scheme and its arbitrary cut-points have become rigid, obscuring the fact that rate of energy expenditure is a continuous variable, and cut-points are arbitrary.

Categories of Intensity of Physical Activity

Category	Range of Metabolic Equivalents (METs)	Examples of Activities
Sedentary Activity	≤1.5 METs	Sleeping, lying down, sitting, watching television
Light-Intensity Activity	>1.5-<3.0 METs	Standing; walking slowly; everyday activities like getting dressed, making a bed, cooking
Moderate-Intensity Activity	≥3.0<6.0 METs	Walking, table tennis, ballroom dancing
Vigorous-Intensity Activity	≥6.0 METs	Running at various speeds, shoveling snow, mowing the lawn walking with a hand mower

SOURCE: Pate,2008.

Relative Rate of Energy Expenditure

Rate of energy expenditure expressed in METs, kilocalories, or kilojoules is an absolute measure of intensity. For all people, higher rates of energy expenditure require a greater level of effort, and the above categorical terms for the commonly used categories—sedentary, light, moderate, vigorous—reflect that fact. For most healthy and reasonably fit youth and adults, the categorical terms and the individual's perceived level of effort closely align. Older and unfit persons, however, require a greater relative, or perceived, level of effort to accomplish a given physical activity (see the table below). For example, a healthy person with the capacity to expend energy at a rate of 12 METs feels as though he or she is performing vigorous activity when jogging (MET level above 7), whereas an older or unfit person with a capacity of only 5 METs feels as though he or she is performing vigorous activity when walking (MET level of 3-4). Recognizing that level of fitness determines the rate of energy at which physical activity can be performed is important when planning programs to improve the fitness of any individual or group.

Relative Intensity of Activity for Younger and Fit Persons and for Older and Unfit Persons

Relative Intensity	Younger and Fit (12 MET capacity)	Older and Unfit (5 MET capacity)
Light	<3.2	<1.8
Moderate	3.2-7.5	1.8-3.3
Vigorous	≥7.6	≥3.4

SOURCE: Adapted from Table D-1 in PAGAC, 2008.

STATUS OF PHYSICAL ACTIVITY BEHAVIORS AMONG YOUTH

This section reviews what is known about the status of physical activity behaviors among youth, first for vigorous or moderate-intensity activity, next for sedentary or light-intensity activity, and finally for vigorous or moderate-intensity activity during the school day.

Vigorous or Moderate-Intensity Physical Activity

Vigorous or moderate-intensity physical activity is important for normal growth and development (see Chapter 3), including maintenance of healthy body composition, and reduces the risk of acquiring risk factors for the development of chronic diseases later in life. The currently recommended dose of physical activity for children and adolescents is at least 60 minutes of vigorous or moderate-intensity physical activity per day with vigorous physical activity on at least 3 of those days (Strong et al, 2005; PAGAC, 2008).

In 2005, a panel was convened by the Centers for Disease Control and Prevention specifically to consider the physical activity needs of children and adolescents (6-18 years of age). The panel reported beneficial effects of regular physical activity on muscular health, cardiovascular health, adiposity, blood pressure, blood lipid levels, self-concept, anxiety, depressive symptoms, and academic performance. The optimal dose was more difficult to determine for at least two reasons (also see Box 2-2). First, different health outcomes accrue from different doses. Second, research demonstrates a positive dose response rather an ideal dose. The panel concluded, however, that "school-aged youth should participate every day in 60 minutes or more of moderate to vigorous physical activity that is enjoyable and developmentally appropriate" (Strong et al, 2005, p. 736). In 2008, The Physical Activity Guidelines Advisory Committee also reviewed the scientific evidence relating to the physical activity and the health of children and adolescents (PAGAC, 2008). The Committee confirmed the benefits reported by the previous panel. The Committee also agreed that it is difficult to select a minimal or optimal dose of physical activity for youth but reaffirmed the recommendation for 60 minutes or more per day of vigorous and moderate physical activity. The Committee further commented that the weekly activities should include some vigorous activity on at least 3 days and some activities to strengthen muscles and bones.

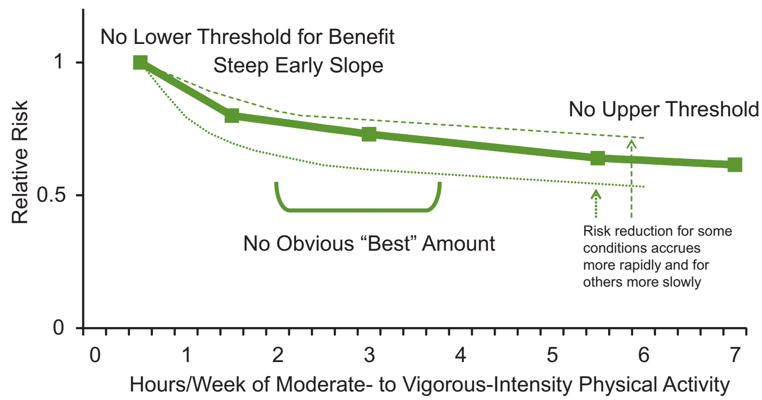
BOX 2-2
Dose of Physical Activity

The dose of physical activity, sometimes referred to as volume or amount, is a function of the type, frequency, duration, and intensity of the activity. Until recently, benefits appeared to derive almost exclusively from vigorous or moderate-intensity physical activity, and almost all epidemiologic, clinical, and intervention research focused on that intensity range. Evidence derived from that research indicated that for both adults and youth, health benefits are more closely related to the total dose of vigorous or moderate-intensity physical activity than to any of the components of dose (i.e., type, frequency, duration, intensity) (PAGAC, 2008). Research has consistently demonstrated an inverse relationship between the dose of regular vigorous or moderate-intensity physical activity and a wide variety of adverse health outcomes (e.g., heart disease, diabetes, functional limitation, depressive symptoms) (PAGAC, 2008).

Dose of vigorous or moderate-intensity physical activity has been measured in a variety of ways, including minutes per week, kilocalories or kilojoules of energy expenditure, or even miles or minutes of running per week. A frequently used method to describe the dose of vigorous or moderate-intensity physical activity is to multiply the time spent in the activity by its MET value. For example, running at 5 miles per hour (about 8 METs) for 20 minutes provides a dose of 160 MET-minutes.

Accelerometers permit estimates of the total dose of physical activity performed in a day regardless of intensity (see also Box 2-3). By estimating intensity for every minute, however, accelerometers can provide an estimate of the total dose of vigorous or moderate-intensity physical activity. Accelerometers are not yet able to "know" exactly what type of physical activity is being performed (e.g., cycling, stair climbing, raking, sweeping), and as a result, may over- or underestimate the rate of energy expenditure. Nevertheless, the products are improving rapidly, and their capability to measure sedentary and light-intensity as well as vigorous or moderate-intensity activities makes them an increasingly valuable tool.

The inverse relationship between dose of vigorous or moderate-intensity physical activity and reduced risk of adverse health outcomes clearly demonstrates that larger doses provide more health benefits. Selecting a single dose to recommend has been more difficult, especially for youth because less research is available on this question, and the pattern of the dose-response curve is less well established (PAGAC, 2008). A composite of the findings for adults from 10 studies of regular physical activity and all-cause mortality indicates a curvilinear relationship, with the risk of mortality decreasing as the dose of regular vigorous or moderate-intensity physical activity increases (PAGAC, 2008; Powell et al., 2011) (see the figure below). Four points are worth noting about the dose-response curve. First, there is no lower threshold for benefit; some vigorous or moderate-intensity physical activity is preferable to none. Second, the slope is steepest at the left side of the curve, suggesting that the most rapid reduction in risk occurs when the least physically active people become slightly more active. Third, there is no obvious best dose, making a range of doses (e.g., 150 to 300 minutes per week of vigorous or moderate-intensity physical activity for adults) as in the current U.S. guidelines (PAGAC, 2008) preferable to a single dose. Fourth, at levels of activity commonly achieved in the general population, there is no upper threshold above which risk ceases to decline, although the rate of decline decreases.



Risk of all-cause mortality by hours/week of vigorous or moderate-intensity physical activity.
SOURCE: Adapted from PAGAC, 2008.

The available evidence indicates that the dose-response curves for the beneficial effect of regular vigorous or moderate-intensity physical activity on the risk for type 2 diabetes, hip fracture, cardiovascular disease, coronary heart disease, stroke, depression, dementia, breast cancer, and colon cancer are similarly shaped (PAGAC, 2008) but with slightly different slopes (Powell et al., 2011); insufficient data are available with which to prepare similar dose-response curves for other health outcomes. Risk reduction accrues more rapidly for diabetes and hip fracture and less rapidly for breast and colon cancer. Risk reduction for cardiovascular disease, depression, and dementia appears to be quite similar to the curve for all-cause mortality. These differences are not surprising given the wide variety of physiologic pathways through which regular physical activity produces its various health benefits. The shape of the dose-response curve and the differences in the slopes of the curves for different health outcomes demonstrate the difficulty of identifying a specific dose or even a range of doses of vigorous or moderate-intensity physical activity that should be recommended.

Available information indicates that relatively few youth achieve a daily dose of at least 60 minutes of vigorous or moderate-intensity physical activity. Information on the proportion of youth who are vigorously active on 3 or more days per week is not available. However, about 10 percent of middle and high school students responding to the Youth Risk Behavior Survey (YRBS), conducted by the Centers for Disease Control and Prevention (CDC) and state health departments, self-reported that on no days in the previous week did they spend at least 60 minutes doing vigorous or moderate-intensity physical activity, about 50 percent reported doing so on at least 5 days, and about 30 percent reported meeting the recommended 7 days (CDC, 2012b) (Figure 2-1). In a different ongoing national survey of 8th-, 10th-, and 12th-grade students, *Monitoring the Future*, fewer than half of students reported doing 60 or more minutes of "vigorous activity" every or almost every day (Delva et al., 2006).

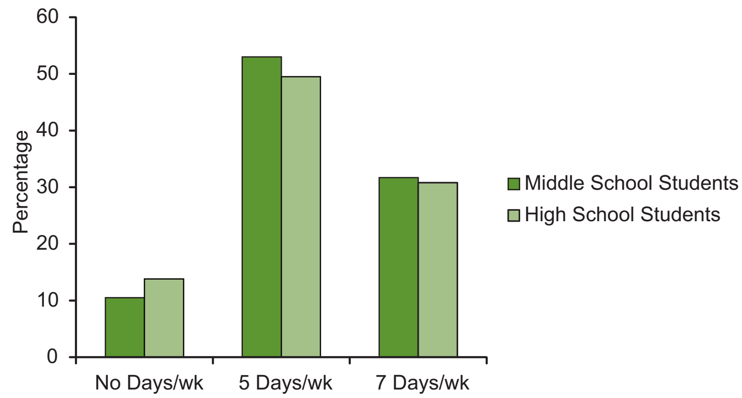


FIGURE 2-1 Percentage of middle and high school students reporting they engaged in no days, 5 days, or 7 days per week of 60+ minutes of vigorous or moderate-intensity physical activity.
NOTE: The middle school estimate is the mean of 15 statewide surveys; the high school estimate is based on a nationwide sample.
SOURCE: CDC, 2012.

Results from surveys measuring physical activity with accelerometers and including younger children similarly suggest that few children, especially older ones, meet the currently recommended volume of vigorous or moderate-intensity physical activity. A study of accelerometer-measured physical activity among students of central Massachusetts found that almost all students in grades 1-6, but fewer than one-third of high school students, performed at least 60 minutes of vigorous or moderate-intensity physical activity at least 5 days per week (Pate et al., 2002) (see Figure 2-2); the proportion of students meeting the 7-day recommendation would, of course, be lower. Also worth noting is that for high school students in this study, the accelerometer-estimated prevalence is about half the self-reported estimated prevalence for the same dose among students responding to the YRBS (Figure 2-1). (See Box 2-3 on measuring physical activity.)

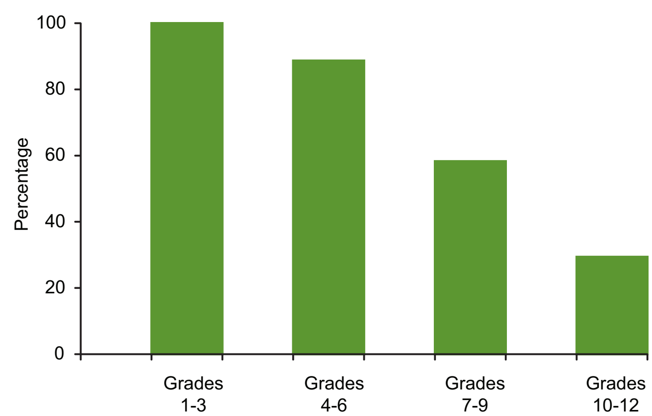


FIGURE 2-2 Percentage of students performing accelerometer measured vigorous or moderate-intensity physical activity for at least 60 minutes on at least 5 days per week, by grade.
SOURCE: Adapted from Pate et al., 2002.

BOX 2-3
Measuring Physical Activity

Physical activity has been measured in multiple ways—self-reported measures (e.g., surveys, activity logs); instrumental measures (e.g., pedometers, accelerometers), often called "objective" measures; and direct observation—none of which is completely satisfactory.

Self-report surveys, in which youth are asked to provide information about their physical activity behaviors, have been the most common method of measuring physical activity. They vary considerably in the detail requested and obtained. For example, the 3-Day Physical Activity Recall (3DPAR) asks about the predominant activity performed (a list of likely options is provided) and the intensity of that activity (light, moderate, hard, very hard) during each of 34 30-minute segments between 7 AM and midnight (Pate et al., 2003). The 3DPAR has been used with children as young as fifth grade (Powell et al., 2009), but understandably has been used largely as a research tool. In contrast, the Youth Risk Behavior Survey, used to monitor a number of important health-related behaviors of youth, currently asks the following question: "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)." Self-reported information has been and will remain important. It is relatively inexpensive to obtain and can provide information about what specific activities were performed, as well as where and why. The YRBS, for example, inquires about participation in physical education classes and on sports teams. Self-reported information also has important limitations and weaknesses. Readers might try asking themselves the above question about physical activity during the past 7 days to realize how difficult it is to provide an accurate response. High school students likely are better than middle school students at answering such conceptually complex questions, and the questions as asked would be inappropriate for elementary school students—self-report has been discouraged as a mode of physical activity assessment for children less than 10 years of age (Kohl and Hobbs, 1998). Moreover, even though students appear to answer personally sensitive questions (e.g., about their sexual behaviors) frankly, self-reported information is at risk of bias due to social acceptability and level of knowledge and experience. Self-reported data also are much more accurate for vigorous-intensity than for moderate- and light-intensity activities and generally overestimate the amount of vigorous and moderate-intensity physical activity performed. Further, some studies have asked parents to provide information on the physical activity behavior of elementary-aged youth. The accuracy of parent proxy reports of children's physical activity behavior has not been established.

Instrumental monitors, such as pedometers and accelerometers, provide more objective assessments of physical activity and are being used with increasing frequency. Pedometers and accelerometers, about the size of a watch, usually are attached at hip level to a belt or other article of clothing. Participants are instructed to wear them during waking hours for several days, often a week, except when bathing or swimming. Pedometers detect the vertical force associated with each step and the output (number of steps taken) is reasonably straightforward. Accelerometers are more complex. They record the force of movements in up to three directions, and as they have become more sophisticated, require more complicated software to download and process the raw data. The instruments avoid the subjective weaknesses of self-reported data but have their own problems. First, they must be properly calibrated to assess the existence and force of any movement. Moreover, accelerometers are reasonably good at detecting and quantifying common ambulatory movements (e.g., walking, running) but not as good for stair climbing; cycling; water activities; or activities primarily of the upper body, such as sweeping or raking. In addition, the instruments cannot determine exactly what activity is being done, or where or why. The cut-points used to place movements in the common intensity categories (sedentary, light, moderate, vigorous) also may over or underestimate the volume of activity depending on the predominate physical activity behaviors of the subjects under investigation (Matthews et al., 2008; Troiano et al., 2008), and they cannot assess relative intensity. Still, instruments measuring physical activity continue to improve and are becoming less costly, and they are useful across the full age spectrum. They appear to be the best method for collecting information about activities in the low and middle ranges of rate of energy expenditure and are expected to become even better with more research and experience.

Direct observation can be carried out with a number of reliable and valid tools (e.g., System for Observing Fitness Instruction Time [SOFIT], System for Observing Play and Leisure Activity in Youth [SOPLAY], System for Observing Play and Relationships in Communities [SOPARC]) developed to allow one or multiple observers to capture physical activity levels of youth across various settings and activities, such as physical education class, recess, or leisure play in neighborhood settings such as parks (McKenzie et al., 1991). Observations capture information on sedentary (e.g., lying down or sitting), moderate-intensity (e.g., walking), and vigorous (e.g., running) physical activity behavior from a sample of study participants. The observer can also record what activity is being done, where, and why. Some observation instruments also allow additional contextual information to be collected, such as social groups and social behavior during activities (System for Observing Children's Activity and Relationships during Play [SOCARP]). Direct observation also has limitations, however: it is expensive, observers who collect the data must be trained in the use of the instruments, a sample of study participants rather than a census is observed, and observers must be physically present or capture the entire area on video for later review.

Results of other surveys confirm the decline in vigorous or moderate-intensity physical activity with age (Nader et al., 2008; Troiano et al., 2008). Figure 2-3 displays the mean number of minutes of vigorous or moderate-intensity physical activity per day rather than the proportion who do or do not achieve a set number of minutes, as presented in Figures 2-1 and 2-2. These three figures illustrate some of the difficulties entailed in comparing studies that used different measurement methods (i.e., self-report versus accelerometer measured) and different types of data summary (i.e., proportion meeting a specific standard versus average of the whole group).

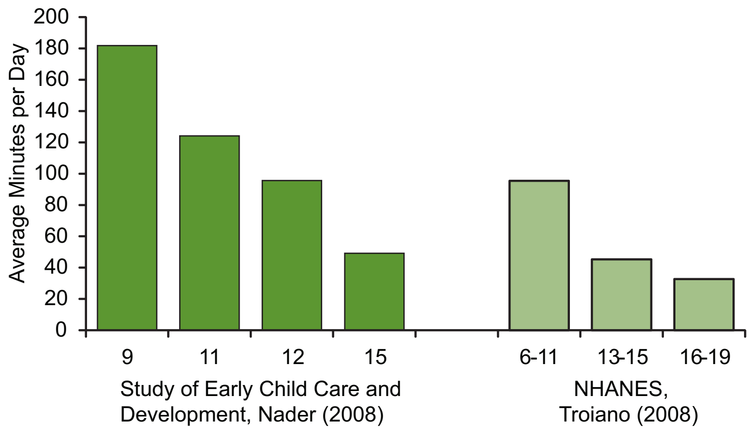


FIGURE 2-3 Average minutes/day of accelerometer measured vigorous or moderate-intensity physical activity by years of age and source.
NOTE: NHANES = National Health and Nutrition Examination Survey.
SOURCES: Nader et al., 2008; Troiano et al., 2008.

In addition to the low proportion of children and adolescents meeting currently recommended physical activity levels and the decline in vigorous or moderate-intensity physical activity with age, data from the above and other surveys indicate, almost without exception, that girls are less active than boys (see Figure 2-4). Patterns of activity by race/ethnicity are less clear. Large surveys (e.g., YRBS, Monitoring the Future) using self-reported information usually find that whites report more vigorous or moderate-intensity physical activity than other racial/ethnic groups (Simons-Morton et al., 1997; Delva et al., 2006; CDC, 2012b). In the National Health and Nutrition Examination Survey (NHANES) survey, however, in which physical activity is assessed using accelerometers, non-Hispanic blacks are the group with the most vigorous or moderate-intensity physical activity (Troiano et al., 2008; Gortmacher et al., 2012). In a study of sixth-grade girls from six states, also using accelerometers to assess physical activity, white girls had the highest average number of minutes of vigorous or moderate-intensity physical activity, while African American girls had the highest prevalence of meeting physical activity recommendations (Pate et al., 2006a). An analysis of youth aged 12-19 who performed treadmill tests as part of the NHANES found that about one-third of subjects failed to meet standards for cardiovascular fitness, but there were no significant differences in the prevalence of acceptable cardiovascular fitness among non-Hispanic white, non-Hispanic black, and Mexican American subjects (Pate et al., 2006a). Physical fitness and physical activity are different but directly related concepts. Finding no differences in cardiovascular fitness among groups suggests that there also are no differences in overall amounts of vigorous and moderate-intensity physical activity.

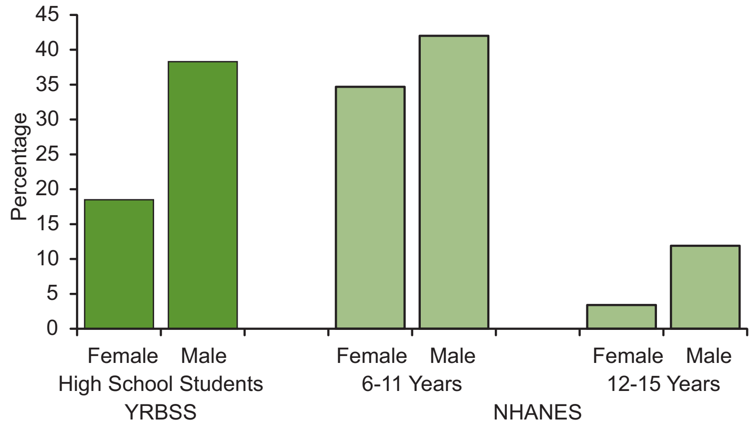


FIGURE 2-4 Percentage of youth reporting at least 60 minutes of vigorous or moderate-intensity physical activity daily by sex: self-reported estimates from the Youth Risk Behavior Survey (YRBS) (2011) and accelerometer estimates from the National Health and Nutrition Examination Survey (NHANES) (2003-2004).
SOURCES: Troiano et al., 2008; CDC, 2012b.

Fewer data are available with which to assess the influence of socioeconomic status on physical activity behaviors, and these data, too, provide no clear picture. Proxy information from the NHANES for children aged 6-11 indicate that a higher proportion from low-income than from high-income families meet current recommendations for vigorous or moderate-intensity physical activity (Fakhouri et al., 2013). Self-reported information from children 9-13 years of age and their parents shows a slightly lower percentage (74 percent) of children from low income families (≤$25,000/year) than from high income families (>$50,000/year) (78 percent) engaging in free-time vigorous or moderate-intensity physical activity (CDC, 2003). This same survey did find that substantially fewer children from low-income (24 percent) than high-income (49 percent) families participate in organized physical activity because of transportation problems, expense, and lack of opportunities.

Despite limited information about differences, if any, in physical activity behaviors among racial/ethnic groups or different socioeconomic groups, information about the variability of funding among school districts across the United States suggests that not all students have equal opportunities for participating in physical activity during the school day.

Schools are funded by local and state governments, as well as the federal government. During the past 50 years, local and state governments have each provided about 45 percent of school funding, with the federal government providing about 10 percent. Considerable variation exists, however, among states and school districts in the per pupil expenditures for elementary and secondary education and in the sources of the funds.

In the 2008-2009 school year, per pupil expenditures ranged from $6,612 in Utah to $19,698 in the District of Columbia (see Figure 2-5). The source of those funds also varied markedly among states. The federal portion of annual expenditures ranged from 4 percent in New Jersey to 16 percent in South Dakota (New America Foundation, 2012). The proportion of state funding, mainly from income and sales taxes, ranged from 86 percent in Vermont to 28 percent in Illinois; local funding, mainly from property taxes, ranged from 60 percent in Nevada to 3 percent in Hawaii.

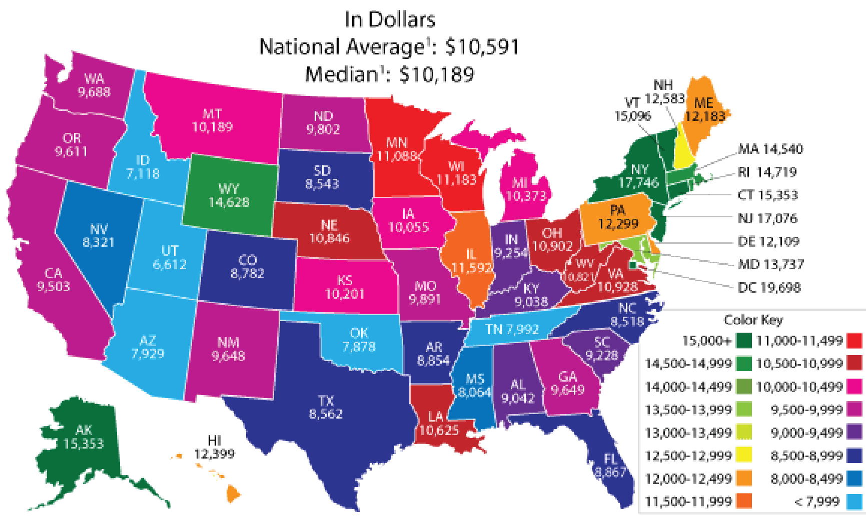


FIGURE 2-5 Per pupil expenditures for public elementary and secondary education in the United States, 2008-2009.

[1] U.S. estimates are for the 50 states and the District of Columbia.

NOTE: The prekindergarten student membership was imputed for some states, affecting the total student count and calculation of per pupil expenditures. Some values were affected by redistribution of reported expenditure values to correct for missing data items and/or to distribute state direct support expenditures.

SOURCE: U.S. Department of Education, 2009.

Substantial within-state variation in per pupil expenditures also exists. A general assumption is that the quality of education is directly linked to the quantity of funding. However, different systems have different levels of efficiency, living costs and workforce salaries vary among and within states. In addition, educating children from low-income homes, those with disabilities, or those for whom English is a second language costs more. Various methods have been proposed for comparing funding levels among different school districts, including simple dollar-to-dollar comparisons; cost-of-living adjustments; and “level-of-effort” adjustments, such as proportion of total taxable state and local resources or state per capita gross domestic product (Epstein, 2011).

While the best way to measure and resolve differences in educational opportunity among and within states is uncertain, it is clear that substantial differences exist. Children and adolescents from low-income families are more likely to live in low-income school districts and have fewer resources for public education. It seems likely that fewer resources for educational systems result in fewer opportunities for school-related physical activity. However, as noted above, information about the differences in physical activity behaviors among racial/ethnic groups and among different socioeconomic groups is sparse and inconsistent.

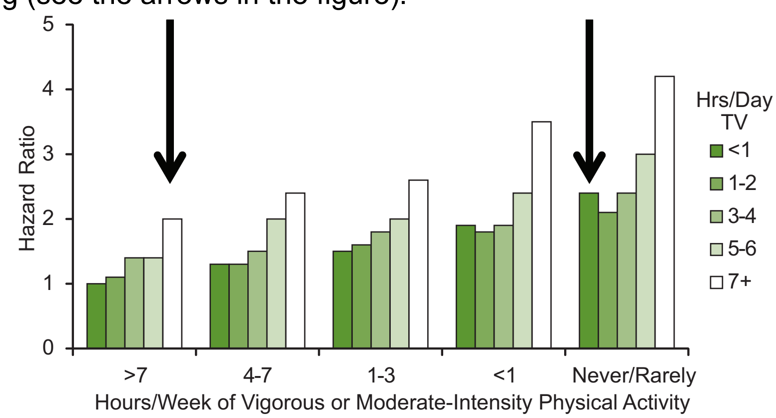
Sedentary- or Light-Intensity Physical Activity

Recent evidence indicates that light intensity physical activity, although not likely a substitute for vigorous or moderate-intensity physical activity, is beneficial to health. Research has focused on the detrimental health impact of sedentary-intensity physical activity, usually sitting or watching television, but the evidence can just as well be described as showing benefits from light-intensity physical activity (see Box 2-4). The relative merits of different levels and combinations of physical activity intensities are being investigated and discussed, but the lower end of spectrum of rate of energy expenditure is now receiving attention previously reserved for the higher end.

BOX 2-4
Recognizing the Value of Light-Intensity Physical Activity

Thirty to 40 years ago, only vigorous physical activity was thought to provide reductions in disease risk. By the early 1990s, however, it was clear that moderate-intensity physical activities were healthful, too. The joint Centers for Disease Control and Prevention (CDC)-American College of Sports Medicine (ACSM) recommendations of 1995 formalized acceptance of the health benefits of moderate-intensity physical activity (Pate et al., 1995). The recognition that the benefits of regular physical activity did not require the effort, commitment, and skill of an athlete solidified the public health value of physical activity and has guided epidemiologic, intervention, and clinical research ever since. That outcome has been good. It led, however, to a rigid categorization of physical activity into the good—vigorous or moderate-intensity—and the bad—sedentary or light-intensity. In some scientific reports and even in official documents (PAGAC, 2008), “physical activity” has been used to mean vigorous or moderate-intensity physical activity. This usage has become common, making it difficult for many to accept the emerging evidence for the health benefits of light-intensity physical activity.

Recent research among adults indicates that replacing sedentary activities with light-intensity physical activity while holding the volume of vigorous or moderate-intensity physical activity constant provides health benefits (Hu et al., 2003; Healy et al., 2008a; Healy et al., 2008b; Katzmarzyk et al., 2009; Wijndaele et al., 2010; Grøntved and Hu, 2011; Wijndaele et al., 2011; Matthews et al., 2012). Data from a National Institutes of Health (NIH)-AARP study of more than 200,000 adults demonstrate that light-intensity physical activity augments the benefits of more intense physical activity (Matthews et al., 2012). At every volume of vigorous or moderate-intensity physical activity the risk of cardiovascular mortality increases as the volume of sedentary activity, assessed as hours of watching television, increases (see the figure below). Worth noting is the essentially equivalent risk among those who do the most vigorous or moderate-intensity physical activity and the most television watching and those who do no vigorous or moderate-intensity physical activity and the least television watching (see the arrows in the figure).



Cardiovascular mortality by hours/week of vigorous or moderate-intensity physical activity (MVPA) and hours/day of television viewing.
SOURCE: Matthews et al., 2012. Reprinted with permission.

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The health impact of sedentary-intensity physical activity among children and adolescents is likely the same. A qualitative review of 232 studies found a dose-response relationship between more sedentary behavior and unfavorable health outcomes, including unfavorable body composition, decreased fitness, lower scores for self-esteem and pro-social behavior, and decreased academic achievement (Tremblay et al., 2011). Cohort studies among youth that have controlled for vigorous or moderate-intensity physical activity have yet to demonstrate a relationship between reductions in sedentary activity (which is the same as increases in light-intensity activity) and health or risk factor outcomes (Carson and Janssen, 2011; Ekelund et al., 2012).

The implications of these findings for behavioral recommendations regarding beneficial physical activity are still under discussion. Sedentary activities fill about half the waking hours of children and adolescents (probably relatively less for children and more for adolescents). Sedentary and light-intensity activities together fill 80-95 percent of waking hours (see Figure 2-6). More remains to be learned about the differences in health improvement, academic performance, and classroom behavior engendered by different intensities of physical activity. It is clear that the physiologic effects differ for different intensities. Higher-intensity activities, for example, provide greater cardiovascular fitness and lower cardiovascular mortality risk at all volumes of sedentary activity. Most likely, different intensities provide different benefits. Current consensus is that children and adolescents need some vigorous activity daily for maximum current and future health. Light-intensity physical activity can now be viewed as a healthy shift away from sedentary physical activity as well. Higher rates of energy expenditure are preferred over lower rates across the full range of intensities. The behavioral differences between sedentary-intensity and vigorous or moderate-intensity physical activities are considerable, and interventions to discourage the former and those to promote the latter can be expected to be quite different.

An important aspect of sedentary-intensity physical activity is the large portion of waking hours it fills. Assuming about 15 hours per day of wakefulness, sedentary- and light-intensity physical activities fill 80 percent of waking hours for youth who spend 3 hours doing vigorous or moderate-intensity physical activities (see Figure 2-6). For youth just meeting the 60-minute daily recommendation for the latter activities, the former would fill 93 percent of the day. For the majority of youth not meeting the current recommendation for vigorous or moderate-intensity physical activity, nearly the whole day comprises sedentary- and light-intensity physical activities (Treuth et al., 2012).

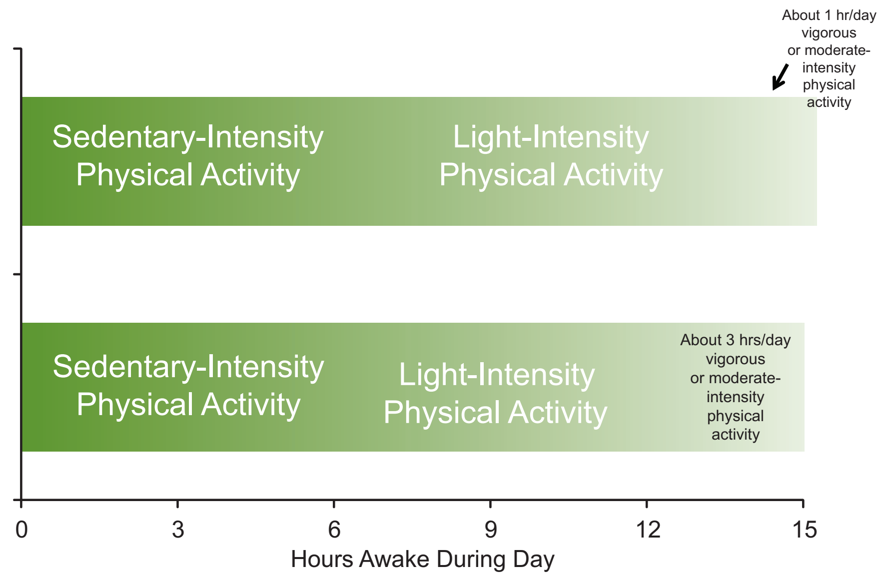

FIGURE 2-6 Approximate number of hours spent during the day at different levels of energy expenditure.
SOURCE: Treuth et al., 2012.

Various suggestions have been made about what aspects of youth's sedentary physical activity should be avoided and monitored, including limiting television viewing to less than 2 hours per day, limiting television viewing to less than 3 hours per day, limiting computer use to less than 3 hours per day, and limiting total media time to less than 2 hours per day (see, for example, *HealthyPeople 2020* Objectives [HealthyPeople.gov, 2012]).

Not surprisingly, surveys and studies of sedentary behavior among children and adolescents have used various methods of data collection (e.g., self-report, accelerometer, proxy), have assessed different aspects of sedentary-intensity physical activity (e.g., total sedentary time, watching television for more than 2 or 3 hours), and have reported the data in different formats (e.g., percentage meeting specified requirement, mean minutes of sedentary physical activity). Taken together, the results of these surveys and studies indicate that children and adolescents spend a great deal of time in activities requiring very low energy expenditure. The results also indicate that girls are more likely than boys and older adolescents are more likely than children to engage in these low-energy activities, although the differences are generally smaller than for vigorous or moderate-intensity physical activity.

Data from the YRBS and the NHANES are the most frequently cited. Based on accelerometry-assessed physical activity, youth aged 6-19 engage in sedentary physical activity 6 to 8 hours per day (Matthews et al., 20012) (see Figure 2-7). Figure 2-7 also provides estimates of the average time per day spent using different types of media (TVB, 2012). Reports from the YRBS suggest that about one-third of both middle and high school students report watching television for at least 3 hours per day. In response to a different question, those in this age group (not necessarily the same students) report using a computer for at least 3 hours per day (CDC, 2012b). Other reports (Anderson et al., 2008; Sisson et al., 2009; Wright et al., 2009) and a review (Pate et al., 2011) are available. Data from two reasonably comparable studies demonstrate the reduction in vigorous or moderate-intensity physical activity and the rise in sedentary and light-intensity activity as girls grow from age 5 to age 8, and to age 12 (Janz et al., 2005; Pate et al., 2006b) (see Figure 2-8).

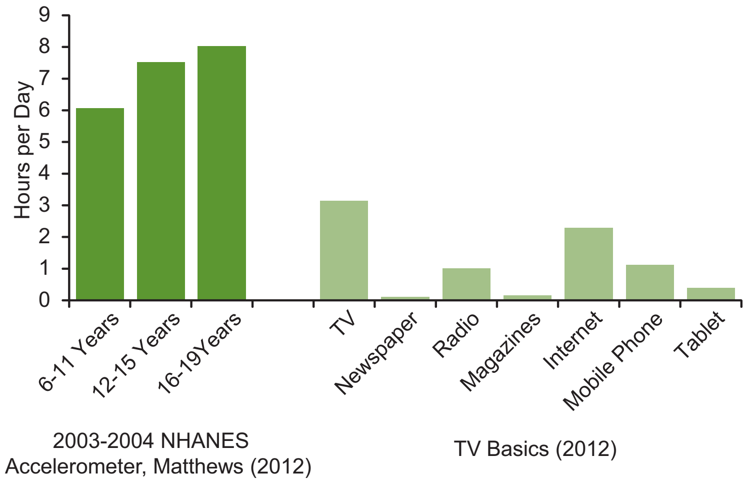

FIGURE 2-7 Hours per day spent in sedentary activity by age group, ages 6-19, and hours per day using different media sources, ages 13-17.
NOTE: NHANES = National Health and Nutrition Examination Survey.
SOURCES: Matthews et al., 2012; TVB, 2012.

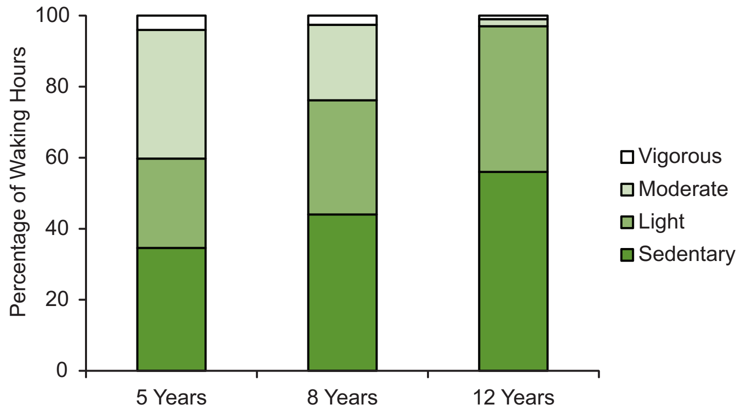

FIGURE 2-8 Percentage of waking hours spent in sedentary, light, moderate, and vigorous physical activity by girls aged 5 and 8 (all from Iowa) and aged 12 (from Arizona, California, Louisiana, Maryland, Minnestota, and South Carolina).
SOURCES: Janz et al., 2005; Pate et al., 2006b.

Vigorous or Moderate-Intensity Physical Activity During the School Day

In the United States, elementary and secondary students spend 180 days every year at school. On those days, about 6.5 hours, or about 40 percent of their waking hours, make up the official school day. Including time spent going to and from school and in school-related after-school activities, students spend half or more of the available hours of every school day at school or going to and from school. Given the large proportion of total waking hours spent at school and on school-related activities, remarkably little is known about students' physical activity behaviors during school hours and during school-related after-school activities.

A recent analysis of the potential impact of selected school-based policies indicates that the current dose of vigorous or moderate-intensity physical activity at school could be substantially increased (Bassett et al., 2013) (see Figure 2-9) (see also Chapter 7).

- Compared with no physical education, a usual physical education class adds about 23 minutes of vigorous or moderate-intensity physical activity to a student's day.
- Using a standardized high-quality physical education program can add another 5 minutes. High-quality or enhanced physical education programs strive, among other things, to spend at least 50 percent of physical education time in vigorous or moderate-intensity physical activity.
- Programs that enable and encourage more vigorous or moderate-intensity physical activity during recess by providing age-appropriate equipment, blacktop games, adult encouragement and supervision, or both can add another 5 minutes.
- Inserting vigorous or moderate-intensity physical activity into the classroom by incorporating physical activity into the lesson or by specific activity breaks can add about 19 minutes per day above the usual time.
- Walking or biking to school compared with being driven can add about 16 minutes of vigorous or moderate-intensity physical activity to the school day.
- After-school activity programs can add another 10 minutes of vigorous or moderate intensity physical activity per school day.

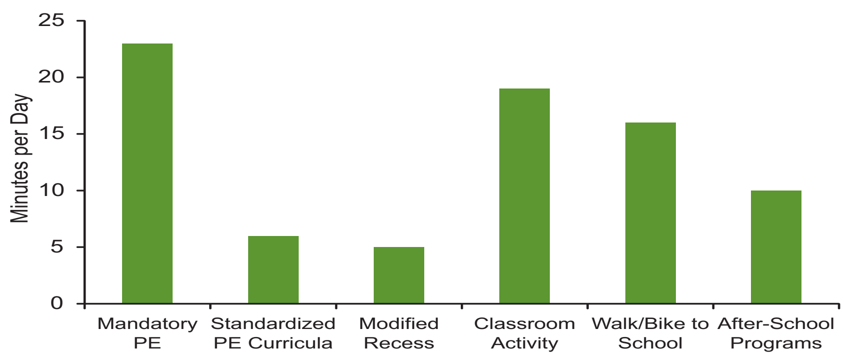

FIGURE 2-9 Minutes per day of vigorous or moderate-intensity physical activity gained by implementing school-based policies.
NOTE: PE = physical education.
SOURCE: Bassett et al., 2013.

Despite evidence that policies and programs can increase vigorous or moderate-intensity physical activity among children and adolescents on school days, however, only rough estimates are available, at best, of students' baseline physical activity behaviors at school and during school-related activities. Therefore, only rough estimates can be made of the volume of vigorous or moderate-intensity physical activity that is being and could be achieved.

Physical Education

Children in elementary and middle school spend about 10 to 40 percent of their time in physical education class engaged in vigorous or moderate-intensity physical activity (Simons-Morton et al., 1993, 1994; McKenzie et al., 1996; Sallis et al., 1997; Belsky et al., 2003; McKenzie et al., 2006). On average, they have about two physical education class periods per week, each for about 30 minutes (Belsky et al., 2003). Assuming that 35 percent of physical education time is spent in vigorous or moderate-intensity physical activity, children spend an average of 4 minutes per school day doing vigorous or moderate-intensity physical activity in physical education classes (see Table 2-1). If elementary school students had 30 minutes of physical education daily (150 minutes per week) and middle school students had 45 minutes of physical education daily (225 minutes per week), the estimated number of minutes per day spent doing vigorous or moderate-intensity physical activity during physical education would increase to about 11 minutes and 16 minutes, respectively. If the proportion of time in vigorous or moderate-intensity physical activity during physical education were increased to 50 percent through the use of standardized high-quality physical education programs, the average time per day would increase to 15 minutes and 23 minutes for elementary and middle school students, respectively. High school students also average about 2 days per week of physical education classes (Delva et al., 2006). If the proportion of time they spend in vigorous or moderate-intensity physical activity during physical education were assumed to be similar to that for primary school students, they would average 4 minutes per day currently, 16 minutes per day if they attended the classes daily, and 23 minutes per day if the classes were daily and of high quality (Table 2-1). These estimates are a bit lower than those in a recent analysis (Bassett et al., 2013).

TABLE 2-1 Estimated Current and Potential Minutes of Vigorous or Moderate-Intensity Physical Activity on School Days for Physical Education, Classroom Physical Activity, Recess, Total School Hours, Active Transport, and After-School Sports and Activity Programs for Elementary, Middle, and High School Students

Physical Education	**Estimated Current Minutes**	**If Daily Physical Education (min)**	**If Enhanced Daily Physical Education (min)**
Elementary	4	11	15
Middle	4	16	23
High	4	16	23
Classroom Physical Activity	**Estimated Current Minutes**		**If Enhanced Classroom Activity (min)**
Elementary	?		≥19
Middle	?		≥19
High	?		≥19
Recess	**Estimated Current Minutes**		**If Enhanced Recess (min)**
Elementary	9		14
Middle	9		14
High	Not applicable		Not applicable
Total School hours	**Estimated Current Minutes**	**If Daily Physical Education (min)**	**If Enhanced Daily Physical Education, Classroom Activity, and Recess (min)**
Elementary	≥15	≥21	≥49
Middle	≥15	≥26	≥57
High	≥5	≥21	≥42
Active Transport (Walking/biking)	**Estimated Current Minutes**		**If Proportion of Students using Active Transport Doubled (min)**
Elementary	2		4
Middle	2		4
High	1		3
After-School Activity Programs	**Estimated Current Minutes**		**If All Students Participated (min)**
Elementary	?		≥10
Middle	?		≥10
High	?		≥10

SOURCES: Simons-Morton et al., 1993, 1994; McKenzie et al., 1996; Sallis et al., 1997; Belsky et al., 2003; Ridgers et al., 2005; Delva et al., 2006; McKenzie et al., 2006; Tudor-Locke et al., 2006; Lee et al., 2007; Fairclough et al., 2012; Gauthier et al., 2012; Rush et al., 2012; Bassett et al., 2013.

Classroom Physical Activity

Information is insufficient with which to estimate the amount of vigorous or moderate-intensity physical activity in which an average student engages during usual instructional classroom time. As noted earlier, it is estimated that classroom physical activity could add 19 minutes of such activity to every school day (Bassett et al., 2013), perhaps at the primary and secondary school levels (Table 2-1).

Recess

An estimated 97 percent of primary schools have regularly scheduled recess for about 30 minutes per day (Lee et al., 2007), and children spend roughly 30 percent of their time at recess doing vigorous or moderate-intensity physical activity (Ridgers et al., 2005), for an estimated average time per day in vigorous or moderate-intensity physical activity during recess of 9 minutes. As noted, enhanced-quality recess (e.g., providing age-appropriate equipment, blacktop games, adult encouragement and supervision) could add an estimated 5 minutes (Bassett et al., 2013), for a total of 14 minutes per day (Table 2-1).

Total During School Hours

The committee found few estimates of total vigorous or moderate-intensity physical activity or step counts during school hours. The estimates it did find are from a limited number of schools and only one in the United States (Tudor-Locke et al., 2006; Fairclough et al., 2012; Gauthier et al., 2012; Rush et al., 2012). Together, these estimates suggest that about 40 percent of the usual volume of physical activity takes place during school hours, but no estimate of the total energy expenditure or time in vigorous or moderate-intensity physical activity was available. The estimates in Table 2-1 suggest that primary school students currently spend at least 15 minutes per school day and high school students at least 5 minutes per school day engaged in vigorous or moderate-intensity physical activity during school hours. With high-quality daily physical education, enhanced-quality recess, and vigorous or moderate-intensity physical activity inserted into usual classroom activities, the estimated minutes per school day would be at least 49, 57, and 42 minutes for elementary, middle, and high school students, respectively (Table 2-1). These totals do not include vigorous or moderate-intensity physical activity that might accrue during other parts of the school day such as during the lunch break or, for the upper grades, movement from one classroom to another.

Active Transport

Students who walk or bike to school average about 16 minutes per day of vigorous or moderate-intensity physical activity during transit (Bassett et al., 2013). Currently, approximately 13 percent of primary school students, 11 percent of middle school students, and 8 percent of high school students usually walk or bicycle to school (McDonald, 2007; McDonald et al., 2011). Thus, the average minutes per day of vigorous or moderate-intensity physical activity during active transit for all students is about 2 minutes for elementary and middle school students and about 1 minute for high school students. Because many students live too far from school to be able to walk or bike (Falb et al., 2007; McDonald, 2007; McDonald et al., 2011), a doubling of the current prevalence of students using active transport is perhaps as much as could be expected without the creation of numerous smaller schools nearer to children's home or major changes in school busing practices. The average number of minutes for all students would then increase to 4 minutes per day for elementary and middle school students and 3 minutes per day for high school students. Of course, for those students who can walk or bicycle to school, active transport provides the full 16 minutes of vigorous or moderate-intensity physical activity.

After-School Interscholastic and Intramural Sports, Physical Activity Clubs, and Other After-School Programs

Despite the growing popularity of these after-school activities, no good estimates of the number of participants exist. As noted earlier, after-school activity programs for elementary and middle school students are estimated to add about 10 minutes per day of vigorous or moderate-intensity physical activity (Bassett et al., 2013).

TRENDS IN PHYSICAL ACTIVITY BEHAVIORS AMONG YOUTH

This section reviews trends in physical activity behaviors among youth, examining in turn vigorous or moderate-intensity activity, sedentary and light-intensity activity, and physical activity not necessarily related to school.

Vigorous or Moderate-Intensity Physical Activity

Although estimates of children and adolescents currently achieving the recommended volume of vigorous or moderate-intensity physical activity vary depending on how the data were collected, it is clear that few children are sufficiently physically active. An important question is whether the current status of physical activity among youth is an improvement, a worsening, or no different relative to previous years. If the situation is improving (i.e., children have been becoming more active), no changes or new efforts may be warranted; if the situation is stable or worsening, actions are needed. Few data sources provide clear and convincing evidence on trends in children's level of physical activity, but taken together, the evidence is persuasive that children and adolescents in the United States have become increasingly less physically active over the past 40 to 50 years.

The YRBS provides self-reported information on physical activity-among high school students for 1993-2011. Although the data span 20 years, trends in vigorous or moderate-intensity physical activity are obscured because the survey questions have been modified over time to align with changes in the recommended volume of physical activity for youth (annual surveillance reports from CDC's website for 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, and 2011) (see Figure 2-10 and Box 2-5). The largest change is an increase from 70 percent in 1995 to 84 percent in 2005 in the percentage of students who participate in physical education and who report averaging more than 20 minutes per class exercising or playing sports. In 2011 there was a sharp increase over 2009 in the proportion of students reporting at least 60 minutes of vigorous or moderate-intensity physical activity on at least 5 days in the preceding week (37 percent to 50 percent), and a corresponding decline in the number reporting that much activity on no days of the preceding week (23 percent to 14 percent) (Figure 2-10). These sharp changes are thought to be an artifact arising from a shift in the format of the questionnaire such that students had fewer opportunities to describe the types and amounts of their physical activity.

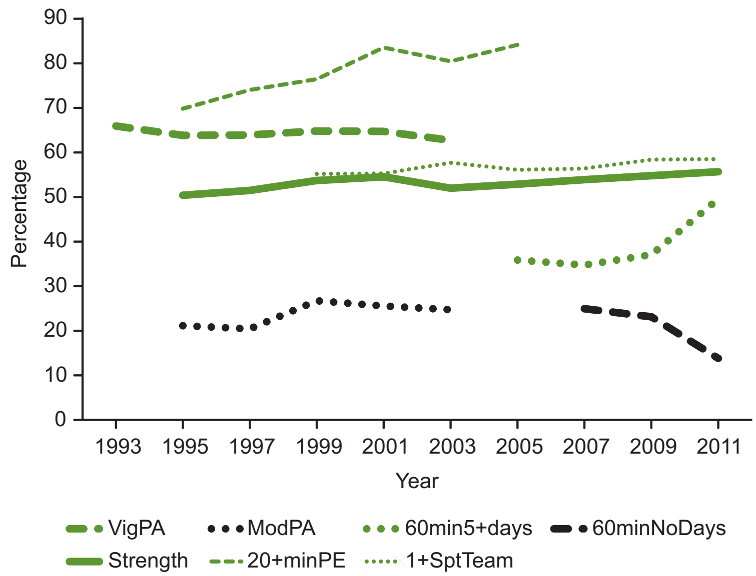

FIGURE 2-10 Percentage of high school students meeting physical activity recommendations, doing strength training, playing on one or more sports teams, and engaging in 20 minutes or more of vigorous or moderate-intensity physical activity during physical education.
NOTES: VigPA = Activities that caused sweating and hard breathing for at least 20 minutes on at least 3 of the 7 preceding days; ModPA = walked or bicycled for at least 30 minutes on at least 5 of the 7 preceding days; 60min5+days = physical activity that caused increased heart rate and hard breathing for a total of at least 60 minutes on at least 5 of the 7 preceding days; 60minNoDays = physical activity that caused increased heart rate and made hard breathing for a total of at least 60 minutes on none of the 7 preceding days; 1+SptTeam = played on at least one sports team run by the student's school or community groups during the 12 months before the survey; 20+minPE = among students who attended physical education classes, exercised or played sports for more than 20 minutes during average physical education class; strength = activities such as push-ups, sit-ups, or weight lifting on at least 3 of the 7 preceding days.
SOURCE: CDC, 2012.

A clear example of a decline in physical activity among youth is the decrease in the proportion of school children walking or bicycling to school. Between 1969 and 2001, this proportion dropped from 42 percent to 13 percent; among children living within 1 mile of their school, it dropped from 86 percent to 50 percent (McDonald, 2007) (see Figure 2-13).

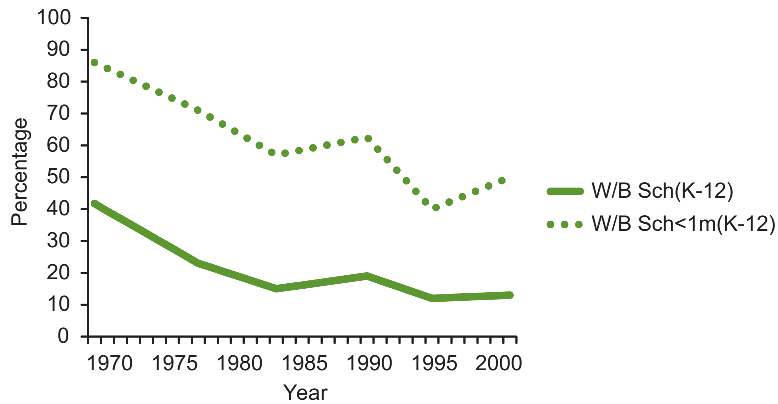

FIGURE 2-11 Percentage of students walking or bicycling to school.
SOURCE: McDonald, 2007.

BOX 2-5
Progression of the Recommended Dose of Physical Activity for Youth

The dose of physical activity recommended for youth has changed during the past 30 years (see the table below). Initially, with little information specific to youth available, the recommended dose for adults, children, and adolescents was the same. As knowledge accumulated and the special needs of children and adolescents were taken into account, the dose recommended for the latter age groups has differed from that recommended for adults.

Changes Over Time of the Recommended Volume of Physical Activity for Children and Youth

Time Period	Recommendation	Comment
1985	Vigorous physical activity for 20+ min/day on 3+ days/week	Same as recommendation for adults; activity should be continuous
1995	Vigorous physical activity for 20+ min/day on 3+ days/week, or moderate physical activity for 30+ min/day on 5+ days/week	Same as recommendation for adults; activity can be accumulated during the day in 8- to 10-minute bouts
2005	60+ minutes/day of mainly vigorous or moderate-intensity physical activity	Recommendation specifically for children and adolescents; activity should be varied, developmentally appropriate, and enjoyable

Dose is the amount, or volume, of physical activity performed (see Box 2-2). For aerobic activities, dose is determined by the frequency, duration, and intensity of the activity. During the late 1970s and 1980s, the dose recommended for adults and children was 20 minutes or more of continuous vigorous activity on 3 or more days per week (HHS, 1984; ACSM, 1988). This recommendation, based largely on the dose required for short-term training response in young adults (Simons-Morton et al.,1988), assumed that benefits were derived only from vigorous physical activity. By the mid-1990s, consensus had been reached that health benefits accrued from moderate-intensity physical activity as well and the recommended dose was expanded to include either the dose of vigorous physical activity previously recommended or a dose of 30 minutes or more per day of moderate-intensity physical activity on 5 or more days per week (Pate et al., 1995; HHS, 1996). The dose of vigorous intensity activity and the dose of moderate intensity activity could be accumulated in segments as short as 8 to 10 minutes in length.

In 2005, a panel convened by the Centers for Disease Control and Prevention specifically to consider the physical activity needs of children and adolescents (aged 6-18) recommended that "school-aged youth should participate daily in 60 minutes or more of vigorous or moderate-intensity physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities" (Strong et al., 2005, p. 736). The Physical Activity Guidelines Advisory Committee Report 2008, noting a direct relationship between volume of physical activity in youth and cardiorespiratory fitness, muscular strength, less adiposity among youth of normal weight, cardiovascular and metabolic health, bone mineral content and density, and several mental health outcomes, reiterated the value of 60 minutes or more of vigorous or moderate-intensity physical activity per day for important health benefits (PAGAC, 2008). The committee further commented that the weekly activities should include some vigorous activity on at least 3 days and some activities to strengthen muscles and bones.

Sedentary- or Light-Intensity Physical Activity

The above-noted evidence accumulated during the past decade indicating the health benefits of light-intensity physical activity compared with sedentary-intensity activities has spurred interest in monitoring trends in these two types of physical activity. One of the difficulties has been deciding which sedentary behaviors to monitor. Use of accelerometers in recent years has enabled researchers to measure total sedentary time, but long-term trends have depended on self-reported data, primarily regarding television viewing time and more recently also regarding time spent watching videos, playing video games, and using a computer. Television viewing time has been monitored, often for business reasons, for a number of years. The average number of hours children and teens spent watching television daily declined slightly during the early 1990s, from about 3.3 hours per day to about 3 hours per day, and rose during the 2000s to about 3.4 hours per day (see Figure 2-12) (TVB, 2012). If television use includes DVDs, prerecorded shows, or television shows on other platforms (e.g., Internet, cell phone), then total television use has increased since the late 1990s, as has the use of computers for purposes other than school work (Rideout et al., 2010). The prevalence of high school students reporting on the YRBS that they watched at least 3 hours per day of television declined from 38 percent in 2003 to 32 percent in 2011, while the prevalence of using computers for at least 3 hours per day increased from 21 percent in 2005 to 31 percent in 2011 (CDC, 2012a).

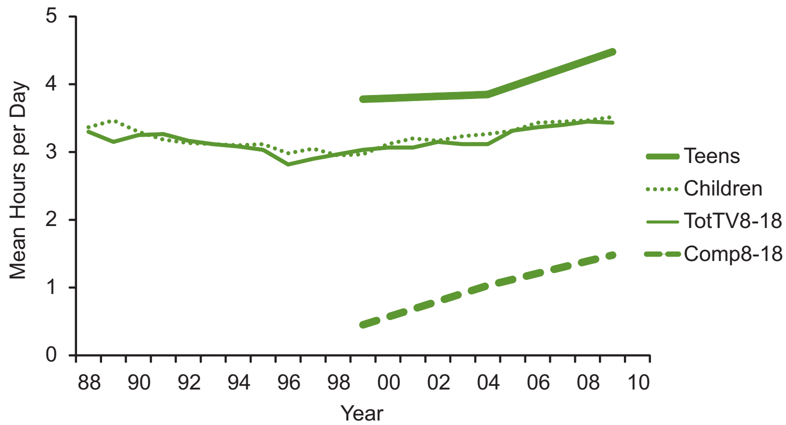

FIGURE 2-12 Hours/day spent watching television by age group, 1998-2009, and hours/day spent watching television and using computers for youth aged 8-18.
NOTES: TotTV = total television content includes not only watching standard television programs but also pre-recorded shows, DVDs, and television content on other platforms (e.g., Internet, Cell phones, iPod); computer = does not include time spent using a computer for school work.
SOURCES: Rideout et al., 2010; TV Basics, 2012.

Physical Activity Not Necessarily Related to School

Indirect and inferential evidence from several different types of research suggests that children and adolescents today are less physically active than previous generations. For example, comparisons with traditional cultures indicate a decline in routine physical activity. Old Order Amish and Old Order Mennonite cultures eschew modern conveniences. Comparisons of accelerometer-measured routine physical activity among children from Amish and Mennonite traditional cultures and samples of U.S. and Canadian children indicate that the former children are more physically active (Tremblay et al., 2005; Esliger et al., 2010; Hairston et al., 2012). Children from Maryland's Eastern Shore spent 53 min/day less in vigorous or moderate-intensity physical activity and 34 min/day less in light-intensity physical activity than the Old Order Amish children with whom they were compared (Hairston et al., 2012). This translates to 87 min/day of sedentary physical activity.

Declines in cardiorespiratory fitness among children around the world have been documented. American researchers usually have preferred not to compare current measures of cardiorespiratory fitness among American children with results of surveys from previous years because of differing measurement methods (Pate et al., 2006a), although one review has suggested declines since the 1960s (Malina, 2007). Assessments have been performed, however, in other countries using more consistent measurement techniques and they indicate a global decline in cardiorespiratory fitness among youth (Santtila et al., 2006; Tomkinson and Olds, 2007; Albon et al., 2010; Boddy et al., 2012; Tomkinson et al., 2012) or, in one case, a decline in physical activity behaviors (Salmon et al., 2005) (Table 2-2).

TABLE 2-2 Declines in Physical Fitness Among Children Around the World

Source	Location	Time Period	Age Range	Method of Assessment	Findings
Boddy et al. (2012)	United Kingdom	1998-2010	9-10 years (cohort)	20-meter shuttle run	1.8% decline per year
Tomkinson et al. (2012)	Asia (China, Japan, S. Korea, Singapore)	1964-2009	9-17 years	Long-distance running time	16% decline
Santtila et al. (2006)	Finland	1975-2004	20 years	12-minute run	8% decline
Albon et al. (2010)	New Zealand	1991-2003	10-14 years	550-meter run	1.6% decline per year
Salmon et al. (2005)	Australia	1985-2001	9-13 years	Walking trips to school	17% decline
				taking physical education	28% decline
				Participating in school sport	11% increase
Tomkinson and Olds (2007)	27 countries (varying time periods and age ranges)	1958-2003	6-19 years	Various	0.36% decline per year

A review of evidence from around the world found that youth's participation in "active transport, physical education, and organized sports is declining in many countries (Dollman et al., 2005, p. 892). The authors also comment that "young people would like to be active but are constrained by external factors such as school policy or curricula, parental rules in relation to safety and convenience, and physical environmental factors" (p. 892).

Finally, several studies provide empirical evidence for a gradual decline in physical activity among adults in occupation, transportation, and household tasks (Lanningham-Foster et al., 2003; Brownson et al., 2005; Church et al., 2011; Archer et al., 2013). Of interest, there is little evidence to suggest either a decrease or an increase in adult leisure-time physical activity. Although the evidence in these reports pertains to adult behavior, there can be little doubt that the declines in physical activity due to mechanization, technology, and social norms apply to children and adolescents as well.

PUBLIC POLICY SURVEILLANCE TRENDS

This section first provides an overview of state and local public policy surveillance trends and a summary of existing evidence on the implementation and effectiveness of these policies in practice. Currently, the only national physical activity-related public policy surveillance systems focus on state laws, defined as statutory (legislative) and administrative (regulatory) laws, and school district wellness policies. These policy surveillance systems contain quantitative data on the strength and comprehensives of public policies developed using systematic and reliable coding systems. The policy surveillance data are useful both for tracking progress and changes in codified public policies over time and across jurisdictions, and are an effective tool for influencing behavior change at the population, as opposed to the individual, level, and have been shown to have significant long-term effects on population health and health behavior. Examples include fluoridating drinking water and requiring the use of seat belts in motor vehicles (CDC, 1999). The Institute of Medicine (2012, p. 329) report *Accelerating Progress in Obesity Prevention* suggests that schools should be "a national focal point for obesity prevention." Thus, the committee sought to examine the current state of knowledge regarding the status of and trends in national, state, and local policies related to physical activity and Physical Education in schools. Currently, there are no federal mandates regarding physical activity and physical education in schools; however, there are existing state and local laws.

A number of available sources provide information on policies regarding school-based physical activity (see Table 2-3). The School Health Policies and Practices Study (SHPPS) (Burgeson et al., 2001; Lee et al., 2007) and the Shape of the Nation Report (NASPE, 2010; 2012) collect relevant policy information through self-report surveys, while the National Cancer Institute's Classification of Laws Associated with School Students (C.L.A.S.S.) (Mâsse et al., 2007) and the Robert Wood Johnson Foundation-supported Bridging the Gap program (www.bridgingthegapresearch.org) compile state laws and then apply scoring systems to rank the laws in comparison with national standards and recommendations. Bridging the Gap also conducts the largest, ongoing, nationwide evaluation of the congressionally-mandated school district wellness policies (Bridging the Gap, 2013). The district wellness policy data are coded using identical coding schemes as the state law data, thus enabling multilevel evaluations of the impact of state laws and district policies on school practices and student behaviors.

SHPPS compiles information collected through self-report surveys to assess school-based physical education and activity policies and practices at the state, district, school, and classroom levels. State-level data were collected from education agencies in all 50 states and the District of Columbia. District and school-level data were collected from nationally representative samples of public school districts and public and private elementary and secondary schools. Classroom-level data were collected from teachers of randomly selected classes.

The Shape of the Nation survey collects the following information on physical education: (1) time requirements; (2) high school graduation requirements; (3) exemptions/waivers and substitutions; (4) physical activity; (5) local school wellness policy; (6) standards, curriculum and instruction; (7) class size; (8) student assessment and program accountability; (9) body mass index (BMI) collection; (10) physical education teacher certification/licensure; (11) national board certification in physical education; and, (12) state physical education coordinator requirements (NASPE and AHA, 2012).

The NASBE State School Health Policy Database, begun in 1998 and continuously updated, (http://www.nasbe.org/healthy_schools/hs/index.php) is another data source that supplements the SHPPS survey by providing supplemental information on the presence of relevant state laws and policies. The database provides a summary description of the actual state-level laws, legal codes, rules, regulations, administrative orders, mandates, standards, and resolutions (see Appendix C for a summary table of the laws). The database includes a summary of the most recent state-level laws, rules, etc. on the books, but does not provide historical information on laws that were in place dating back to 1998. The other two state-level policy databases vary from the NASBE database by providing scores related to the strength of policies rather than the actual policy language. They also provide historical data by year, which allows for the examination of change in state laws over time.

The C.L.A.S.S. database contains state-level information on policy areas including (1) physical education class time, (2) staffing requirements for physical education, (3) physical education curriculum standards, (4) assessment of health-related fitness during physical education, (5) physical activity time requirements outside of physical education, and (6) recess. C.L.A.S.S. uses a 0 to 4 or 0 to 5 rating scale, depending on the category, that captures information on the specificity, strength of language, and stringency of a law. Each year's rating reflects laws in place as of December 31 of that year. Bridging the Gap, described in detail below, collects data on both state and school district policies related to physical education and physical activity and applies a 0 to 3 rating scale. All sources in Table 2-3 contain information on laws for elementary, middle, and high schools. All contain some duplicative information, but also other measures that are unique to that source.

TABLE 2-3 Data Sources for Policies Related to School-based Physical Activity-Related Policies

Data Source	Time Period	Method of Assessment	Levels
School Health Policies and Practices Study	2000, 2006	Self-report surveys, separate respondents for each level	State (census), district, school, classroom (nationally representative sample)
Shape of the Nation	Every few years from 1987 to 2012	Self-report surveys, state physical education coordinators	State (census)
C.L.A.S.S.	2003-2008, biennially starting in 2010	Coded (scored) state laws	State (census)
Bridging the Gap	2006-2012	Coded (scored) state laws	State (census), district (nationally representative sample)

Given the overlap in these data sources, the following information on state- and school district-level policies was taken from two sources—one self-reported and the other objectively collected and coded. Tables 2-4 through 2-6 present trend data for 2000-2012 on the prevalence of state-level policies related to school-based physical education and physical activity. Table 2-4 presents information extracted from the SHPPS in 2000 and 2006 (Burgeson et al., 2001; Lee et al., 2007), while Tables 2-5 and 2-6 present information compiled from Bridging the Gap (Chiriqui et al., in press). Starting with the 2006-2007 school year, Bridging the Gap has compiled policies for all 50 states and the District of Columbia annually from the state law databases Westlaw and Lexis-Nexis using keyword searches. All policies are coded using a three-point rating scale, where 0 (none) represents those states with no policy, 1 (weak) represents states with a law that suggests/encourages or imposes a less stringent requirement than the national physical activity/physical education recommendations, and 2 (strong) represents states requiring or exceeding the national recommendations. These three tables highlight only the percentage of states that have strong laws in place. The SHPPS does not use the same data coding format as Bridging the Gap; thus it is not possible to directly compare similar measures across these data sources.

TABLE 2-4 Prevalence of Policies at the State, School District, and School Levels Related to School-Based Physical Education and Physical Activity from the School Health Policies and Practices Study (SHPPS)

		2000 (%)	2006 (%)
Physical Education: Elementary Schools	States requiring physical education	78	80
	Districts requiring physical education	83	78
	Schools requiring physical education	(82)	86
	• 3 days/wk, all year, all grades	25	14
	• daily, 1/2 year, all grades	10	5
	• daily, all year, all grades	8	4
Physical Education: Middle Schools	States requiring physical education	86	93
	Districts requiring physical education	85	90
	Schools requiring physical education	(89)	89
	• 3 days/wk, all year, all grades	18	15
	• daily, 1/2 year, all grades	16	15
	• daily, all year, all grades	6	8
Physical Education: High Schools	States requiring physical education	82	93
	Districts requiring physical education	89	90
	Schools requiring physical education	(94)	89
	• 3 days/wk, all year, all grades	7	3
	• daily, 1/2 year, all grades	12	7
	• daily, all year, all grades	6	2
Physical Education: General	States requiring/encouraging following national or state physical education guidelines	84	82
	Districts requiring following national or state physical education guidelines	75	81
	Schools following national or state physical education guidelines	81	88
	States requiring/encouraging following National Association for Sport and Physical Education (NASPE) guidelines	60	76
	Districts requiring/encouraging following NASPE guidelines	51	55
	Schools requiring/encouraging following NASPE guidelines	67	65
	States with state-level physical education coordinator	69	88
	Districts with district-level physical education coordinator	62	69
	Schools with someone to oversee physical education	86	91
Recess: Elementary	States requiring/recommending regularly scheduled recess	26	37
	Districts requiring/recommending regularly scheduled recess	87	90
	Schools providing regularly scheduled recess	97	97

		2000 (%)	2006 (%)
	If school has recess, number of minutes/week on average	149 min/wk	148 min/wk
Active Transport	States supporting/promoting active transport	—	14
	Districts supporting/promoting active transport	—	18
	Schools supporting/promoting active transport	—	44

SOURCES: 2000 data extracted from Burgeson et al., 2001; 2006 data extracted from Lee et al., 2007.

Because the SHPPS (see Table 2-4) surveys relevant respondents at multiple levels, results of this survey provide information on changes in policies related to physical education and physical activity at the state, district, and school levels. These data help illustrate how policies are implemented from the state down to the school level. Because schools do not have codified policies, the self-reported method of data collection can provide valuable information on the implementation and enforcement of state- and district-level policies, along with a snapshot of how schools at the local level may be implementing programs and practices beyond what they are required to do by law. In a recent study, for example, Nanney and colleagues (2010) used the SHPPS data to construct a summary scale of the number of physical activity-related policies adopted by states. They identified 146 items in the SHPPS related to physical activity and physical education and found that on average, states had adopted 38 percent of all possible physical activity and physical education policies. However, a disadvantage of self-reported data is that they are subject to human error, such as respondent bias or misinterpretation of the survey questions, such as over-reporting on the presence of laws, policies and practices. For example, see Tables 2-5 and 2-6. Tables 2-5 and 2-6 present annual quantitative data on trends in codified state laws. In general these data show that, in most instances, physical education laws at the state-level have changed little during the past 6 years.

TABLE 2-5 Trends in State Physical Education Policies for Elementary, Middle, and High Schools

		SY 2006-07 (%)	SY 2007-08 (%)	SY 2008-09 (%)	SY 2009-10 (%)	SY 2010-11 (%)	SY 2011-12 (%)
PE Addressed in State Policy[a]	Elementary	94	96	96	96	98	98
	Middle	94	96	96	96	98	98
	High	92	96	98	98	98	98
Clear PE Curriculum in All Grades[b]	Elementary	59	61	61	63	63	63
	Middle	55	57	59	61	61	61
	High	41	41	45	47	47	49
Time Requirement of ≥150 minutes/week of PE[c]	Elementary	10	12	10	10	10	10
Time Requirement of ≥225 minutes/week of PE[d]	Middle	2	2	2	2	2	2
	High	2	4	2	2	2	2
PE Promotes a Physically Active Lifestyle[e]	Elementary	57	61	67	73	75	73
	Middle	57	61	67	73	75	73
	High	57	61	67	73	75	73
PE Competency Assessment[f]	Elementary	55	59	65	71	73	73
	Middle	55	59	65	71	73	73
	High	53	57	63	69	71	71
PE Courses or Credits Required for Graduation and/or Count toward GPA	High	73	78	78	78	80	80
All Students Required to Receive Daily PE	Elementary	4	6	6	6	6	6
	Middle	4	6	6	6	6	6
	High	2	4	4	4	4	4
Teacher-Student Ratio for PE Specific and Required	Elementary	8	8	8	8	10	10
	Middle	8	8	8	8	10	10
	High	8	8	8	8	10	10
Safe/Adequate PE Equipment and Facilities Specified and Required	Elementary	2	2	2	2	2	2
	Middle	4	4	4	4	4	4
	High	2	2	4	4	4	4
PE Required to Be Taught by Qualified Instructors[g]	Elementary	14	16	18	20	24	25
	Middle	16	20	20	22	25	28
	High	12	16	18	20	24	25
District Required to Provide Training for PE Instructors[h]	Elementary	2	2	4	4	6	6
	Middle	2	2	2	2	4	4
	High	2	2	2	2	4	4

		SY 2006-07 (%)	SY 2007-08 (%)	SY 2008-09 (%)	SY 2009-10 (%)	SY 2010-11 (%)	SY 2011-12 (%)
PE Waivers Prohibited[i]	Elementary	6	6	8	8	8	8
	Middle	6	6	6	6	6	6
	High	6	6	6	6	6	6
School Districts May Apply for Waiver from State-Level PE Requirement[j]	Elementary	n/a	n/a	2	2	2	—
	Middle	n/a	n/a	2	2	2	—
	High	n/a	n/a	2	2	2	—
Students Required to Participate in an Annual Health Assessment[k]	Elementary	2	0	0	0	0	4
	Middle	2	0	0	0	0	2
	High	2	0	0	0	0	2

NOTE: GPA = grade point average; PE = physical education; SY = school year.

[a]Definitely addressed; any mention of PE.

[b]Clear that district has a PE curriculum/program for each grade (e.g., policy describes a general PE curriculum/program for "K-12," "all levels," or "all students"), or clear that PE program is provided for "K-12," "all levels," or "all grades" and mentions time requirements (without using the word "curriculum").

[c]Or requires schools to follow National Association for Sport and Physical Education (NASPE) standards or the standards of the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) (which embeds NASPE).

[d]Or requires schools to follow NASPE standards or the standards of the AAHPERD.

[e]Requires PE to teach lifetime activities, or requires schools to follow NASPE standards or the standards of AAHPERD, or focuses on self-assessment through a "Fitnessgram" or "Activitygram."

[f]Specifies competency assessment: requires a competency assessment or assessment of knowledge, skill, or practice as part of the physical education curriculum.

[g]Requires that physical education be taught by a licensed instructor, or requires schools to follow NASPE standards or the standards of the AAHPERD.

[p]Provision of PE training is required for PE teachers. If PE-specific training is provided for a broader set of staff or teachers, it is assumed that PE teachers are included and will receive training as well.

[i]Prohibits substituting other activities, including physical activities, for physical education.

[j]n/a = variable not compiled prior to SY 2008-2009.

[k]Type of assessment is specified and required, assessment is annual, and a positive approach to communicating results is mentioned.

SOURCE: Chiriqui et al., in press.

TABLE 2-6 Trends in State Policies Related to Physical Activity for Elementary, Middle, and High Schools

		SY 2006-07 (%)	SY 2007-08 (%)	SY 2008-09 (%)	SY 2009-10 (%)	SY 2010-11 (%)	SY 2011-12 (%)
Moderate to Vigorous Physical Activity Addressed but Is Less Than 50% of Time Spent in PE[a]	Elementary	16	18	24	25	31	29
	Middle	12	12	14	14	20	18
	High	10	10	10	12	18	16
At Least 50% of Time Spent in PE Must Be Devoted to Moderate to Vigorous Physical Activity	Elementary	0	0	0	0	0	0
	Middle	0	0	0	0	0	0
	High	0	0	0	0	0	0
Physical Activity Goals Specified[b]	Elementary	35	37	39	41	45	47
	Middle	27	27	33	35	35	35
	High	24	24	27	29	29	29
Physical Activity outside of PE for Every Grade Level[c]	Elementary	16	16	20	22	24	24
	Middle	10	8	10	12	12	10
	High	8	6	6	6	6	4
Specific Amount of Time for Required Physical Activity[d]	Elementary	n/a	n/a	14	16	18	20
	Middle	n/a	n/a	6	8	8	8
	High	n/a	n/a	2	2	2	2
Physical Activity Opportunities Provided throughout the Day[e]	Elementary	2	2	2	2	2	2
	Middle	2	2	2	2	2	2
	High	2	2	2	2	2	2
Physical Activity Not to Be Used as Punishment[f]	Elementary	4	4	4	4	4	2
	Middle	4	4	4	4	4	2
	High	4	4	2	2	2	0
Daily Recess Required and Specified	Elementary	6	6	8	10	12	10

NOTE: PE = physical education; SY = school year.

[a]Any of the following: suggested, duration is not specified, or duration is less than 50% of class time.

[b]Includes goals for physical activity that are designed to promote student wellness in a manner that the local education agency determines is appropriate.

[c]Clear that each grade will receive physical activity outside of physical education.
[d]Variable not added until SY 2008-2009.
[e]Not including recess. Either of the following is required: regular physical activity throughout the school day or training for teachers in activities that incorporate physical activity throughout the day.
[f]Prohibits using extra or restricted physical activity as a punishment, with exceptions for individualized academic plans or individualized education plans.
SOURCE: Chiriqui et al., in press.

Trends in State Laws Related to Physical Education and Physical Activity

Tables 2-4 and 2-5 show an increase over time in the number of state laws addressing physical education, revealing that by school year (SY) 2011-2012, nearly all states (98 percent) across all grade levels mentioned physical education in a state-level law. However, very few states have a strong law, with only 10, 2, and 2 percent of laws that address requirements for elementary, middle, and high schools, respectively, meeting national recommendations for at least 150 (for elementary schools) and at least 225 minutes (for secondary schools) weekly of physical education, and with virtually no change occurring in these policies from SY 2006-2007 to SY 2011-2012. Similarly, very little change has occurred across states during the past 6 years with respect to requiring daily physical education, and most states continue to allow physical education waivers with the exception of 8, 6, and 6 percent of states prohibiting them at the elementary, middle, and high school levels, respectively. Some positive changes in state laws have occurred, including steady increases across all grades in the number of states requiring that schools promote a physically active lifestyle and that physical education be taught by qualified instructors. Some slight change even has taken place across all grade levels in the number of states requiring a specific teacher-student ratio for physical education classes.

Currently no states require that at least 50 percent of time spent in physical education be devoted to vigorous or moderate-intensity physical activity. Some improvement has occurred over the past 6 years in states having a requirement for any percentage of time in vigorous or moderate-intensity physical activity in physical education, with elementary schools seeing the largest increase in such requirements. Further, fewer than one-quarter of all states require physical activity outside of physical education for all grade levels and only about 1 in 5 states require daily recess at the elementary level. Requirements for physical activity outside of physical education decrease significantly when addressing middle and high schools, and recess policies only apply to elementary schools. Finally, there has been a decline in the percent of states prohibiting using physical activity as a punishment. Examining these trends shows there are significant opportunities to enact and strengthen state level physical education and physical activity laws.

Trends in States Reporting on Physical Education and Physical Activity Requirements and Fitness Assessments

Implementing laws that require a reporting mechanism are one way to monitor law compliance. The reporting measures presented in Table 2-7 show trends in state and school district policies that address some kind of formal reporting to stakeholders, such as a School Board, parents, the state, etc. The requirement may include reporting on mandatory minutes or participation rates for physical education and other school-based physical activity. For example, the law/policy might state: "The district will report to the State Board of Education by June 15th (each year) the daily physical education/physical activity for students by school, grade, and class." Policies may also require reporting of the results of fitness assessments (e.g., Fitnessgram®, Presidential Fitness Test, Activitygram) to parents, the school board, or the state. The requirement might read: "Students' health-related fitness reports will be shared with parents/legal guardians at grades 5, 8, and high school."

Table 2-7 shows that most states and districts currently do not require formal reporting on physical education and physical activity in schools.

TABLE 2-7 Trends in States Mandating Reporting on Physical Education and Physical Activity Requirements and Fitness Assessments

		SY 2010-2011 (%)	SY 2011-2012 (%)
Reporting on PE/PA Requirements Not Mentioned/No Policy	Elementary	86	82
	Middle	92	86
	High	92	86
Reporting on PE/PA Requirements Suggested/Required but Vague	Elementary	4	6
	Middle	4	8
	High	4	6
Districts Required to Report on PE/PA Requirements	Elementary	10	12
	Middle	4	6
	High	4	6
Reporting on Fitness Assessments Not Mentioned/No Policy	Elementary	96	92
	Middle	96	92
	High	96	92
Reporting on Fitness Assessments Suggested/Required but Vague	Elementary	0	0
	Middle	0	0
	High	0	0
Districts Required to Report on Fitness Assessments	Elementary	4	8
	Middle	4	8
	High	4	8

NOTE: Variables not added until SY 2010-2011. PA = physical activity; PE = physical education; SY = school year.
SOURCE: Chiriqui et al., in press.

Trends in School District Wellness Policies

In addition to state laws, Bridging the Gap researchers annually collect and code congressionally mandated school district wellness policies, which are required to include physical activity goals. District wellness policies and other relevant school district policy documents (e.g., regulations, curriculum standards) are gathered annually from a nationally representative sample of school districts (N = ~600 school districts/year). Web searches are conducted, and telephone and mail follow-up with districts is used, if necessary, to identify the policies. District-level policies are coded using the same 0, 1, 2 scoring described above for state laws.

Figures 2-13 through 2-16 show that local school districts have been steadily enacting and strengthening the physical education and physical activity provisions included in local wellness policies since the policies' initial required enactment at the beginning of school year (SY) 2006-2007. Although addressing physical education is not required for local wellness policies, about 90 percent of students attend school in districts that have this provision across all grade levels.

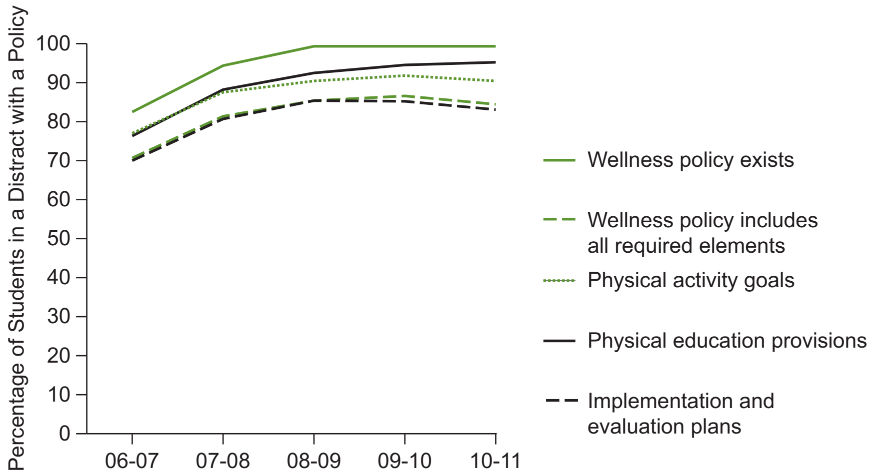

FIGURE 2-13 Progress in adopting district wellness policies and required policy components.
SOURCE: Chriqui et al., 2012.

School districts have steadily increased the number of physical education provisions included in local wellness policies, and districts also are increasingly enacting strong provisions that require/are aligned with national recommendations. However, provisions on physical education continue to vary in strength. Consistent with the absence of strong state laws, few districts have implemented strong policies meeting the national standards of at least 150 physical education minutes weekly at the elementary level and at least 225 physical education minutes weekly at the middle and high school levels.

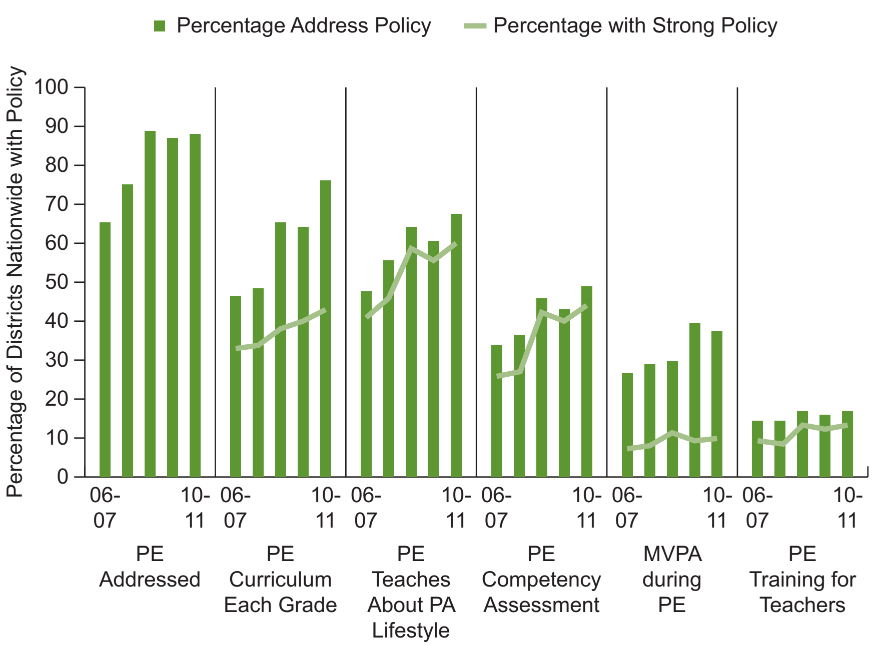

FIGURE 2-14 Selected physical education* provisions in district wellness policies, by year.
NOTE: Physical education is not a required element of wellness policies, but is commonly addressed. MVPA = moderate to vigorous physical activity; PA = physical activity; PE = physical education.
SOURCE: Chriqui et al., 2012.

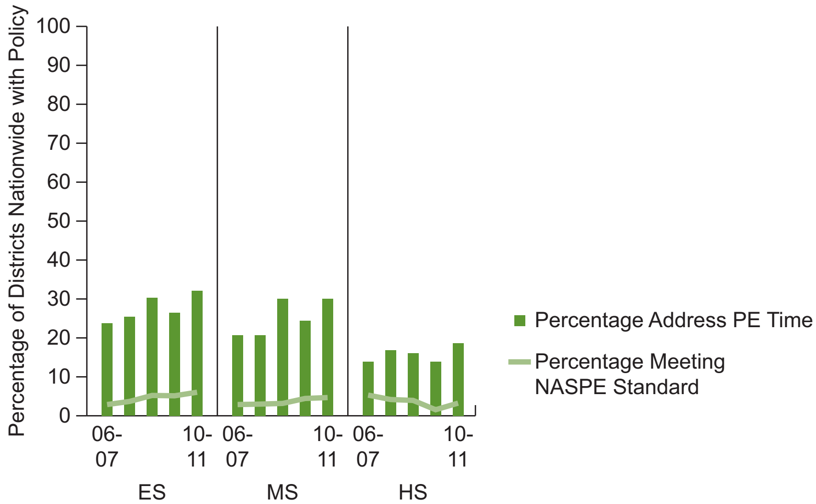

FIGURE 2-15 Provisions on physical education time in district wellness policies, by year and grade level.
NOTE: ES = elementary school; HS = high school; MS = middle school; NASPE = National Association for Sport and Physical Education; PE = physical education.
SOURCE: Chriqui et al., 2012.

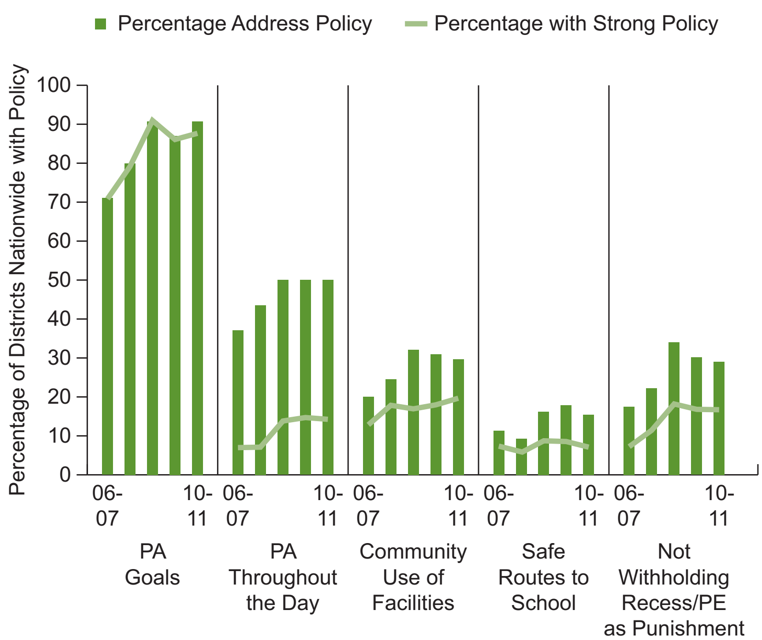

FIGURE 2-16 Selected physical activity provisions in district wellness policies by year.
NOTE: PA = physical activity; PE = physical education.
SOURCE: Chriqui et al., 2012.

As with physical education provisions, school districts have steadily been increasing the number of other physical activity-related provisions included in wellness policies. However, fewer than 10 percent of districts include language ensuring efforts by local schools to promote safe routes to school, and only one in five districts require that communities be permitted to use school facilities for physical activities outside of school hours and prohibit withholding recess/physical education as a punishment.

Evidence showing that strong policies are associated with increased physical education and/or physical activity during the school day is growing. For example, studies conducted by Barroso and colleagues (2009), Evenson and colleagues (2009), and Kelder and colleagues (2009), and all show an increase in the number of weekly physical education minutes after the passage of state laws requiring daily physical education. However, implementation of state policies varied across the affected school districts (Kelder et al., 2009; Evenson et al., 2009), and some schools cited competing time demands as a barrier to full implementation (Evenson et al., 2009). More recently, Perna and colleagues (2012) examined the association between strong state laws and weekly physical education time using the C.L.A.S.S. state policy and SHPPS school-level physical education time-related measures. They found that in states with stronger laws, 27-60 more minutes of physical education was provided weekly in elementary and middle schools compared with states with weak or no laws. However, they found no differences in weekly physical education minutes in high schools regardless of the stringency of state laws. In another study using the C.L.A.S.S. state policy data, Carlson and colleagues (2013) examined the association between the strength of state laws and the level of implementation, monitoring and enforcement at the school level by interviewing state-level physical education coordinators. They found no policies with strong language and eight policies with moderate or weak language. They also found that none of the interviewed coordinators knew the level of implementation of the policies at the local level. In general, they found that information on school-level implementation was lacking because there were no policies in place for monitoring or enforcement. More locally, Schwartz and colleagues (2012) examined the relationship between the strength and comprehensiveness of all School District Wellness Policies in the state of Connecticut and school-level implementation. They found that schools located in districts with stronger, more comprehensive wellness policies were more likely to fully implement the policies. Finally, examining the association between the presence of stronger state and district-level policies and both weekly physical education and recess minutes in elementary schools, Slater and colleagues (2012) found laws at both levels to be associated with schools providing at least 150 weekly minutes of physical education. They also found that weak state laws were associated with schools offering at least 20 minutes of daily recess. As both the SHPPS and Bridging the Gap data show, however, schools are likely to provide recess regardless of whether there is an existing state- or district-level policy requiring it.

Declining Student Enrollment in Physical Education

The data also illustrate the slippage in physical education that can occur at both the state and local levels when weaker policies in this area are enacted (see also Figure 1-2 in Chapter 1). For example, the 2012 *Shape of the Nation Report* (NASPE and AHA, 2012) provides a current picture of physical education in the American education system. The 2012 survey found areas of both improvement and decline in the status of physical education. As all policy data sources highlighted in this report show the majority of states mandate physical education at all school levels. According to the 2012 *Shape of the Nation Report*, however, most schools do not require a specific amount of instructional time, and more than half allow exemptions, waivers, and/or substitutions for physical education (NASPE and AHA, 2012). Further, the 2011 YRBS found that 48-69 percent of students did not attend physical education classes in an average week.

The 2012 *Shape of the Nation Report* also shows that in most states, all children in elementary and middle schools are required to take physical education when it is offered. In high school, however, students may have flexibility in when they take physical education as long as they satisfy the requirement for graduation. This flexibility creates a situation in which not all high school students take physical education at the same time. According to CDC 2011 data, in high schools where physical education was not offered daily, 68 percent of students in 9th grade, 55 percent in 10th grade, 43 percent in 11th grade, and 39 percent in 12th grade attended physical education on one or more days during a typical week. In schools where physical education is offered daily, 41 percent of students in 9th grade, 33 percent in 10th grade, 25 percent in 11th grade, and 24 percent in 12th grade attended daily physical education classes (CDC, 2012b). Across the nation, 52 percent of high school students attend physical education at least 1 day per week, and only 31.5 percent have daily physical education (CDC, 2012b).

Trends in Policies on After-School Programs

After-school programs normally held before and/or after school offer additional opportunities to increase physical activity among youth. These opportunities also can be influenced by policy. Currently, no national surveillance system monitors the existence of such policies. However, Beets and colleagues (2010b) conducted a systematic review of state-level after-school program organizations to identify existing standards and policies, which they found in 47 states. They found that only about one-third of states' written documentation specifically addressed providing opportunities for physical activity during after-school programs, and only 4 states had comprehensive language specifying training requirements, student/staff ratios, planning/evaluation of after-school physical activity, and time allocated for physically activity. In a follow-up study, Beets and colleagues (2010a) examined the amounts of physical activity children obtained while attending after-school programs in states with comprehensive policies addressing physical activity and found that children did not meet the physical activity levels outlined in the policies. Given the variation in the language of existing policies, they suggest the need to develop a model policy for incorporating physical activity into after-school programs.

Recently, the Healthy Out of School Time Coalition was formed, consisting of individuals from major after-school program organizations and policy leaders, to develop evidenced-based Healthy Eating and Physical Activity Quality Standards for use in out-of-school-time settings. The final consensus document recommends that after-school programs provide children "with at least 30 minutes of organized, inclusive physical activity for every three hours of program time" (Wiecha et al., 2012, p. 574). In addition to this recommendation, the standards address policy content, the provision of staff training, and appropriate program infrastructure and curriculum, as well as the provision of supportive social and physical environments.

Discrepancy between Policy and Reality

Recent data (NASPE and the AHA, 2010) show that although many states mandate that physical education be included in the school curriculum, schools seldom adhere to specific guidelines regarding time allocation (McCullick et al., 2012). Moreover, although elementary, middle, and high school students report meeting the national recommendation for minutes per week or per day of physical education, this may not be true in actuality. On the school schedule, the minutes allotted for physical education may be presented and reported, but the actual number of minutes in which students are engaged in physical education remains undocumented. Nor is it clear whether the time allotted for physical education was canceled or shortened on a weekly basis because of assemblies, disciplinary actions, or other school activities. Seldom are time allocations for physical education enforced or are schools held accountable for policy enforcement.

Overall, policies requiring increased physical education and physical activity at school each day have the potential to affect large numbers of children and adolescents and are an effective strategy for promoting regular physical activity. However, external and internal barriers to policy implementation need to be considered, as is highlighted by a recent study (Amis et al., 2012) finding that priority given to standardized testing and varsity sports over physical education, as well as insufficient resources and inundation with new policy requirements, all serve as barriers to successful implementation of strong policies on physical activity. These findings are supported by results of a study conducted with California school board members (Cox et al., 2011), who cited most frequently as barriers to policy implementation lack of adequate funding; limited time during the school day; and competing priorities, such as core curriculum classes and standardized testing. (See this discussion of these issues in Chapters 5 and 6.)

Existing evidence also shows some grade-level, racial/ethnic, and socioeconomic disparities in participation in physical education across secondary schools (i.e., grades 8-12). Johnston and colleagues (2007) conducted a national study of 504 middle/junior high and high schools from a representative sample of geographic (urban/rural) and regional locations. The overall requirement for participation in physical education drops sharply from 8th to 12th grade—87 percent in 8th grade; 47 percent in 10th grade; and 20 percent in 12th grade. The evidence also indicates a significant decrease in the minutes per week of physical education—from 172.3 minutes per week in 8th grade, to 163.9 minutes in 10th grade, to 88.6 minutes in 12th grade. The number of days per week on which students in 8th, 10th, and 12th grades receive physical education also declines from 3.5 to 2.7 to 1.4 days, respectively.

From 8th to 12th grade, moreover, the percentage of students taking physical education is lower in schools attended by Hispanic students than in those attended by white students (Johnston et al., 2007). They found no significant differences for African American students. Johnston and colleagues (2007) also found that schools with a greater percentage of students of higher socioeconomic status were more likely to require students to take physical education and actually have students take it than those schools with a greater percentage of students of lower socioeconomic status. These findings suggest that differences do exist in the provision of physical education across grade, race/ethnicity, and socioeconomic status in secondary schools. However, in general, data on differences in the percentage of students taking physical education by race/ethnicity and socioeconomic status is sparse. Thus, it is important that schools closely examine and address these disparities, but there is also a need to examine these disparities more closely.

SUMMARY

Few children in the United States, probably no more than half, meet the guideline of at least 60 minutes of vigorous or moderate-intensity physical activity daily. The reason this statistic cannot be more specific is that different measurement methods yield different estimates. Some consistent patterns can be reported, however. The proportion meeting the guideline declines with age, with more elementary school children than middle and high school students achieving the goal, and boys are more likely than girls to meet the guideline regardless of whether the information is self-reported or derived from objective measurement with accelerometers or pedometers. There are no consistent patterns across different ethnic groups or socioeconomic classes, although fewer data are available with which to examine these issues. One can also say with reasonable certainty that over the past 30-40 years, probably even longer, the volume and intensity of daily physical activity among youth have gradually declined.

During about half of their waking hours, youth engage in activities with low rates of energy expenditure—1.5 METs or less—commonly called sedentary activities. Evidence is clear for adults and accumulating for children that shifting time spent in sedentary activities to even light-intensity physical activity is beneficial from a health perspective.

Remarkably little information exists about the physical activity behaviors of students during school hours or in school-related activities. Even the nation's best public health surveillance systems do not obtain that information. Aside from a few good one-time surveys of physical activity during physical education classes, little information is available on students' physical activity during the school day or in after-school programs. This lack of information is surprising given that school-related physical activity must be a large component of the overall volume of physical activity of youth, and that vigorous or moderate-intensity physical activity is vital to students' healthy growth and development, and is associated with academic performance and classroom behavior (see Chapters 3 and 4). Substantial evidence exists that the volume of student's vigorous or moderate-intensity physical activity can be increased through daily physical education, recess, classroom physical activity, active transport to school, and before- and after-school activities (see Chapter 6).

State and district level laws and policies related to physical activity have the potential to exert a positive influence on the physical activity behaviors of large numbers of children and adolescents. Evidence that such laws and policies have not only potential but actual influence is emerging. Also emerging is evidence of slippage between the intent and implementation of these policies, such that their ultimate impact is commonly less, sometimes appreciably so, than expected. The factors that create an effective policy are still being elucidated. Policies that include required reporting of outcomes, provision of adequate funding and easing of competing priorities appear more likely to be effective, as well as implemented. Further evaluation of policies on physical activity and physical education is needed to fully understand their impact in changing health behavior.

Monitoring of state and district laws and policies has improved over the past decade. In general, the number of states and districts with laws and policies pertaining to physical education has increased, although many such policies remain weak. For example, most states and districts have policies regarding physical education but few require daily physical education or a minimum number of minutes of physical education per week. Although some comprehensive national guidelines exist, more are needed to define quality standards for school-based physical activity policies so that more uniform programs and practices can be created across states, school districts, and ultimately schools.

An important need going forward will be augmentation of the few monitoring systems that exist for school-related physical activity behaviors. It is important to know not only how much vigorous or moderate-intensity physical activity youth are performing but also how much of that activity is taking place in each segment of the school day (i.e., physical education, recess, classroom, transportation to and from school, school-related before- and after-school activities).

The YRBS, the NHANES, and Monitoring the Future provide much useful information but not enough about physical activity during and related to school. Such national surveys are not designed to provide local or even state estimates. State departments of education, local school districts, and state and local health departments will need to collaborate to provide adequate monitoring.

Finally, in addition to improved monitoring of physical activity behaviors, there is a need for augmented monitoring of physical activity-related guidelines, policies, and practices at the federal, state, and local levels. Surveillance of both student behavior and policy is necessary.

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3
Physical Activity and Physical Education: Relationship to Growth, Development, and Health

Key Messages

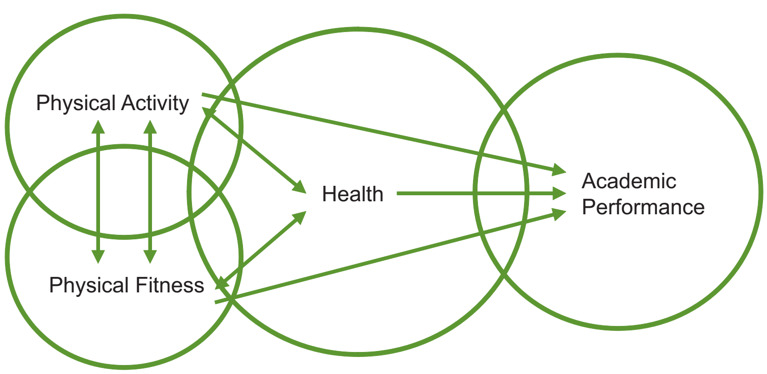
- Regular physical activity promotes growth and development and has multiple benefits for physical, mental, and cognitive health that undoubtedly contribute to learning.
- Specifically, physical activity reduces the risk for heart disease, diabetes mellitus, osteoporosis, high blood pressure, obesity, and metabolic syndrome and improves various other aspects of health and fitness, including aerobic capacity, muscle and bone strength, flexibility, insulin sensitivity, and lipid profiles and reduces stress, anxiety and depression.
- Physical activity can improve mental health by decreasing and preventing conditions such as anxiety and depression, as well as improving mood and other aspects of well-being
- Physical activity programming specifically designed to do so can improve psychosocial outcomes such as self-concept, social behaviors, goal orientation and most notably self-efficacy. These attributes in turn are important determinants of current and future participation in physical activity.
- Sedentary behaviors such as sitting and television viewing contribute to health risks both because of and independently of their impact on physical activity.
- Health-related behaviors and disease risk factors track from childhood to adulthood, indicating that early and ongoing opportunities for physical activity are needed for maximum health benefit.
- To be effective, physical activity programming must align with the predictable developmental changes in children's exercise capacity and motor skill, which affect the activities in which they can successfully engage.
- Frequent bouts of physical activity throughout the day yield short-term benefits for mental and cognitive health while also providing opportunities to practice skills and building confidence that promotes ongoing engagement in physical activity.
- Distinct types of physical activity address unique health concerns and contribute in distinct ways to children's health, suggesting that a varied regimen including aerobic and resistance exercise, structured and unstructured opportunities, and both longer sessions and shorter bouts will likely confer the greatest benefit.

The behaviors and traits of today's children, along with their genetics, are determinants of their growth and development; their physical, mental, and psychosocial health; and their physical, cognitive, and academic performance. Technological advances of modern society have contributed to a sedentary lifestyle that has changed the phenotype of children from that of 20 years ago. Children today weigh more and have a higher body mass index (BMI) than their peers of just a generation earlier (Ogden et al., 2012). Behaviorally, most children fail to engage in vigorous or moderate-intensity physical activity for the recommended 60 minutes or more each day, with as many as one-third reporting no physical activity in the 5 days preceding a recent survey (CDC, 2012). This lack of participation in physical activity has contributed to a greater prevalence of pediatric obesity, a decrease in fitness (e.g., flexibility, muscular strength, cardiorespiratory capacity), and a greater risk for disease (Boreham and Riddoch, 2001; Eisenmann, 2003; Malina, 2007; Steele et al., 2008). (See Box 3-1 for an overview of the relationship between physical activity and physical fitness.)

BOX 3-1
Physical Activity and Physical Fitness

As noted in Chapter 1 (see the box titled "Key Terms Used in This Report"), physical activity, a behavior, is defined as bodily movement that increases energy expenditure, whereas fitness is a physiological trait, commonly defined in terms of cardiorespiratory capacity (e.g., maximal oxygen consumption), although other components of fitness have been defined (IOM, 2012b). Exercise, a subset of physical activity, is "planned, structured and repetitive" (Carpersen et al., 1985) and designed to target a particular outcome, for example, cardiorespiratory capacity or another component of fitness. Physical education provides opportunities for developmentally appropriate physical activity, usually structured to promote motor skill development, fitness, and health.

The relationship between physical activity and physical fitness is complex and bidirectional. Numerous studies have shown a significant relationship between physical activity and cardiorespiratory fitness, which may mean that physical activity improves fitness or that physically fit individuals choose to engage in physical activity more than their less fit peers, or both. Experimental studies have shown that exercise training improves fitness (Malina et al., 2004), although the response is variable and clearly influenced by genetics (Bouchard, 2012), and physical activity and fitness are independently related to health and academic performance (see the figure below).



Conceptual framework illustrating relationships among physical activity, physical fitness, health, and academic performance.

While more can always be learned, the evidence for the health benefits of physical activity is irrefutable (HHS, 1996, 2008). Adults engaged in regular physical activity have lower rates of chronic disease (e.g., coronary heart disease, cardiovascular disease, type 2 diabetes, hypertension, osteoporosis and some cancers) and are less likely to die prematurely (HHS, 1996, 2008; Bauman, 2004). And while the ill effects of chronic disease are manifested mainly in adults, it is increasingly understood that the development of these conditions starts in childhood and adolescence (Hallal et al., 2006; Cook et al., 2009; Halfon et al., 2012). It appears evident, then, that promotion of health-enhancing behaviors must also start early in life. Indeed, growing evidence points to long-term effects of child and adolescent physical activity on adult morbidity and mortality in addition to its more immediate effects (Hallal et al., 2006) (Figure 3-1).

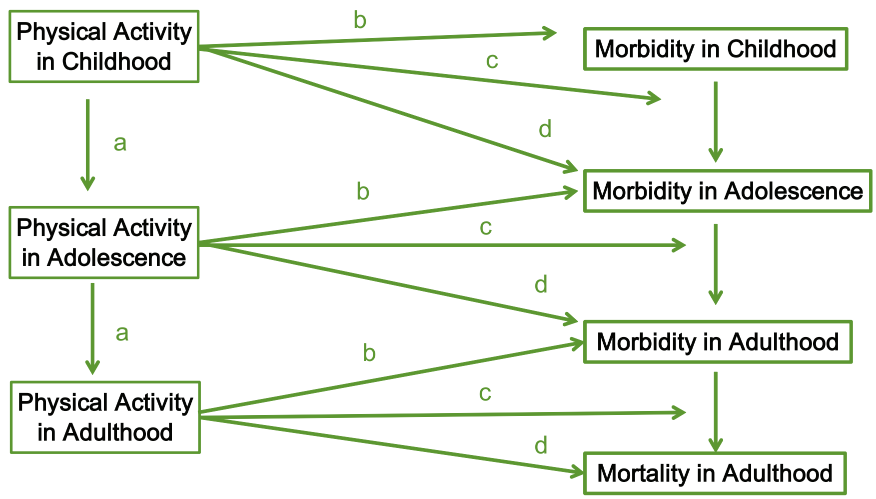


FIGURE 3-1 Conceptual model of how physical activity in childhood and adolescence is beneficial to health. Physical activity has both immediate and long-term health benefits: (a) Physical activity tends to track; early physical activity is associated with physical activity in subsequent life stages. (b) Physical activity reduces morbidity risk in childhood and adolescence. (c) Physical activity may be important treating and slowing some diseases in children and adolescents (d) Early physical activity influences future morbidity (e.g., physical activity in childhood and adolescence may reduce fracture risk later in life).
SOURCE: Adapted from Hallal et al., 2006.

Evidence for both direct and indirect health effects of physical activity has been reported (Hallal et al., 2006), and the need for ongoing participation in physical activity to stimulate and maintain the chronic adaptations that underlie those benefits is well documented. To understand the relationship of physical activity and aerobic fitness to health during childhood, it is important first to recognize the developmental changes that occur throughout maturation. During the early stages of adolescence, for example, participation in physical activity and corresponding physical fitness begin to decline (Duncan et al., 2007). Such differences across stages of development highlight the importance of examining the effects of growth and maturation on physical and cognitive health. Accordingly, this chapter reviews how physical activity may influence developmental processes and other aspects of somatic growth and maturation. A complete review of the effects of physical activity on all tissues and systems is beyond the scope of this report. Rather, the focus is on components of body composition and systems that underlie engagement in physical activity, physical fitness and chronic disease risk and that in turn influence other aspects of health and academic performance (discussed in Chapter 4). Addressed in turn is the relationship between physical activity and physical, mental, and psychosocial health. Structural and functional brain maturation and how physical activity may influence those developmental processes and cognitive health is also reviewed in chapter 4.

PHYSICAL HEALTH

This section reviews what is known about the relationship between physical activity and (1) somatic growth, development, and function, and (2) health- and performance-related fitness.

Somatic Growth, Development, and Function

Growth occurs through a complex, organized process characterized by predictable developmental stages and events. Although all individuals follow the same general course, growth and maturation rates vary widely among individuals. Just as it is unrealistic to expect all children at the same age to achieve the same academic level, it is unrealistic to expect children at the same age to have the same physical development, motor skill, and physical capacity. Regular physical activity does not alter the process of growth and development. Rather, developmental stage is a significant determinant of motor skill, physical capacity and the adaptation to activity that is reasonable to expect (see Box 3-2).

BOX 3-2
Growth, Development, and Maturation

Growth
Growth is the normal process of increase in size as a result of accretion of tissues characteristic of the organism; growth is the dominant biological activity for most of the first two decades of life. Changes in size are the outcome of an increase in cell number (hyperplasia), an increase in cell size (hypertrophy), and an increase in intercellular substances (accretion).

Development
Encompassing growth and maturation, development denotes a broader concept; when used in a biological context, development refers to differentiation and specialization of stem cells into different cell types, tissues, organs, and functional units. Development continues as different systems become functionally refined. Development also refers to the acquisition and refinement of behavior relating to competence in a variety of interrelated domains, such as motor competence, and social, emotional, and cognitive competence.

Maturation
Maturation is the timing and tempo of progress toward the mature state and vary considerably among individuals and variation in progress toward the mature state over time implies variation in rate of change. Two children may be the same size but at different points on the path to adult size or maturity.

Developmental Stages

Postnatal growth is commonly divided into three or four age periods. Infancy spans the first year of life. Childhood extends from the end of infancy to the start of adolescence and is often divided into early childhood, which includes the preschool years, and middle childhood, which includes the elementary school years, into the fifth or sixth grade. Adolescence is more difficult to define because of variation in its onset and termination although it is commonly defined as between 10 and 18 years of age (WHO, 1986). The rapid growth and development of infancy continues during early childhood, although at a decelerating rate, whereas middle childhood is a period of slower, steady growth and maturation. Differences between boys and girls are relatively small until adolescence, which is marked by accelerated growth and attainment of sexual maturity (Tanner, 1962).

Across developmental stages, neurological development and control of movement advances in cephalocaudal and proximodistal directions; that is, it advances "head to toe" (cephalocaudal) and "midline to periphery" (proximodistal), while predictable changes in body proportions also occur. For example, the head accounts for 25 percent of recumbent length in an infant and only 15 percent of adult height, while the legs account for 38 percent of recumbent length at birth and 50 percent of adult height. These changes in body proportions occur because body parts grow at different rates. From birth to adulthood, as the head doubles in size, the trunk triples in length, and arm and leg lengths quadruple.

Coincident with these changes in body proportions, and in part because of them, the capacity to perform various motor tasks develops in a predictable fashion. For example, running speed increases consistent with the increase in leg length. Neurological development also determines skill progression. Young children, for example, when thrown a ball, catch it within the midline of the body and do not attempt to catch it outside the midline or to either side of the body. As proximodistal development proceeds, children are better able to perform tasks outside their midline, and by adolescence, they are able to maneuver their bodies in a coordinated way to catch objects outside the midline with little effort.

Physically active and inactive children progress through identical stages. Providing opportunities for young children to be physically active is important not to affect the stages but to ensure adequate opportunity for skill development. Sound physical education curricula are based on an understanding of growth patterns and developmental stages and are critical to provide appropriate movement experiences that promote motor skill development (Clark, 2005). The mastery of fundamental motor skills is strongly related to physical activity in children and adolescents (Lubans et al., 2010) and in turn may contribute to physical, social, and cognitive development. Mastering fundamental motor skills also is critical to fostering physical activity because these skills serve as the foundation for more advanced and sport-specific movement (Clark and Metcalfe, 2002; Robinson and Goodway, 2009; Lubans et al., 2010; Hands et al., 2009). Physical activity programs, like physical education, should be based on developmentally appropriate motor activities to foster self-efficacy and enjoyment and encourage ongoing participation in physical activity.

Biological Maturation

Maturation is the process of attaining the fully adult state. In growth studies, maturity is typically assessed as skeletal, somatic, or sexual. The same hormones regulate skeletal, somatic, and sexual maturation during adolescence, so it is reasonable to expect the effect of physical activity on these indicators of maturity to be similar. Skeletal maturity is typically assessed from radiographs of the bones in the hand and wrist; it is not influenced by habitual physical activity. Similarly, age at peak height velocity (the most rapid change in height), an indicator of somatic maturity, is not affected by physical activity, nor is the magnitude of peak height velocity, which is well within the usual range in both active and inactive youth. Discussions of the effects of physical activity on sexual maturation more often focus on females than males and, in particular, on age at menarche (first menses). While some data suggest an association between later menarche and habitual physical activity (Merzenich et al., 1993), most of these data come from retrospective studies of athletes (Clapp and Little, 1995). Whether regular sports training at young ages before menarche "delays" menarche (later average age of menarche) remains unclear. While menarche occurs later in females who participate in some sports, the available data do not support a causal relationship between habitual physical activity and later menarche.

Puberty is the developmental period that represents the beginning of sexual maturation. It is marked by the appearance of secondary sex characteristics and their underlying hormonal changes, with accompanying sex differences in linear growth and body mass and composition. The timing of puberty varies, beginning as early as age 8 in girls and age 9 in boys in the United States and as late as ages 13-15 (NRC/IOM, 1999). Recent research suggests that the onset of puberty is occurring earlier in girls today compared with the previous generation, and there is speculation that increased adiposity may be a cause (Bau et al., 2009; Rosenfield et al., 2009). Conversely, some data suggest that excess adiposity in boys contributes to delayed sexual maturation (Lee et al., 2010). Pubescence, the earliest period of adolescence, generally occurs about 2 years in advance of sexual maturity. Typically, individuals are in the secondary school years during this period, which is a time of decline in habitual physical activity, especially in girls. Physical activity trends are influenced by the development of secondary sex characteristics and other physical changes that occur during the adolescent growth spurt, as well as by societal and cultural factors. Research suggests that physical inactivity during adolescence carries over into adulthood (Malina, 2001 a,b; CDC, 2006).

It is critical that adolescents be offered appropriate physical activity programs that take into account the physical and sociocultural changes they are experiencing, so they will be inspired to engage in physical activity for a lifetime. As discussed below, adequate physical activity during puberty may be especially important for optimal bone development and prevention of excess adiposity, as puberty is a critical developmental period for both the skeleton and the adipose organ.

Adolescence is the transitional period between childhood and adulthood. The adolescent growth spurt, roughly 3 years of rapid growth, occurs early in this period. An accelerated increase in stature is a hallmark, with about 20 percent of adult stature being attained during this period. Along with the rapid increase in height, other changes in body proportions occur that have important implications for sports and other types of activities offered in physical education and physical activity programs. As boys and girls advance through puberty, for example, biacromial breadth (shoulder width) increases more in boys than in girls, while increases in bicristal breadth (hip width) are quite similar. Consequently, hip to shoulder width ratio, which is similar in boys and girls during childhood, decreases in adolescent boys while remaining relatively constant in girls (Malina et al., 2004). Ratios among leg length, trunk length and stature also change during this period. Prior to adolescence, boys have longer trunks and shorter legs than girls (Haubenstricker and Sapp, 1980). In contrast, adolescent and adult females have shorter legs for the same height than males of equal stature. Body proportions, particularly skeletal dimensions, are unlikely to be influenced by physical activity; rather, body proportions influence performance success, fitness evaluation, and the types of activities in which a person may wish to engage. For example, there is evidence that leg length influences upright balance and speed (Haubenstricker and Sapp, 1980). Individuals who have shorter legs and broader pelvises are better at balancing tasks than those with longer legs and narrower pelvises, and longer legs are associated with faster running times (Dintiman et al., 1997). Also, longer arms and wider shoulders are advantageous in throwing tasks (Haubenstricker and Sapp, 1980), as well as in other activities in which the arms are used as levers. According to Haubenstricker and Sapp (1980), approximately 25 percent of engagement in movement-related activities can be attributed to body size and structure.

Motor Development

Motor development depends on the interaction of experience (e.g., practice, instruction, appropriate equipment) with an individual's physical, cognitive, and psychosocial status, and proceeds in a predictable fashion across developmental periods. Clark and Metcalfe (2002) provide an eloquent metaphor—"the mountain of motor development"—to aid in understanding the global changes seen in movement across the lifespan. Early movements, critical for an infant's survival, are reflexive and dominated by biology, although environment contributes and helps shape reflexes. This initial *reflexive period* is followed quickly by the *preadapted period*, which begins when an infant's movement behaviors are no longer reflexive and ends when the infant begins to apply basic movement skills (e.g., crawling, rolling, standing and walking) are accomplished before 12 months of age. The period of *fundamental motor patterns* occurs approximately between the ages of 1 and 7 years, when children begin to acquire basic fundamental movement skills (e.g., running, hopping, skipping, jumping, leaping, sliding, galloping, throwing, catching, kicking, dribbling, and striking). Practice and instruction are key to learning these skills, and a great deal of time in elementary school physical education is devoted to exploration of movement. Around age 7, during the so-called *context-specific period* of motor development, children begin to refine basic motor skills and combine them into more specific movement patterns, ultimately reaching what has been called *skillfulness*. *Compensation*, the final period of motor development, occurs at varying points across the life span when, as a result of aging, disease, injury, or other changes, it becomes necessary to modify movement.

While all children need not be "expert" in all movement skills, those who do not acquire the fundamental motor skills will likely experience difficulty in transitioning their movement repertoire into specific contexts and physical activity engagement (Fisher et al., 2005; Barnett et al., 2009; Cliff et al., 2009; Robinson et al., 2012). A full movement repertoire is needed to engage in physical activities within and outside of the school setting. Thus, beyond contributing to levels of physical activity, physical education programs should aim to teach basic fundamental motor skills and their application to games, sports, and other physical activities, especially during the elementary years (i.e., Fundamental Motor Patterns Context period). At the same time, it is important to be mindful of the wide inter-individual variation in the rate at which children develop motor skill, which is determined by their biological makeup, their rate of physical maturation, the extent and quality of their movement experiences, and their family and community environment.

An increasing amount of evidence suggests that people who feel competent in performing physical skills remain more active throughout their lives (Lubans et al., 2010). Conversely, those who are less skilled may be hesitant to display what they perceive as a short coming and so may opt out of activities requiring higher levels of motor competence (Stodden et al., 2008). Children who are less physically skillful tend to be less active than their skillful counterparts (Wrotniak et al., 2006; Williams et al., 2008; Robinson et al., 2012) and thus have a greater risk of overweight and obesity (Graf et al., 2004). Fundamental skills are the building blocks of more complex actions that are completed in sport, physical activity, and exercise settings. For example, throwing is a fundamental skill that is incorporated into the context-specific throw used in activities such as handball, softball, and water polo. Fundamental skills are of primary interest to both physical education teachers and coaches and physical education classes should be designed to challenge learners to develop their motor skills.

In 1998, the Centers for Disease Control and Prevention's (CDC) Division of Nutrition and Physical Activity organized a workshop to determine future directions for research on physical activity. The workshop convened 21 experts from a wide range of academic disciplines. One recommendation resulting from the proceedings was for future research to describe the temporal relationship between motor development and physical activity (Fulton et al., 2001), signifying the importance of better understanding the nature of the relationship between motor competence and physical activity. The assumption of this relationship is implied in multiple models of motor development (Clark and Metcalfe, 2002; Seefeldt, 1980; Stodden et al., 2008), which emphasize the importance of motor competence as a prerequisite for engagement in physical activity throughout the lifespan.

Two models that are commonly used to examine this relationship are Seefeldt's (1980) hierarchical order of motor skill development and the dynamic association model of Stodden and colleagues (2008). Seefeldt (1980) proposed a hierarchical order of motor skill development that includes four levels: reflexes, fundamental motor skills, transitional motor skills, (i.e., are fundamental motor skills performed in various combinations and with variations and are required to participate in entry-level organized sports, like throwing for distance, throwing for accuracy, and/or catching a ball while in motion), and specific sports skills and dances. With improved transitional motor skills, children are able to master complex motor skills (e.g., those required for playing more complex sports such as football or basketball). At the end of this developmental period, children's vision is fully mature. The progression through each level occurs through developmental stages as a combined result of growth, maturation, and experience. Seefeldt (1980) hypothesized the existence of a "proficiency barrier" between the fundamental and transitional levels of motor skill development. If children are able to achieve a level of competence above the proficiency barrier, they are more likely to continue to engage in physical activity throughout the lifespan that requires the use of fundamental motor skills. Conversely, less skilled children who do not exceed the proficiency barrier will be less likely to continue to engage in physical activity. Thus, it is assumed that "a confident and competent mover will be an active mover" (Clark, 2005, p. 44). For example, to engage successfully in a game of handball, baseball, cricket, or basketball at any age, it is important to reach a minimum level of competence in running, throwing, catching, and striking. The assumption of the existence of a relationship between motor competence and physical activity is at the "heart of our physical education programs" (Clark, 2005, p. 44). A thorough understanding of how this relationship changes across developmental stages is crucial for curriculum development, and delivery and teaching practices.

Lubans and colleagues (2010) recently examined the relationship between motor competence and health outcomes. They reviewed 21 studies identifying relationships between fundamental motor skills and self-worth, perceived physical competence, muscular and cardio-respiratory fitness, weight status, flexibility, physical activity and sedentary behavior. Overall, the studies found a positive association between fundamental motor skills and physical activity in children and adolescents, as well as a positive relationship between fundamental motor skills and cardio-respiratory fitness. Other research findings support the hypothesis that the most physically active preschool (Fisher et al., 2005; Williams et al., 2008; Robinson et al., 2012), elementary school-age (Bouffard et al., 1996; Graf et al., 2004; Wrotniak et al., 2006; Hume et al., 2008; Lopes et al., 2011), and adolescent (Okely et al., 2001) youth are also the most skilled.

An advantage of the "proficiency barrier" hypothesis proposed by Seefeldt (1980) is its recognition that the relationship between motor competence and physical activity may not be linear. Rather, the hypothesis suggests that physical activity is influenced when a certain level of motor competence is not achieved and acknowledges that below the proficiency barrier, there is bound to be substantial variation in children's motor competence and participation in physical activity. The proficiency barrier is located between the fundamental and transitional motor skill periods. The transition between these two levels of motor competence is expected to occur between the early and middle childhood years. Stodden and colleagues (2008) suggest that the relationship between motor competence and physical activity is dynamic and changes across time. In their model the "development of motor skill competence is a primary underlying mechanism that promotes engagement in physical activity" (p. 290).

The skill–physical activity relationship is considered reciprocal. It is expected that as motor skill competence increases, physical activity participation also increases, and that the increased participation feeds back into motor skill competence. The reciprocal relationship between motor skill competence and physical activity is weak during the early childhood years (ages 2 to 8) because of a variety of factors, including environmental conditions, parental influences, and previous experience in physical education programs (Stodden et al., 2008). Also, children at this age are less able to distinguish accurately between perceived physical competence and actual motor skill competence (Harter and Pike, 1984; Goodway and Rudisill, 1997; Robinson and Goodway, 2009; Robinson, 2011), and thus motor skill is not expected to strongly influence physical activity. The literature supports this hypothesis, as indicated by low to moderate correlations between motor skill competence and physical activity in preschool (Sääkslahti et al., 1999; Williams et al., 2008; Cliff et al., 2009; Robinson and Goodway, 2009; Robinson, 2011) and early elementary school–age children (Raudsepp and Päll, 2006; Hume et al., 2008; Morgan et al., 2008; Houwen et al., 2009; Ziviani et al., 2009; Lopes et al., 2011).

In older children, perceived competence is more closely related to actual motor skill competence. Older, low skilled children are aware of their skill level and are more likely to perceive physical activity as difficult and challenging. Older children who are not equipped with the necessary skills to engage in physical activity that requires high levels of motor skill competence may not want to display their low skill competence publicly. As children transition into adolescence and early adulthood, the relationship between motor skill competence and physical activity may strengthen (Stodden et al., 2008). Investigators report moderate correlations between motor skill competence and physical activity in middle school-age children (Reed et al., 2004; Jaakkola et al., 2009). Okely and colleagues (2001) found that motor skill competence was significantly associated with participation in organized physical activity (i.e., regular and structured experiences related to physical activity) as measured by self-report. A strength of the model of Stodden and colleagues (2008) is the inclusion of factors related to psychosocial health and development that may influence the relationship between motor skill competence and physical activity contributing to the development and maintenance of obesity. Other studies have found that perceived competence plays a role in engagement in physical activity engagement (Ferrer-Caja and Weiss, 2000; Sollerhed et al., 2008).

Motor skill competence is an important factor; however, it is only one of many factors that contribute to physical activity. For instance, three studies have reported negative correlations between girls' motor competence and physical activity (Reed et al., 2004; Cliff et al., 2009; Ziviani et al., 2009), suggesting that sex may be another determining factor. A possible explanation for these findings is that since girls tend to be less active than boys, it may be more difficult to detect differences in physical activity levels between high- and low-skilled girls. It is also possible that out-of-school opportunities for physical activity are more likely to meet the interests of boys, which may at least partially explain sex differences in physical activity levels (Le Masurier et al., 2005). Previous research suggests that in general, boys are more motor competent than girls (Graf et al., 2004; Barnett et al., 2009; Lopes et al., 2011) and that this trend, which is less apparent in early childhood, increases through adolescence (Thomas and French, 1985; Thomas and Thomas, 1988; Thomas, 1994), although one study reports that girls are more motor competent than boys (Cliff et al., 2009).

One component of motor competence is the performance of gross motor skills, which are typically classified into object control and locomotor skills. Consistent evidence suggests that boys are more competent in object control skills and girls are more competent in locomotor skills (McKenzie et al., 2004; Morgan et al., 2008; Barnett et al., 2009). In light of these sex differences, it is important to examine the relationships of object control and locomotor skills with physical activity separately for boys and girls. For boys, object control skills are more related to physical activity than are locomotor skills (Hume et al., 2008; Morgan et al., 2008; Williams et al., 2008; Cliff et al., 2009), whereas evidence suggests that the reverse is true for girls (McKenzie et al., 2002; Hume et al., 2008; Cliff et al., 2009; Jaakkola et al., 2009). Three studies report a significant relationship between balance and physical activity for girls but not boys (Reed et al., 2004; Ziviani et al., 2009). Cliff and colleagues (2009) suggest that object control and locomotor skills may be more related to boys' and girls' physical activity, respectively, because of the activity type in which each sex typically engages.

The relationship between motor competence and physical activity clearly is complex. It is quite likely that the relationship is dynamic and that motor competence increases the likelihood of participating in physical activity while at the same time, engaging in physical activity provides opportunities to develop motor competence (Stodden et al., 2008). Despite some uncertainty the literature does reinforce the important role of physical education in providing developmentally appropriate movement opportunities in the school environment. These opportunities are the only means of engaging a large population of children and youth and providing them with the tools and opportunities that foster health, development, and future physical activity.

Stature

Regular physical activity has no established effect on linear growth rate or ultimate height (Malina, 1994). Although some studies suggest small differences, factors other than physical activity, especially maturity, often are not well controlled. It is important to note that regular physical activity does not have a negative effect on stature, as has sometimes been suggested. Differences in height among children and adolescents participating in various sports are more likely due to the requirements of the sport, selection criteria, and inter-individual variation in biological maturity than the effects of participation per se (Malina et al., 2004).

Body Weight

Although physical activity is inversely related to weight, correlations are generally low (~r – 0.15) and differences in body weight between active and inactive boys and girls tend to be small (Saris et al., 1986; Mirwald and Bailey, 1986; Beunen et al., 1992; Lohman et al., 2006), except in very obese children and adolescents. Similarly, physique, as represented in somatotypes, does not appear to be significantly affected by physical activity during growth (Malina et al., 2004). In contrast, components of weight can be influenced by regular physical activity, especially when the mode and intensity of the activity are tailored to the desired outcome. Much of the available data in children and adolescents is based on BMI, a surrogate for composition, and indirect methods based on the two-compartment model of body composition in which body weight is divided into its fat-free and fat components (Going et al., in press). While studies generally support that physical activity is associated with greater fat-free mass and lower body fat, distinguishing the effects of physical activity on fat-free mass from expected changes associated with growth and maturation is difficult, especially during adolescence when both sexes have significant growth in fat-free mass. The application of methods based on the two-compartment model is fraught with errors, especially when the goal is to detect changes in fat-free mass, and no information is available from these methods regarding changes in the major tissue components of fat-free mass—muscle and skeletal tissue.

Muscle Skeletal muscle is the largest tissue mass in the body. It is the main energy-consuming tissue and provides the propulsive force for movement. Muscle represents about 23-25 percent of body weight at birth and about 40 percent in adults, although there is a wide range of "normal" (Malina, 1986, 1996). Postnatal muscle growth is explained largely by increases in cell size (hypertrophy) driving an increase in overall muscle mass. The increase in muscle mass with age is fairly linear from young childhood until puberty, with boys having a small but consistent advantage (Malina, 1969, 1986). The sex difference becomes magnified during and after puberty, driven primarily by gender-related differences in sex steroids. Muscle, as a percentage of body mass, increases from about 42 percent to 54 percent in boys between ages 5 and 11, whereas in girls, it increases from about 40 percent to 45 percent between ages 5 and 13 and thereafter declines (Malina et al., 2004). It should be noted that absolute mass does not decline; rather, the relative decline reflects the increase in the percentage of weight that is fat in girls. At least part of the sex difference is due to differences in muscle development for different body regions (Tanner et al., 1981). The growth rate of arm muscle tissue during adolescence in males is approximately twice that in females, whereas the sex difference in the growth of muscle tissue in the leg is much smaller. The sex difference that develops during puberty persists into adulthood and is more apparent for the musculature of the upper extremities.

Gender-related differences in muscular development contribute to differences in physical performance. Muscle strength develops in proportion to the cross-sectional area of muscle and growth curves for strength are essentially the same as those for muscle (Malina and Roche, 1983). Thus, the gender difference in muscle strength is explained largely by differences in skeletal muscle mass rather than muscle quality or composition. Aerobic (endurance) exercise has little effect on enhancing muscle mass but does result in significant improvement in oxygen extraction and aerobic metabolism (Fournier et al., 1982). In contrast, numerous studies have shown that high-intensity resistance exercise induces muscle hypertrophy, with associated increases in muscle strength. In children and adolescents, strength training can increase muscle strength, power, and endurance. Multiple types of resistance training modalities have proven effective and safe (Bernhardt et al., 2001), and resistance exercise is now recommended for enhancing physical health and function (Behringer et al., 2010). These adaptations are due to muscle fiber hypertrophy and neural adaptations, with muscle hypertrophy playing a more important role in adolescents, especially in males. Prior to puberty, before the increase in anabolic sex steroid concentrations, neural adaptations explain much of the improvement in muscle function with exercise in both boys and girls.

Skeleton The skeleton is the permanent supportive framework of the body. It provides protection for vital organs and is the main mineral reservoir. Bone tissue constitutes most of the skeleton, accounting for 14-17 percent of body weight across the age span (Trotter and Peterson, 1970; Trotter and Hixon, 1974). Skeletal strength, which dictates fracture risk, is determined by both the material and structural properties of bone, both of which are dependent on mineral accrual. The relative mineral content of bone does not differ much among infants, children, adolescents, and adults, making up 63-65 percent of the dry, fat-free weight of the skeleton (Malina, 1996). As a fraction of weight, bone mineral (the ash weight of bone) represents about 2 percent of body weight in infants and about 4-5 percent of body weight in adults (Malina, 1996). Bone mineral content increases fairly linearly with age, with no sex difference during childhood. Girls have, on average, a slightly greater bone mineral content than boys in early adolescence, reflecting their earlier adolescent growth spurt. Boys have their growth spurt later than girls, and their bone mineral content continues to increase through late adolescence ending with greater skeletal dimensions and bone mineral content (Molgaard et al., 1997). The increase in total body bone mineral is explained by both increases in skeletal length and width, and a small increase in bone mineral density (Malina et al., 2004).

Many studies have shown a positive effect of physical activity on intermediate markers of bone health, such as bone mineral content and density. Active children and adolescents have greater bone mineral content and density than their less active peers, even after controlling for differences in height and muscle mass (Bailey et al., 1999; Wang et al., 2004; Hind and Burrows, 2007; Tobias et al., 2007). Exercise interventions support the findings from observational studies, showing beneficial effects on bone mineral content and density in exercise participants versus controls (Petit et al, 2002; Specker and Brinkley, 2003), although the benefit is less than is suggested by cross-sectional studies comparing active versus inactive individuals (Bloomfield et al., 2004). The relationship between greater bone mineral density and bone strength is unclear, as bone strength cannot be measured directly in humans. Thus, whether the effects of physical activity on bone mineral density translate into similar benefits for fracture risk is uncertain (Karlsson, 2007). Animal studies have shown that loading causes small changes in bone mineral content and bone mineral density that result in large increases in bone strength, supporting the notion that physical activity probably affects the skeleton in a way that results in important gains in bone strength (Umemura et al., 1991). The relatively recent application of peripheral quantitative computed tomography for estimating bone strength in youth has also provided some results suggesting an increase in bone strength with greater than usual physical activity (Sardinha et al, 2008; Farr et al., 2011).

The intensity of exercise appears to be a key determinant of the osteogenic response (Turner and Robling, 2003). Bone tissue, like other tissues, accommodates to usual daily activities. Thus, activities such as walking have a modest effect at best, since even relatively inactive individuals take many steps (>1,000) per day. Activities generating greater muscle force on bone, such as resistance exercise, and "impact" activities with greater than ordinary ground reaction forces (e.g., hopping, skipping, jumping, gymnastics) promote increased mineralization and modeling (Bloomfield et al., 2004; Farr et al., 2011). Far fewer randomized controlled trials (RCTs) examining this relationship have been conducted in children than in adults, and there is little evidence on dose-response to show how the type of exercise interacts with frequency, intensity and duration. Taken together, however, the available evidence supports beneficial effects of physical activity in promoting bone development (Bailey et al., 1996; Modleskey et al, 2002).

Physical activity may reduce osteoporosis-related fracture risk by increasing bone mineral accrual during development; by enhancing bone strength; and by reducing the risk of falls by improving muscle strength, flexibility, coordination and balance (Bloomfield et al., 2004). Early puberty is a key developmental period. Approximately 26 percent of the mineral in the adult skeleton is accrued during the 2 years around the time of peak height velocity (Bailey et al., 2000). This amount of mineral accrual represents approximately the same amount of bone mineral that most people will lose in their entire adult lives (Arlot et al, 1997). The increase in mineral contributes to increased bone strength. Mineral is accrued on the periosteal surface of bone, such that the bone grows wider. Increased bone width, independent of the increased mineral mass, also contributes to greater bone strength. Indeed, an increase of as little as 1 millimeter in the outer surface of bone increases strength substantially. Adding bone to the endosteal surface also increases strength (Parfitt, 1994; Wang et al., 2009). Increases in testosterone may be a greater stimulus of periosteal expansion then estrogen since testosterone contributes to wider and stronger bones in males compared with females. Retrospective studies in tennis players and gymnasts suggest structural adaptations may persist many years later in adulthood, and are greatest when “impact” activity is initiated in childhood (Kannus et al., 1995; Bass et al., 1998). RCTs on this issue are few, although the available data are promising (McKay et al., 2000; Fuchs et al., 2001; MacKelvie et al., 2001, 2003; Linden et al., 2006). Thus, impact exercise begun in childhood may result in lasting structural changes that may contribute to increased bone strength and decreased fracture risk later in life (Turner and Robling, 2003; Ferrari et al., 2006).

Adipose tissue The adipose "organ" is composed of fat cells known as adipocytes (Ailhaud and Hauner, 1998). Adipocytes are distributed throughout the body in various organs and tissues, although they are largely clustered anatomically in structures called fat depots, which include a large number of adipocytes held together by a scaffold-like structure of collagen and other structural molecules. In the traditional view of the adipocyte, the cell provides a storage structure for fatty acids in the form of triacylglycerol molecules with fatty acids being released when metabolic fuel is needed (Arner and Eckel, 1998). While adipocytes play this critical role, they are also involved in a number of endocrine, autocrine and paracrine actions and play a key role in regulating other tissues and biological functions, for example, immunity and blood pressure, energy balance, glucose and lipid metabolism, and energy demands of exercise (Ailhaud and Hauner, 1998; Frühbeck et al., 2001). The role of adipocytes in regulation of energy balance and in carbohydrate and lipid metabolism and the potential effects of physical activity on adipocyte function are of particular interest here, given growing concerns related to pediatric and adult obesity (Ogden et al., 2012) and the associated risk of cardiometabolic disease (Weiss et al., 2004; Eisenmann, 2007; Eisenmann et al., 2007; Steele et al., 2008). Metabolic differences among various fat depots are now well known (Frühbeck et al., 2001), and there is significant interest in the distribution of adipose tissue, the changes that occur during childhood and adolescence, and their clinical significance.

Adipocytes increase in size (hypertrophy) and number (hyperplasia) from birth through childhood and adolescence and into young adulthood to accommodate energy storage needs. The number of adipocytes has been estimated to increase from about 5 billion at birth to 30-50 billion in the non-obese adult, with an increase in average diameter from about 30-40 μm at birth to about 80-100μm in the young adult (Knittle et al., 1979; Bonnet and Rocour-Brumioul, 1981; Chumlea et al., 1982). In total, the adipose organ contains about 0.5 kg of adipocytes at birth in both males and females, increasing to approximately 10 kg in average weight-for-height males and 14 kg in females (Malina et al., 2004). There is wide inter-individual variation, however, and the difficulty of investigating changes in the number and size of adipocytes is obvious given the invasiveness of the required biopsy procedures; understandably, then, data on these topics are scarce in children and adolescents. Also, since only subcutaneous depots are accessible, results must be extrapolated from a few sites.

Based on such information, the average size of adipocytes has been reported to increase two- to three-fold in the first year of life, with little increase in nonobese boys and girls until puberty (Malina et al., 2004). A small increase in average adipocyte size at puberty is more obvious in girls than in boys. There is considerable variation in size across various subcutaneous sites and between subcutaneous and internal depots. The number of adipocytes is difficult to estimate. Available data suggest that the cellularity of adipose tissue does not increase significantly in early postnatal life (Malina et al., 2004). Thus, gain in fat mass is the result of an increase in the size of existing adipocytes. From about 1-2 years of age and continuing through early and middle childhood, the number of adipocytes increases gradually two- to three-fold. With puberty, the number practically doubles, followed by a plateau in late adolescence and early adulthood. The number of dipocytes is similar in boys and girls until puberty, when girls experience a greater increase than boys.

The increases in the number of adipocytes during infancy and puberty are considered critical for enlargement of the adipose tissue organ and for the risk of obesity. Since size and number are linked, the number of adipocytes can potentially increase at any age if provided that fat storage mechanisms are stimulated by chronic energy surfeit (Hager, 1981; Chumlea et al., 1982).

Energy expenditure through regular physical activity is a critical element in preventing energy surfeit and excess adiposity. While cellularity undoubtedly is strongly genetically determined, regular physical activity, through its contribution to energy expenditure, can contribute to less adipocyte hyperplasia by limiting hypertrophy.

Fat distribution Fat distribution refers to the location of fat depots on the body. The metabolic activities of fat depots differ, and small variation can have a long-term impact on fat distribution. Differences in metabolic properties across depots also have clinical implications. Visceral adipose tissue in the abdominal cavity is more metabolically active (reflected by free fatty acidflux) than adipose tissue in other areas (Arner and Eckel, 1998) and higher amounts of visceral adipose tissue are associated with greater risk of metabolic complications, such as type 2 diabetes and cardiovascular disease (Daniels et al., 1999; He et al., 2007; Denker et al., 2012). In contrast, subcutaneous fat, particularly in the gluteofemoral region, is generally associated with a lower risk of cardiometabolic disease. Age- and sex-associated variations in fat distribution contribute to age- and sex-associated differences in cardiometabolic disease prevalence. Girls have more subcutaneous fat than boys at all ages although relative fat distribution is similar. After a rapid rise in subcutaneous fat in the first few months of life, both sexes experience a reduction through age 6 or 7 (Malina and Roche, 1983; Malina and Bouchard, 1988; Malina, 1996). Girls then show a linear increase in subcutaneous fat whereas boys show a small increase between ages 7 and 12 or 13 and then an overall reduction during puberty. The thickness of subcutaneous fat on the trunk is approximately one-half that of subcutaneous fat on the extremities in both boys and girls during childhood. The ratio increases with age in males during adolescence but changes only slightly in girls. In males, the increasing ratio of trunk to extremity subcutaneous fat is a consequence of slowly increasing trunk subcutaneous fat and a decrease in subcutaneous fat on the extremities. In girls, trunk and extremity subcutaneous fat increase at a similar rate; thus the ratio is stable (Malina and Bouchard, 1988). As a consequence, the sex difference in the distribution of body fat develops during adolescence. It is important to note that changes in subcutaneous fat pattern do not necessarily represent changes in abdominal visceral adipose tissue.

Tracking of subcutaneous fat has been investigated based on skinfold thicknesses and radiographs of fat widths in males and females across a broad age range (Katzmarzyk et al., 1999; Campbell et al., 2012). Results indicate that subcutaneous fat is labile during early childhood. After age 7 to 8, correlations between subcutaneous fat in later childhood and adolescence and adult subcutaneous fat are significant and moderate. Longitudinal data on tracking of visceral adipose tissue are not available, but percent body fat does appear to track. Thus, children and especially adolescents with higher levels of body fat have a higher risk of being overfat at subsequent examinations and in adulthood, although variation is considerable, with some individuals moving away from high fatness categories whereas some lean children move into higher fatness categories.

In cross-sectional studies, active children and adolescents tend to have lower skinfold thicknesses and less overall body fat than their less active peers (Loftin et al., 1998; Rowlands et al., 2000; Stevens et al., 2005; Lohman et al., 2006), although the correlations are modest, reflecting variation in body composition at different levels of physical activity, as well as the difficulty of measuring physical activity. Longitudinal studies indicate small differences in fatness between active and inactive boys and girls. Although some school-based studies of the effects of physical activity on body composition have reported changes in BMI or skinfolds in the desired direction (Gortmaker et al., 1999; McMurray et al., 2002), most have not shown significant effects. High levels of physical activity are most likely needed to modify skinfold thicknesses and percent body fat. In adults, visceral adipose tissue declines with weight loss with exercise. In contrast, in a study of obese children aged 7-11, a 4-month physical activity program resulted in minimal change in abdominal visceral adipose tissue but a significant loss in abdominal subcutaneous adipose tissue (Gutin and Owens, 1999). In adults, decreases in fatness with exercise are due to a reduction in fat cell size, not number (You et al., 2006); whether this is true in children is not certain but appears likely. Given that adipocyte hypertrophy may trigger adipocyte hyperplasia (Ballor et al., 1998), energy expenditure through regular physical activity may be important in preventing excess adipose tissue cellularity. Regular physical activity also affects adipose tissue metabolism so that trained individuals have an increased ability to mobilize and oxidize fat, which is associated with increased levels of lipolysis, an increased respiratory quotient, and a lower risk of obesity (Depres and Lamarche, 2000).

Cardiorespiratory System

The ability to perform sustained activity under predominantly aerobic conditions depends on the capacity of the cardiovascular and pulmonary systems to deliver oxygenated blood to tissues and on the ability of tissues (primarily skeletal muscle) to extract oxygen and oxidize substrate. By age 2, the systems are fully functional, although children lack the cardiorespiratory capacity of older children and adults because of their small size (Malina et al., 2004). Children's aerobic capacity and consequently their ability to exercise for longer periods of time increase as they grow. Maximal aerobic power (L/min) increases fairly linearly in boys until about age 16, whereas it increases in girls until about age 13 and then plateaus during adolescence (Malina et al., 2004; Eisenmann et al., 2011). Differences between boys and girls are small (~10 percent) during childhood and greater after the adolescent growth spurt, when girls have only about 70 percent of the mean value of boys. Changes with age and gender differences are explained largely by differences in the size of the relevant tissues. Dimensions of the heart and lungs enlarge with age in a manner consistent with the increase in body mass and stature (Malina et al., 2004). The increase in the size of the heart is associated with increases in stroke volume (blood pumped per beat) and cardiac output (product of stroke volume and heart rate, liters per minute), despite a decline in heart rate during growth. Similarly, increase in lung size (proportional to growth in height) results in greater lung volume and ventilation despite an age-associated decline in breathing frequency. From about age 6 to adulthood, maximal voluntary ventilation approximately doubles (50 to 100 L/min) (Malina et al., 2004). The general pattern of increase as a function of height is similar in boys and girls. In both, lung function tends to lag behind the increase in height during the adolescent growth spurt. As a result, peak gains in lunch function occur about 2 years earlier in girls than in boys.

Blood volume is highly related to body mass and heart size in children and adolescents, and it is also well correlated with maximal oxygen uptake during childhood and adolescence (Malina et al., 2004). Blood volume increases from birth through adolescence, following the general pattern for changes in body mass. Both red blood cells and hemoglobin have a central role in transport of oxygen to tissues. Hematocrit, the percentage of blood volume explained by blood cells, increases progressively throughout childhood and adolescence in boys, but only through childhood in girls. Hemoglobin content, which is related to maximal oxygen uptake, heart volume, and body mass, increases progressively with age into late adolescence. Males have greater hemoglobin concentrations then females, especially relative to blood volume, which has functional implications for oxygen transport during intense exercise.

Growth in maximal aerobic power is influenced by growth in body size, so controlling for changes in body size during growth is essential. Although absolute (liters per minute) aerobic power increases into adolescence relative to body weight, there is a slight decline in both boys and girls, suggesting that body weight increases at a faster rate than maximal oxygen consumption, particularly during and after the adolescent growth spurt (Malina et al., 2004). Changes in maximal oxygen consumption during growth tend to be more closely related to fat-free mass than to body mass. Nevertheless, sex differences in maximal oxygen consumption per unit fat-free mass persist, and maximal oxygen consumption per unit fat-free mass declines with age.

Improvements in cardiorespiratory function—involving structural and functional adaptations in the lungs, heart, blood and vascular system as well as the oxidative capacity of skeletal muscle—occur with regular vigorous and moderate-intensity physical activity (Malina et al., 2004). Concern about the application of invasive techniques limits the available data on adaptations in the oxygen transport system in children. Nevertheless, it is clear that aerobic capacity in youth increases with activity of sufficient intensity and that maximal stroke volume, blood volume, and oxidative enzymes improve after exercise training in youth (Rowland, 1996). Training-induced changes in other components of the oxygen transport system remain to be determined.

Health- and Performance-Related Fitness

Physical fitness is a state of being that reflects a person's ability to perform specific exercises or functions, and is related to present and future health outcomes. Historically, efforts to assess the physical fitness of youth focused on measures designed to evaluate the ability to carry out certain physical tasks or activities, often related to athletic performance. In more recent years, the focus has shifted to place greater emphasis on evaluating health-related fitness (IOM, 2012a) and assessing concurrent or future health status. Health- and performance-related fitness, while overlapping, are different constructs. Age- and gender-related changes in the components of both are strongly linked to the developmental changes in tissues and systems that occur during childhood and adolescence. Although genetic factors ultimately limit capacity, environmental and behavioral factors, including physical activity, interact with genes to determine the degree to which an individual's full capacity is achieved.

Health-Related Fitness

Cardiorespiratory endurance, muscular strength and endurance, flexibility and body composition are components of health-related fitness historically assessed in school-based fitness assessment programs (IOM, 2012a). These components of health-related fitness are considered important since they can be linked to the risk of cardiometabolic disease and musculoskeletal disability, chronic hypokinetic-related diseases.

Cardiorespiratory endurance Cardiorespiratory (aerobic) endurance reflects the functioning of the pulmonary and cardiovascular systems to deliver oxygen and the ability of tissues (primarily skeletal muscle) to extract oxygen from the blood. Defined clinically as the maximum oxygen consumption during a maximal graded exercise test, in practice it is usually measured indirectly as performance on a field test of endurance, such as 1- or 2-mile run time (IOM, 2012a). During childhood, aerobic capacity approximately doubles in both boys and girls, although girls on average possess a lower capacity. Males continue to improve during adolescence, up to ages 17-18 while aerobic capacity plateaus around age 14 in females (Malina et al., 2004), resulting in an approximately 20 percent difference between males and females (Rowland, 2005).

Favorable associations have been found between aerobic endurance and high density lipoproteins, systolic blood pressure, diastolic blood pressure, BMI, measures of fatness, arterial stiffness and measures of insulin sensitivity (Boreham et al., 2004; Imperatore et al., 2006; Hussey et al., 2007; Ondrak et al., 2007). Some evidence suggests a decline in aerobic endurance among U.S. youth in recent decades (Eisenmann, 2003; Carnethon et al., 2005; Pate et al., 2006), coincident with increased sedentariness and obesity and a greater prevalence of metabolic syndrome in youth. Aerobic exercise has been shown to increase cardiorespiratory endurance by about 5-15 percent in youth (Malina et al., 2004; HHS, 2008). The programs that produce this benefit involve continuous vigorous or moderate-intensity aerobic activity of various types for 30-45 minutes per session at least 3 days per week over a period of at least 1 to 3 months (Baquet et al., 2002); improvements are greater with more frequent exercise (Baquet et al., 2003).

Muscle strength and endurance Muscle strength is defined as the highest force generated during a single maximum voluntary contraction, whereas muscle endurance is the ability to perform repeated muscular contraction and force development over a period of time. Muscle strength and endurance are correlated, especially at higher levels of force production. Muscle strength is proportional to the cross-sectional area of skeletal muscle; consequently, strength growth curves parallel growth curves for body weight and skeletal muscle mass (Malina et al., 2004).

Both males and females show impressive increases in muscle strength from childhood to adolescence. Strength in children increases linearly with boys having a slight advantage over girls. However, these sex differences are magnified during the adolescent years due to maturation (Malina and Roche, 1983). Differences in muscle strength between boys and girls become more apparent after puberty, primarily as the result of the production of sex steroid hormones. In boys, the increase in strength during adolescence lags at least a year behind the growth spurt (peak height velocity), which may explain why some boys experience a brief period of clumsiness or adolescent during puberty, as they have not yet acquired the muscle strength necessary to handle the changes associated with their larger bodies. Muscle strength increases at its greatest rate approximately 1 year after peak height velocity in boys, whereas for girls, the strength spurt generally occurs during the same year as peak height velocity (Bar-Or, 1983).

A compelling body of evidence indicates that with resistance training, children and adolescents can significantly increase their strength above that expected as a result of normal growth and maturation, provided that the training program is of sufficient intensity, volume, and duration (Committee on Sports Medicine Fitness, 2001). Both boys and girls can benefit, and strength gains in children as young as 5-6 have been reported (Faigenbaum et al., 2009), although most studies are of older children and adolescents. Gains in muscle strength of about 30 percent are typical, although considerably larger gains have been reported. Adolescents make greater gains than preadolescents in absolute strength, whereas reported relative (percent above initial strength) gains in strength during preadolescence and adolescence are similar. A variety of programs and modalities have proved efficacious (Council on Sports Medicine Fitness, 2008), as long as load (~10-15 repetition maximum) and duration (~8-20 weeks) are adequate. As in adults, training adaptations in youth are specific to the muscle action or muscle groups that are trained, and gains are transient if training is not maintained (Faigenbaum et al., 2009).

Youth resistance training, as with most physical activities, does carry some degree of risk of musculoskeletal injury, yet the risk is no greater than that associated with other sports and activities in which children and adolescents participate (Faigenbaum et al., 2009; Council on Sports medicine and Fitness, American Academy of Pediatrics, 2008) as long as age-appropriate training guidelines are followed). A traditional area of concern has been the potential for training-induced damage to growth cartilage, which could result in growth disturbances. However, a recent review found no reports of injury to growth cartilage in any prospective study of resistance training in youth and no evidence to suggest that resistance training negatively impacts growth and maturation during childhood and adolescence (Faigenbaum et al., 2009). Injuries typically occur in unsupervised settings and when inappropriate loads and progressions are imposed.

In addition to the obvious goal of gaining strength, resistance training may be undertaken to improve sports performance and prevent injuries, rehabilitate injuries, and enhance health. Appropriately supervised programs emphasizing strengthening of trunk muscles in children theoretically benefit sport-specific skill acquisition and postural control, although these benefits are difficult to study and thus are supported by little empirical evidence (Council on Sports Medicine Fitness, 2008). Similarly, results are inconsistent regarding the translation of increased strength to enhanced athletic performance in youth. Limited evidence suggests that strength-training programs that address common overuse injuries may help reduce injuries in adolescents but whether the same is true in preadolescents is unclear (Council on Sports Medicine Fitness, 2008). Increasing evidence suggests that strength training, like other forms of physical activity, has a beneficial effect on measurable health indices in youth, such as cardiovascular fitness, body composition, blood lipid profiles and insulin sensitivity (Faigenbaum, 2007; Benson et al., 2008), bone mineral density and bone geometry (Morris et al., 1997; MacKelvie et al., 2004), and mental health (Holloway et al., 1988; Faigenbaum et al., 1997; Annesi et al., 2005; Faigenbaum, 2007). Some work has shown that muscle fitness, reflected in a composite index combining measures of muscle strength and endurance, and cardiorespiratory fitness are independently and negatively associated with clustered metabolic risk (Steene-Johannessen et al., 2009). Moreover, children with low muscle strength may be at an increased risk of fracture with exercise (Clark et al., 2011). Finally, muscle hypertrophy, which adds to fat-free mass, contributes to resting metabolic rate and therefore total daily energy expenditure. Resistance training may be particularly useful for raising metabolic rate in overweight and obese children without the risk associated with higher impact activities (Watts et al., 2005; Benson et al., 2007).

Flexibility Flexibility has been operationally defined as “the intrinsic property of body tissues, including muscle and connective tissues, that determines the range of motion achievable without injury at a joint or group of joints” (IOM, 2012b, p. 190). At all ages, girls demonstrate greater flexibility than boys, and the difference is greatest during the adolescent growth spurt and sexual maturation. Perhaps the most common field measure of flexibility in children and youth is the sit-and-reach test (IOM, 2012b) of low-back flexibility. Low-back flexibility as measured by this test is stable in girls from age 5 to 11 and increases until late adolescence. In boys, low-back flexibility declines linearly starting at age 5 and, reaches its nadir at about age 12, and then increases into late adolescence. The unique pattern of age- and sex-associated variation is related to the growth of the lower extremities and the trunk during adolescence. In boys, the nadir in low-back flexibility coincides with the adolescent growth spurt in leg length. In both boys and girls, the increase during adolescence coincides with the growth spurt in trunk length and arm length, which influence reach. Flexibility in both males and females tends to decline after age 17, in part as a result of a decline in physical activity and normal aging.

The principal health outcomes hypothesized to be associated with flexibility are prevention of and relief from low-back pain, prevention of musculoskeletal injury, and improved posture. These associations have been studied in adults, with equivocal results (Plowman, 1992). Although flexibility has long been included in national youth fitness tests, it has proven difficult to establish a link between flexibility and health (IOM, 2012a). In contrast to other fitness components that are general or systemic in nature, flexibility is highly specific to each joint of the body. Although appropriate stretching may increase flexibility, establishing a link to improved functional capacity and fitness is difficult. A few studies suggest that improvements in flexibility as measured by the sit-and-reach test may be related to less low-back pain (Jones et al., 2007; Ahlqwist et al., 2008), but the evidence is weak. Consequently, the Institute of Medicine (IOM) Committee on Fitness Measures and Health Outcomes in its recent report elected to forego recommending a flexibility test for a national youth fitness test battery pending further research to confirm the relationship between flexibility and health and to develop national normative data (IOM, 2012a).

Body composition Body composition is the component of health-related fitness that relates to the relative amount of adipose tissue, muscle, bone, and other vital components (e.g., organs, connective tissues, fluid compartments) that make up body weight. Most feasible methods for assessing body composition are based on models that divide the body into fat and fat-free (all nonfat constituents) components (Going et al., in press). Although fat mass and adipose tissue are not equivalent compartments, fat mass is easier to estimate than adipose tissue, and it is correlated with performance and disease risk. In settings in which estimation of body fat is difficult, weight-for-height ratios often are used as surrogates for body composition. Indeed, definitions of pediatric overweight and obesity have been based on BMI, calculated as weight in kilograms divided by height squared. Child and adolescent obesity defined by BMI remains at all-time highs. Population surveys indicate that approximately 33 percent of all boys and girls are overweight, and nearly one in five is obese (Ogden, 2011). The tendency for excess fatness to persist from childhood and adolescence into adulthood (Daniels et al., 2005), coupled with the strong association between obesity and chronic disease (Weiss and Caprio, 2005; Barlow, 2007), has caused great concern for future obesity levels and the health of youth and adults alike (IOM, 2005, 2012b).

The increase in prevalence of obesity is undoubtedly due to a mismatch between energy intake and expenditure. Population surveys have shown that few children and youth meet recommended levels of daily physical activity (see this report Chapter 2. Prospective studies have shown a significant and inverse relationship between habitual physical activity and weight gain (Berkey et al., 2003), and in some studies, physical activity is a better predictor of weight gain than estimates of calorie or fat intake (Berkey et al., 2000; Janssen et al., 2005). These relationships are better established in adults than in children and youth although even in preschool children, low levels of physical activity, estimated from doubly labeled water, were found to be indicative of higher body fat content (Davies et al, 1995). While studies of exercise without caloric restriction generally show only small effects on body weight, significant albeit moderate reductions of body fat are generally reported (Eisenmann, 2003). Moreover, even in the absence of significant weight loss, exercise has beneficial effects on risk factors for cardiometabolic disease (Ross and Bradshaw, 2009; Gutin and Owens, 2011).

Body Mass Index Changes in weight for height with growth and maturation for U.S. boys and girls are described in CDC growth curves (Kuczmarcki et al., 2000). Current growth curves were derived from U.S. population surveys conducted before the increase in weight for height that defines today's pediatric obesity epidemic. In boys and girls, BMI declines during early childhood, reaching its nadir at about age 5-6, and then increases through adolescence. A gender difference emerges during puberty, with males gaining greater fat-free mass than females. Both the period of "adiposity rebound" (the increase in BMI in mid-childhood following the decline in early-childhood) and puberty are times of risk for excess fat gain that correlate with future adiposity (Rolland-Cachera et al., 1984). Physical activity and BMI are inversely correlated in children and adolescents, although the correlations are modest (Lohman et al., 2006), reflecting the difficulty of measuring physical activity, as well as variation in body composition and physical activity at a given weight (Rowlands et al., 2000). Indeed, when studied separately, fat mass index FMI, or fat mass divided by height squared) and fat-free mass index (FFMI, or fat-free mass divided by height squared) both are inversely related to physical activity. With FMI controlled, however, FFMI is positively related to physical activity, indicating that for a given level of body fat, individuals with more fat-free mass are more active (Lohman et al., 2006). BMI cut-points for defining overweight and obesity have historically been based on age- and gender-specific population distributions of BMI. Recent work has shown good correspondence between BMI standards and percent fat standards which were referenced to health criteria (Laurson et al., 2011). These new standards should prove useful for identifying children and adolescents at risk for higher levels of cardiometabolic risk factors.

Percent body fat Direct measures of body fat as a percent of weight provide a better index of adiposity and health risk than BMI (Zeng et al., 2012), which is confounded by variation in lean tissue mass relative to height. Recently, percent fat growth curves were established for representative samples of U.S. boys and girls using National Health and Nutrition Examination Survey (NHANES) data (Laurson et al., 2011; Ogden and Flegal, 2011). Median percent fat for boys aged 5-18, ranged from 14 to 19 percent and for girls across the same ages, ranged from 15 to 28 percent. In both boys and girls, percent fat increases slowly during early childhood, with girls having a consistently greater relative fatness than boys after ages 5-6. In girls, percent fat increases gradually throughout adolescence in the same manner as fat mass. In boys, percent fat increases gradually until the adolescent growth spurt and thereafter gradually declines until about age 16-17, reflecting the rapid growth in fat-free mass relative to fat mass. After age 17, percent fat in males gradually increases again into adulthood.

The increased prevalence of child and adolescent obesity as defined by BMI presumably also reflects increased adiposity, although the degree is not certain as population-based estimates of percent fat have only recently been developed (Laurson et al., 2011). Health-related percent fat standards recently were developed by determining levels of body fat associated with greater occurrence of chronic disease risk factors defined by the metabolic syndrome (Going et al., 2011). In boys and girls, aged 12 to 18, percent fat above 20-24 percent and above 27-31 percent, respectively, was predictive of metabolic syndrome.

Physical activity is inversely correlated with percent body fat (Lohman et al., 2006; Rowlands et al., 2000), although the correlations are modest, and changes in overall fatness as well as subcutaneous adipose tissue with habitual physical activity are reasonably well documented in children and adolescents (Gutin and Humphries, 1998; Gutin and Owens, 1999; Dionne et al., 2000). In youth, as in adults, the effects of exercise without caloric restriction are modest, and are influenced by the initial level of body fat and the duration and regimen of exercise (Going, 1999). Experimental studies have documented reductions in percent body fat with aerobic exercise, especially in children and adolescents who are overweight or obese at the initiation of the exercise program (Davis et al., 2012). Regular physical activity also affects adipose tissue metabolism (Gutin and Owens, 1999). Individuals who engage in aerobic endurance exercise training have an increased ability to mobilize and oxidize fat, which is associated with increased levels of lipolysis (Depres and Lamarche, 2000). Similar information on adipose tissue metabolism in children and youth is lacking although one can reasonably expect similar adaptations in older adolescents.

Metabolic syndrome The tendency for risk factors for cardiometabolic disease to cluster, now called the metabolic syndrome, is well recognized in adults (Alberti and Zimmet, 1998). Similar clustering occurs in older children and especially adolescents (Cook et al., 2003), and interest in metabolic syndrome has increased, driven by the increased prevalence of pediatric obesity and the increasing incidence and earlier onset of type 2 diabetes in youth. There is as yet no accepted definition of metabolic syndrome for use in pediatric populations (Jolliffe and Janssen, 2007). Typically adult definitions are extrapolated to children and adolescents, with appropriate adjustments of the thresholds for the defining variables. Perhaps the most common approach is to emulate the National Cholesterol Education Program (NCEP), which defines metabolic syndrome as exceeding thresholds on three of five components: waist circumference, blood pressure (systolic or diastolic), blood lipids (HDL and triglycerides), and blood glucose (NIH, 2001) levels.

The concept of metabolic syndrome is useful as it provides an integrated index of risk, and it recently was used to derive health-related percent body fat standards (Laurson et al., 2011). Based on NHANES survey data, the prevalence of metabolic syndrome varies with the degree of obesity, and it is estimated at 4-6 percent of children and adolescents (Cook et al., 2003; DuBose et al., 2007); among obese youth, it may be as high as 30-50 percent (Weiss et al., 2004). Youth with metabolic syndrome have an increased risk of type 2 diabetes and cardiovascular disease. In adults, weight loss of 5-10 percent of body weight through caloric restriction and exercise has been shown to reduce the risk of cardiometabolic disease by improving risk factors (Diabetes Prevention Program Research Group, 2002; Ross and Janiszewski, 2008). In particular, weight loss results in reduced visceral adipose tissue, a strong correlate of risk (Knowler et al., 2002), as well as lower blood pressure and blood glucose levels due to improved insulin sensitivity. Even without significant weight loss, exercise can have significant effects on risk in adults by improving glucose metabolism, improving lipid and lipoprotein profile, and lowering blood pressure, particularly for those who are significantly overweight (Ross and Bradshaw, 2009]). Similar benefits have been observed in adolescents.

A growing body of literature addresses the associations of physical activity, physical fitness and body fatness with the risk of metabolic syndrome and its components in children and especially adolescents (Platat et al., 2006; McMurray et al., 2008; Rubin et al., 2008; Thomas and Williams, 2008; Christodoulos et al., 2012). Studies in adults have shown that higher levels of physical activity predict slower progression toward metabolic syndrome in apparently healthy men and women (Laaksonen et al., 2002; Ekelund et al., 2005), an association that is independent of change in body fatness and cardiorespiratory fitness (Ekelund et al., 2007). Few population studies have focused on these relationships in children and adolescents, and the use of self-reported activity, which is imprecise in these populations, tends to obscure associations. In a large sample of U.S. adolescents aged 12-19, in the 1999-2002 NHANES, for example, there was a trend for metabolic syndrome to be more common in adolescents with low activity levels than in those with moderate or high activity levels, although the differences among groups were not statistically significant (Pan and Pratt, 2008). Moreover, for each component of metabolic syndrome, prevalence was generally lower with higher physical activity levels, and adolescents with low physical activity levels had the highest rates of all metabolic syndrome components.

The association between cardiorespiratory fitness and metabolic syndrome also was examined in the 1999-2002 NHANES (Lobelo et al., 2010). Cardiorespiratory fitness was measured as estimated peak oxygen consumption using a submaximal treadmill exercise protocol, and metabolic syndrome was represented as a "clustered score" derived from five established risk factors for cardiovascular disease, an adiposity index, insulin resistance, systolic blood pressure, triglycerides and the ratio of total to HDL cholesterol. Mean clustered risk score decreased across increasing fifths (quintiles) of cardiorespiratory fitness in both males and females. The most significant decline in risk score was observed from the first (lowest) to the second quintile (53.6 percent and 37.5 percent in males and females, respectively), and the association remained significant in both overweight and normal-weight males and in normal-weight females. Other studies, using the approach of cross-tabulating subjects into distinct fitness and fatness categories, have examined associations of fitness and fatness with metabolic risk (DuBose et al., 2007; Eisenmann et al., 2005, 2007a,b). Although different measures of fitness, fatness, and metabolic risk were used, the results taken together across a wide age range (7-18) show that fitness modifies the influence of fatness on metabolic risk. In both males and females, high-fit/low-fatness subjects have less metabolic risk than low-fit/high-fatness subjects (Eisenmann, 2007).

That many adult chronic health conditions have their origins in childhood and adolescence is well supported (Kannel and Dawber, 1972; Lauer et al., 1975; Berenson et al., 1998; IOM, 2004). Both biological (e.g., adiposity, lipids) and behavioral (e.g., physical activity) risk factors tend to track from childhood and especially adolescence into adulthood. Childhood BMI is related to adult BMI and adiposity (Guo et al., 1994, 2000; Freedman et al., 2005) and as many as 80 percent of obese adolescents become obese adults (Daniels et al., 2005). Coexistence of cardiometabolic risk factors, even at young ages (DuBose et al., 2007; Ramirez-Velez et al., 2012) has been noted, and these components of metabolic syndrome also have been shown to track to adulthood (Bao et al., 1994; Katzmarzyk et al., 2001; Huang et al., 2008). Landmark studies from the Bogalusa Heart Study (Berenson et al., 1998; Li et al., 2003) and others (Mahoney et al., 1996; Davis et al., 2001; Morrison et al., 2007, 2008) have demonstrated that cardiometabolic risk factors present in childhood are predictive of adult disease.

The benefits of exercise for prevention and treatment of cardiometabolic disease in adults are well described (Ross et al., 2000; Duncan et al., 2003; Gan et al., 2003; Irwin et al., 2003; Lee et al., 2005; Sigal et al., 2007; Ross et al., 2012). Prospective studies examining the effects of exercise on metabolic syndrome in children and adolescents remain limited, and it is important to refrain from extrapolating intervention effects observed in adults to youth although one might reasonably assume the benefits in older adolescents to be similar to those in young adults. Indeed, based on the inverse associations of physical activity and physical fitness with metabolic syndrome (Kim and Lee, 2009) and of the available intervention studies, some experts have recommended physical activity as the main therapeutic tool for prevention and treatment of metabolic syndrome in childhood (Brambilla et al., 2010). Comparative studies in adults have shown that the effect of exercise on weight is limited and generally less than that of calorie restriction (Brambilla et al., 2010). Moreover, the relative effectiveness of diet and exercise depends on the degree of excess fatness (Brambilla et al., 2010). Comparative studies in children and youth are few, as behavioral interventions in overweight children and adolescents commonly combine exercise and dietary restriction, making it difficult to disentangle their independent effects. Nonetheless, diet and exercise have different effects on body composition, while both contribute to fat loss, only exercise increases muscle mass and thus has a direct effect on metabolic health. In children and youth, as in adults, the effects of exercise on cardiometabolic risk factors is greater in overweight/obese youth than in their normal-weight peers (Kang et al., 2002; Lazaar et al., 2007).

Exercise also may have important benefits even without significant modification of body composition (Bell et al., 2007). Experimental studies in overweight and obese youth have shown that exercise leads to reductions in visceral fat (Owens et al., 1999; Gutin et al., 2002; Lee at al., 2005; Barbeau et al., 2007; Kim, and Lee, 2009), without a significant change in BMI, as well as improvement in markers of metabolic syndrome, primarily fasting insulin and insulin resistance (Treuth et al., 1998; Ferguson et al., 1999; Carrel et al., 2005; Nassis et al., 2005; Meyer et al., 2006; Shaibi et al., 2006; Bell et al., 2007). Results from experimental studies of the effects of exercise on lipids and lipoproteins (Stoedefalke et al., 2000; Kelley and Kelley, 2008; Janssen and LeBlanc, 2010) are mixed. Although some studies have shown improved lipid and lipoprotein profiles, primarily a decrease in LDL-cholesterol and triglyceride concentrations and an increase in HDL-cholesterol (Ferguson et al., 1999), other studies have shown no improvement in these outcomes (Kelley and Kelley, 2008). In part, such conflicting results are likely due to initial differences in body composition and severity of hyperlipidemia. Well-controlled exercise training studies in obese children (Escalante et al., 2012) and children with adverse blood lipid and lipoprotein profiles have shown positive alterations in their profiles (Stoedefalke et al., 2000) whereas results in normolipidemic children and adolescents are equivocal. Similarly, exercise has little effect on resting blood pressure in normotensive children and adolescents (Kelley and Kelley, 2008) whereas reductions in resting systolic and sometimes diastolic pressures have been reported in youth with high blood pressure (Hagberg et al., 1983, 1984; Danforth et al., 1990; Ewart et al., 1998; Janssen and LeBlanc, 2010; Farpour-Lambert et al., 2009).

In adults, physical activity is inversely associated with low-grade inflammation (Warnberg et al., 2010; Ertek et al., 2012), which is now recognized as a significant feature of metabolic syndrome and an independent predictor of cardiometabolic disease (Malina, 2002). In obese children and adolescents, as in their adult counterparts, elevation of inflammatory markers is evident, and observational studies have shown significant relationships among physical activity, physical fitness, and inflammation (Isasi et al., 2003; Platat et al., 2006; Ruiz et al., 2007; Wärnberg et al., 2007; Wärnberg and Marcos, 2008). These relationships are better studied and stronger in adolescents than in children. In one study of boys and girls aged 10-15, those who were obese and unfit, had the highest levels of systemic inflammation whereas those who were obese yet fit had levels as low as those who were lean and fit (Halle et al., 2004). In another study, low-grade inflammation was negatively associated with muscle strength in overweight adolescents after controlling for cardiorespiratory fitness, suggesting that high levels of muscle strength may counteract some of the negative consequences of higher levels of body fat (Ruiz et al., 2008). Experimental studies of the effects of exercise and markers of low grade inflammation in children and adolescents are lacking. Improved cardiorespiratory fitness in adults (Church et al., 2002), however, has been shown to be inversely related to concentration of C-reactive protein (CRP), a marker of low-grade inflammation. In a small study of a lifestyle intervention entailing 45 minutes of physical activity, 3 times per week, for 3 months, a small reduction in body fat and an overall decrease in inflammatory factors (CRP, interleukin [IL]-6) in obese adolescents (Balagopal et al., 2005).

Performance-Related Fitness

Speed, muscle power, agility, and balance (static and dynamic) are aspects of performance-related fitness that change during development in predictable ways associated with the development of tissues and systems discussed above (Malina et al., 2004). Running speed and muscle power are related and both depend on full development of the neuromuscular system. Running speed and muscle power are similar for boys and girls during childhood (Haubenstricker and Seefeldt, 1986). After puberty, largely because of differences in muscle mass and muscle strength, males continue to make significant annual gains, while females tend to plateau during the adolescent years. Sociocultural factors and increasing inactivity among girls relative to boys, along with changes in body proportion and a lowering of the center of gravity, may also contribute to gender differences (Malina et al., 2004).

Balance—the ability to maintain equilibrium—generally improves from ages 3 to 18 (Williams, 1983). Research suggests that females outperform males on tests of static and dynamic balance during childhood and that this advantage persists through puberty (Malina et al., 2004).

Motor performance is related in part to muscle strength. Increases in muscle strength as a result of resistance exercise were described above. A question of interest is whether gains in strength transfer to other performance tasks. Available results are variable, giving some indication that gains in strength are associated with improvement in some performance tasks, such as sprinting and vertical jump, although the improvements are generally small, highlighting the difficulty of distinguishing the effects of training from changes expected with normal growth. Changes in body size, physique, and body composition associated with growth and maturation are important factors that affect strength and motor performance. The relationships vary among performance measures and with age, and these factors often are inadequately controlled in studies of components of performance-related fitness and performance tasks.

PSYCHOSOCIAL HEALTH

Research supports the positive impact of physical activity on the overall psychological health and social engagement of every student. A well-designed physical education curriculum intentionally addresses social and emotional learning objectives (Amis et al., 2012). Simultaneously, exposure to failure experiences, emphasis on competitive sports and elitism for naturally inclined athletes, along with bullying and teasing of unfit, uncoordinated and overweight youth may be an important factor in discouraging participation in current and future physical activity (Amis et al., 2012). School-based physical activity, including physical education and sports, is designed to increase physical activity while also, improving motor skills and development, self-efficacy, and general feelings of competency and engaging children socially (Bailey, 2006). The hoped-for psychosocial outcomes of physical education and other physical activity programs in the school setting have been found to be critical for continued physical activity across the life span and are themselves powerful long-term determinants of physical activity (Bauman et al., 2012). Unfortunately, significant gaps exist between the intent and reality of school-based physical education and other activity programs (HHS, 2013).

A large number of psychological and social outcomes have been examined. Specific aspects of psychosocial health showing a beneficial relationship to physical activity include, among others, self-efficacy, self-concept, self-worth (Haugen et al., 2011), social behaviors (Cradock et al., 2009), pro-school attitudes, motivation and goal orientation (Digelidis et al., 2003) relatedness, friendships (de la Haye et al., 2011; Macdonald-Wallis et al., 2011), task orientation, team building, bullying, and racial prejudice (Byrd and Ross, 1991). Most studies are descriptive, finding bi-directional associations between psychosocial outcomes and physical activity. Reviews and meta-analyses confirm a positive association between physical activity and self-esteem, especially for aerobic activities (McAuley, 1994).

Among psychosocial factors, self-efficacy (confidence in one's ability to be physically active in specific situations) has emerged as an important correlate of physical activity from a large body of work based on the durable and practically useful social learning theory (Bandura and McClelland, 1977; Bandura, 1995). Bandura's theory compels consideration of the psychosocial and physical environments, the individual, and in this case the behavior of physical activity. Using this framework, physical activity itself has been shown to be a consistent positive correlate as well as a determinant of physical activity in children and adolescents. A large amount of reviewed research has found that physical education and physical activity experiences can increase children's confidence in being active and lead to continued participation in physical activity (Bauman et al., 2012). RCTs have shown that both self-efficacy and social interactions leading to perceived social support influence changes in physical activity (Dishman et al., 2009). Skill mastery, a goal of quality physical education (Bailey, 2006), confidence building, and group support are well-known strategies for advancing student learning and well-being in many educational domains in the school setting and apply equally to school physical education and other physical activity. Early observational studies of physical, social, and environmental determinants of physical activity at home, school, and recess indicated that prompts to be active (or not) from peers and adults accounted for a significant amount of the variance in directly observed physical activity (Elder et al., 1998). One longitudinal study following the variability and tracking of physical activity in young children showed that most of the variability in both home and recess activity was accounted for by short-term social and physical environmental factors, such as prompts from others and being outdoors (Sallis et al., 1995). Another study examining activity among preschool children, found that, contrary to common belief, most of the time spent in preschool was sedentary, and correlates of activity were different for preschool boys and girls (Byun et al., 2011). In addition, significant variation in activity by preschool site was noted, indicating that local environmental conditions including physical environment and equipment, policies, and teacher and administrative quality characteristics, play an important role in promoting physical activity (Brown et al., 2009).

Studies in middle and high school populations have strengthened the evidence base on relationships among self-efficacy, physical activity, and social support (from adults and peers). This research has highlighted the central contribution of self-efficacy and social support in protecting against the decline in activity levels among adolescent girls (Dishman et al., 2009, 2010). Evidence indicates further that these impacts spread to activity outside the school setting (Lytle et al., 2009). Findings of a related study suggest that leisure-time physical activity among middle school students was linked to motivation-related experiences in physical education (Cox et al., 2008).

A recent review of reviews (Bauman et al., 2012) found that population levels of physical activity are low, and that consistent individual-level correlates of physical activity are age, sex, health status, self-efficacy, and previous physical activity. Physical activity declines dramatically as children progress from elementary through high school (Nader et al., 2008). Boys are consistently found to be more active than girls from ages 4 to 9. For other age groups of children and adolescents, sex is correlated with but not a determinant of activity (Bauman et al., 2012). These findings suggest the need to tailor physical education and physical activity programs for youth specifically to increase self-efficacy and enjoyment of physical activity among girls (Dishman et al., 2005; Barr-Anderson et al., 2008; Butt et al., 2011).

In summary, a broad range of beneficial psychosocial health outcomes have been associated with physical activity. The promotion of more physical activity and quality physical education in the school setting is likely to result in psychosocially healthier children who are more likely to engage in physical activity as adults. Schools can play an important role in ensuring opportunities for physical activity for a segment of the youth population that otherwise may not have the resources to engage in such activity. It makes sense to assume that if physical activity experiences and environments were once again structured into the daily school environment of children and adolescents individuals' feeling of self-efficacy regarding physical activity would increase in the U.S. population.

MENTAL HEALTH

Mental illness is a serious public health issue. It has been estimated that by 2010, mental illness will account for 15 percent of the global burden of disease (Biddle and Mutrie, 2008; Biddle and Asare, 2011). Young people are disproportionately affected by depression, anxiety, and other mental health disorders (Viner and Booy, 2005; Biddle and Asare, 2011). Approximately 20 percent of school-age children have a diagnosable mental health disorder (U.S. Public Health Service, 2000), and overweight children are at particular risk (Ahn and Fedewa, 2011). Mental health naturally affects academic performance on many levels (Charvat, 2012). Students suffering from depression, anxiety, mood disorders, and emotional disturbances perform more poorly in school, exhibit more behavioral and disciplinary problems, and have poorer attendance relative to mentally healthy children. Thus, it is in schools' interest to take measures to support mental health among the student population. In addition to other benefits, providing adequate amounts of physical activity in a way which is inviting and safe for children of all ability levels is one simple way in which schools can contribute to students' mental health.

Impact of Physical Activity on Mental Health

Several recent reviews have concluded that physical activity has a positive effect on mental health and emotional well-being for both adults and children (Peluso and Guerra de Andrade, 2005; Penedo and Dahn, 2005; Strong et al., 2005; Hallal et al., 2006; Ahn and Fedewa, 2011; Biddle and Asare, 2011). Numerous observational studies have established the association between physical activity and mental health, but are inadequate to clarify the direction of that association (Strong et al., 2005). It may be that physical activity improves mental health, or it may be that people are more physically active when they are mentally healthy. Most likely the relationship is bidirectional.

Several longitudinal and intervention studies have clarified that physical activity positively impacts mental health (Penedo and Dahn, 2005; Strong et al., 2005). Physical activity has most often been shown to reduce symptoms of depression and anxiety and improve mood (Penedo and Dahn, 2005; Dishman, 2006; Biddle and Asare, 2011). In addition to reducing symptoms of depression and anxiety, studies indicate that regular physical activity may help prevent the onset of these conditions (Paffenbarger et al., 1994; Penedo and Dahn, 2005). Reductions in depression and anxiety are the commonly measured outcomes (Strong et al., 2005; Ahn and Fedewa, 2011). However, reductions in states of confusion, anger, tension, stress, anxiety sensitivity (a precursor to panic attacks and panic disorders), posttraumatic stress disorder/psychological distress, emotional disturbance, and negative affect have been observed, as well as increases in positive expectations, fewer emotional barriers, general well-being, satisfaction with personal appearance, and improved life satisfaction, self-worth, and quality of life (Heller et al., 2004; Peluso and Guerra de Andrade, 2005; Penedo and Dahn, 2005; Dishman, 2006; Hallal et al., 2006; Ahn and Fedewa, 2011; Biddle and Asare, 2011). Among adolescents and young adult females, exercise has been found to be more effective than cognitive-behavioral therapy in reducing the pursuit of thinness and the frequency of binging, purging, and laxative abuse (Sundgot-Borgen et al., 2002; Hallal et al., 2006). The favorable effects of physical activity on sleep may also contribute to mental health (Dishman, 2006).

The impact of physical activity on these measures of mental health is moderate with effect sizes generally ranging from 0.4 to 0.7 (Biddle and Asare, 2011). In one meta-analysis of intervention trials, the RCTs had an effect size of 0.3, whereas other trials had an effect size of 0.57.

Ideal Type, Length, and Duration of Physical Activity

Intervention trials that examine the relationship between physical activity and mental health often fail to specify the exact nature of the intervention, making it difficult to determine the ideal frequency, intensity, duration, and type of physical activity involved (Penedo and Dahn, 2005; Ahn and Fedewa, 2011; Biddle and Asare, 2011).

Many different types of physical activity—including aerobic activity, resistance training, yoga, dance, flexibility training, walking programs, and body building—have been shown to improve mood and other mental health indicators. The evidence is strongest for aerobic physical activity, particularly for reduction in anxiety symptoms and stress (Peluso and Guerra de Andrade, 2005; Dishman, 2006; Martikainen, 2013), because more of these studies have been conducted (Peluso and Guerra de Andrade, 2005). One meta-analysis of RCTs concluded that physical activity interventions focused exclusively on circuit training had the greatest effect on mental health indicators, followed closely by interventions that included various types of physical activity (Ahn and Fedewa, 2011). Among studies other than RCTs, only participation in sports had a significant impact on mental health (Ahn and Fedewa, 2011). The few studies that have investigated the impact of vigorous versus lower-intensity physical activity (Larun et al., 2006; Biddle and Asare, 2011) found no difference, suggesting that perhaps all levels of physical activity may be helpful. Among adults, studies have consistently shown beneficial effects of both aerobic exercise and resistance training. Ahn and Fedewa (2011) concluded that both moderate and intense physical activity have a significant impact on mental health, although when just

RCTs were considered, only intense physical activity was significant (Ahn and Fedewa, 2011). Although physical activity carries few risks for mental health, it is important to note that excessive physical activity or specialization too early in certain types of competitive physical activity has been associated with negative mental health outcomes and therefore should be avoided (Peluso and Guerra de Andrade, 2005; Hallal et al., 2006). Furthermore, in order to reach all children, including those that may be at highest risk for inactivity, obesity and mental health problems, physical activity programming needs to be non-threatening and geared toward creating a positive experience for children of all skill and fitness levels (Amis, 2012)

Various types of physical activity programming have been shown to have a positive influence on mental health outcomes. Higher levels of attendance and participation in physical education are inversely associated with feelings of sadness and lower risk of considering suicide (Brosnahan et al., 2004). Classroom physical activity is associated with reduced use of medication for attention deficit hyperactivity disorder (Katz et al., 2010). And participation in recess is associated with better student classroom behavior, better focus and less fidgeting (Pellegrini et al., 1995; Jarrett et al., 1998; Barros et al., 2009).

Strong evidence supports the short-term benefits of physical activity for mental health. Acute effects can be observed after just one episode and can last from a few hours to up to 1 day after. Body building may have a similar effect, which begins a few hours after the end of the exercise. The ideal length and duration of physical activity for improving mental health remain unclear, however. Regular exercise is associated with improved mood, but results are inconsistent for the association between mood and medium- or long-term exercise (Dua and Hargreaves, 1992; Slaven and Lee, 1997; Dimeo et al., 2001; Dunn et al., 2001; Kritz-Silverstein et al., 2001; Sexton et al., 2001; Leppamaki et al., 2002; Peluso and Guerra de Andrade, 2005). Studies often do not specify the frequency and duration of physical activity episodes; among those that do interventions ranged from 6 weeks to 2 years in duration. In their meta-analysis, Ahn and Fedewa (2011) found that, comparing interventions entailing a total of more than 33 hours, 20-33 hours, and less than 20 hours, the longer programs were more effective. Overall, the lack of reporting and the variable length and duration of reported interventions make it difficult to draw conclusions regarding dose (Ahn and Fedewa, 2011).

In addition to more structured opportunities, naturally occurring physical activity outside of school time also is associated with fewer depressive symptoms among adolescents (Penedo and Dahn, 2005). RCTs have demonstrated that physical activity with entire classrooms of students are effective at alleviating negative mental health outcomes (Ahn and Fedewa, 2011). Non-RCT studies have shown individualized approaches to be most effective and small-group approaches to be effective to a more limited extent (Ahn and Fedewa, 2011). Interventions have been shown to be effective at improving mental health when delivered by classroom teachers, physical education specialists, or researchers, but may be most effective when conducted with a physical education specialist (Ahn and Fedewa, 2011). Many physical activity interventions include elements of social interaction and support; however, studies to date have been unable to distinguish whether the physical activity itself or these other factors account for the observed effects on mental health (Hasselstrom et al., 2002; Hallal et al., 2006). Finally, a few trials (Larun et al., 2006; Biddle and Asare, 2011) have compared the effects of physical activity and psychosocial interventions, finding that physical activity may be equally effective but may not provide any added benefit.

Subgroup Effects

Although studies frequently fail to report the age of participants, the data on effects of physical activity on mental health are strongest for adults participating in high-intensity physical activity (Ahn and Fedewa, 2011). However, evidence relating physical activity to various measures of mental health has shown consistent, significant effects on individuals aged 11-20. A large prospective study found that physical activity was inversely associated with depression in early adolescence (Hasselstrom et al., 2002; Hallal et al., 2006); fewer studies have been conducted among younger children. Correlation studies have shown that the association of physical activity with depression is not affected by age (Ahn and Fedewa, 2011).

Few studies have examined the influence of other sociodemographic characteristics of participants on the relationship between physical activity and mental health (Ahn and Fedewa, 2011), but studies have been conducted in populations with diverse characteristics. One study of low-income Hispanic children randomized to an aerobic intensity program found that the intervention group was less likely to present with depression but did not report reduced anxiety (Crews et al., 2004; Hallal et al., 2006). A study that included Black and White children (7-11 years old) found that a 40-minute daily dose of aerobic exercise significantly reduced depressive symptoms and physical appearance self-worth in both Black and White children and increased global self-worth in White children compared to controls (Petty et al., 2009). Physical activity has also been positively associated with mental health regardless of weight status (normal versus overweight) or gender (male versus female) (Petty et al., 2009; Ahn and Fedewa, 2011); however, results are stronger for males (Ahn and Fedewa, 2011).

Improvements in mental health as a result of physical activity may be more pronounced among clinically diagnosed populations especially those with cognitive impairment or post-traumatic stress disorder (Craft and Landers, 1998; Ahn and Fedewa, 2011; Biddle and Asare, 2011). Evidence is less clear for youth with clinical depression (Craft and Landers, 1998; Larun et al., 2006; Biddle and Asare, 2011). Individuals diagnosed with major depression undergoing an intervention entailing aerobic exercise have shown significant improvement in depression and lower relapse rates, comparable to results seen in participants receiving psychotropic treatment (Babyak et al., 2000; Penedo and Dahn, 2005). One program for adults with Down syndrome providing three sessions of exercise and health education per week for 12 weeks resulted in more positive expectations, fewer emotional barriers, and improved life-satisfaction (Heller et al., 2004; Penedo and Dahn, 2005). Ahn and Fedewa (2011) found that compared with nondiagnosed individuals, physical activity had a fivefold greater impact on those diagnosed with cognitive impairment and a twofold greater effect on those diagnosed with emotional disturbance, suggesting that physical activity has the potential to improve the mental health of those most in need.

In sum, although more studies are needed, and there may be some differences in the magnitude and nature of the mental health benefits derived, it appears that physical activity is effective in improving mental health regardless of age, ethnicity, gender, or mental health status.

Sedentary Behavior

Sedentary behavior also influences mental health. Screen viewing in particular and sitting in general are consistently associated with poorer mental health (Biddle and Asare, 2011). Children who watch more television have higher rates of anxiety, depression, and posttraumatic stress and are at higher risk for sleep disturbances and attention problems (Kappos, 2007). Given the cross-sectional nature of these studies, however, the direction of these associations cannot be determined. A single longitudinal study found that television viewing, but not playing computer games, increased the odds of depression after 7-year follow-up (Primack et al., 2009; Biddle and Asare, 2011), suggesting that television viewing may contribute to depression. Because of design limitations of the available studies, it is unclear whether this effect is mediated by physical activity.

Television viewing also is associated with violence, aggressive behaviors, early sexual activity, and substance abuse (Kappos, 2007). These relationships are likely due to the content of the programming and advertising as opposed to the sedentary nature of the activity. Television viewing may affect creativity and involvement in community activities as well; however, the evidence is very limited (Kappos, 2007). Studies with experimental designs are needed to establish a causal relationship between sedentary behavior and mental health outcomes (Kappos, 2007).

Although the available evidence is not definitive, it does suggest that sedentary activity and television viewing in particular can increase the risk for depression, anxiety, aggression, and other risky behaviors and may also affect cognition and creativity (Kappos, 2007), all of which can effect academic performance. It would therefore appear prudent for schools to reduce these sedentary behaviors during school hours and provide programming that has been shown to be effective in reducing television viewing outside of school (Robinson, 1999; Robinson and Borzekowski, 2006).

Mechanisms

It is not surprising that physical activity improves mental health. Both physiological and psychological mechanisms explain the observed associations. Physiologically, physical activity is known to increase the synaptic transmission of monoamines, an effect similar to that of anti-depressive drugs. Physical activity also stimulates the release of endorphins (endogenous opoids) (Peluso and Guerra de Andrade, 2005), which have an inhibitory effect on the central nervous system, creating a sense of calm and improved mood (Peluso and Guerra de Andrade, 2005; Ahn and Fedewa, 2011). Withdrawal of physical activity may result in irritability, restlessness, nervousness, and frustration as a result of a drop in endorphin levels. Although more studies are needed to specify the exact neurological pathways that mediate this relationship, it appears that the favorable impact of physical activity on the prevention and treatment of depression may be the result of adaptations in the central nervous system mediated in part by neurotropic factors that facilitate neurogenerative, neuroadaptive and neuroprotective processes (Dishman, 2006). It has been observed, for example, that chronic wheel running in rats results in immunologic, neural and cellular responses that mitigate several harmful consequences of acute exposure to stress (Dishman, 2006). A recent study found that children who were more physically active produced less cortisol in response to stress suggesting that physical activity promotes mental health by regulating the hormonal responses to stress (Martikainen, 2013).

Psychological mechanisms that may explain why physical activity improves mental health include (1) distraction from unfavorable stimuli, (2) increase in self-efficacy, and (3) positive social interactions that can result from quality physical activity programming (Peluso and de Andrade, 2005) (see also the discussion of psychosocial health above). The relative contribution of physiological and psychological mechanisms is unknown, but they likely interact. Poor physical health also can impair mood and mental function. Health-related quality of life improves with physical activity that increases physical functioning, thereby enhancing the sense of well-being (McAuley and Rudolph, 1995; HHS, 2008).

Physical activity during childhood and adolescence may not only be important for its immediate benefits for mental health but also have implications for long-term mental health. Studies have shown a consistent effect of physical activity during adolescence on adult physical activity (Hallal et al., 2006). Physical activity established in children may persist into adulthood, thereby continuing to confer mental health benefits throughout the life cycle. Furthermore, physical activity in childhood may impact adult mental health regardless of the activity's persistence (Hallal et al., 2006).

Summary

Physical activity can improve mental health by decreasing and preventing conditions such as anxiety and depression, as well as improving mood and other aspects of well-being. Evidence suggests that the mental health benefits of physical activity can be experienced by all age groups, genders, and ethnicities. Moderate effect sizes have been observed among both youth and adults. Youth with the highest risk of mental illness may experience the most benefit. Although evidence is not adequate to determine the ideal regimen, aerobic and high-intensity physical activity are likely to confer the most benefit. It appears, moreover, that a variety of types of physical activity are effective at improving different aspects of mental health; therefore, a varied regimen including both aerobic activities and strength training may be the most effective. Frequent episodes of physical activity are optimal given the well-substantiated short-term effects of physical activity on mental health status. Although there are well-substantiated physiological bases for the impact of physical activity on mental health, physical activity programming that effectively enhances social interactions and self-efficacy also may improve mental health through these mechanisms. Quality physical activity programming is also critical to attract and engage youth of all skills level and to effectively reach those at highest risk.

Sedentary activity may increase the risk of poor mental health status independently of, or in addition to, its effect on physical activity. Television viewing in particular may lead to a higher risk of such conditions as depression and anxiety and may also increase violence, aggression and other high-risk behaviors. These impacts are likely the result of programming and advertising content in addition to the physiological effects of inactivity and electronic stimuli.

In conclusion, frequently scheduled and well-designed opportunities for varied physical activity during the school day and a reduction in sedentary activity have the potential to improve students' mental health in ways that could improve their academic performance and behaviors in school.

SUMMARY

Good health is the foundation of learning and academic performance (see Chapter 4). In children and youth, health is akin to growth. An extensive literature demonstrates that regular physical activity promotes growth and development and has multiple benefits for physical, mental, cognitive, and psychosocial health that undoubtedly contribute to learning. Although much of the evidence comes from cross-sectional studies showing associations between physical activity and various aspects of health, available prospective data support this cross-sectional evidence. Experimental evidence, although more limited for younger children, is sufficient among older children and adolescents to support the notion that children and young adults derive much the same health benefits from physical activity.

Moreover, many adult diseases have their origins in childhood. This finding, together with the finding that health-related behaviors and disease risk factors may track from childhood into adulthood, underscores the need for early and ongoing opportunities for physical activity.

Children's exercise capacity and the activities in which they can successfully engage, change in a predictable way across developmental periods. For example, young children are active in short bursts and their capacity for continuous activity increases as they grow and mature (Figure 3-2). In adults and likely also adolescents, intermittent exercise has much the same benefit as continuous exercise when mode and energy expenditure are held constant. The health benefits of sporadic physical activity at younger ages are not well established. However, the well-documented short-term benefits of physical activity for some aspects of mental and cognitive health suggest that maximum benefit may be attained through frequent bouts of exercise throughout the day.

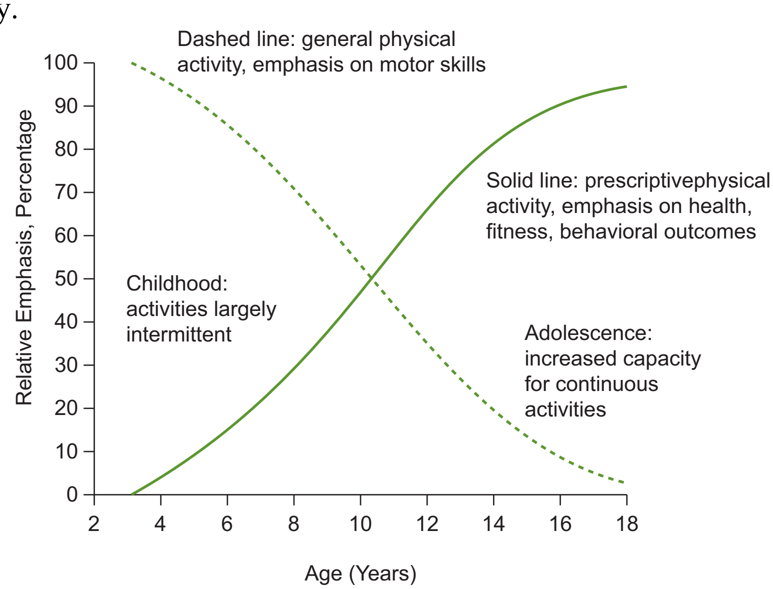


FIGURE 3-2 Changes in physical activity needs with increasing age of children and adolescents.
SOURCE: Adapted from Malina, 1991. Reprinted with permission from Human Kinetics Publishers.

Children require frequent opportunities for practice to develop the skills and confidence that promote ongoing engagement in physical activity. Physical education curricula are structured to provide developmentally appropriate experiences that build the motor skills and self-efficacy that underlie lifelong participation in health-enhancing physical activity, and trained physical education specialists are uniquely qualified to deliver them (see Chapter 5). However, physical education usually is offered during a single session. Therefore, other opportunities for physical activity can supplement physical education by addressing the need for more frequent exercise during the day (see Chapter 6). In addition to the immediate benefits of short bouts of physical activity for learning and for mental health, developmentally appropriate physical activity during those times, along with the recommended time in physical education, can contribute to daily energy expenditure and help lessen the risk of excess weight gain and its comorbidities. Specific types of activities address specific health concerns. For example, vertical jumping activities contribute to energy expenditure for obesity prevention and also promote bone development (via the resulting ground reaction forces), potentially contributing to lower fracture risk. Other activities contribute to prevention of chronic disease. Since different types of physical activity contribute to distinct aspects of physical, mental, and psychosocial health, a varied regimen is likely to be most beneficial overall.

The quality of physical activity programming also is critical; psychosocial outcomes and improvements in specific motor skills, for example, are likely the result of programming designed specifically to target these outcomes rather than just a result of increases in physical activity per se. These psychosocial outcomes also are likely to lead to increased levels of physical activity in both the short and long terms, thereby conferring greater health benefits. Unstructured physical activity or free play also confers unique benefits and is an important supplement to more structured opportunities. Quality physical activity programming that makes these activities attractive, accessible and safe for children and youth of all skill and fitness levels is critical to ensure all youth participate in these activities and can therefore derive the health benefits.

Sedentary activities, such as screen viewing and excessive time spent sitting, may contribute to health risks both because of and independently of their impact on physical activity. Thus, specific efforts in school to reduce sedentary behaviors, such as through classroom and playground design and reduction of television viewing, are warranted.

In sum, a comprehensive physical activity plan with physical education at the core, supplemented by other varied opportunities for and an environment supportive of physical activity throughout the day, would make an important contribution to children's health and development, thereby enhancing their readiness to learn.

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4
Physical Activity, Fitness, and Physical Education: Effects on Academic Performance

Key Messages

- Evidence suggests that increasing physical activity and physical fitness may improve academic performance, and that time in the school day dedicated to recess, physical education class, and physical activity in the classroom may also facilitate academic performance.
- Available evidence suggests that mathematics and reading are the academic topics that are most influenced by physical activity. These academic topics depend on efficient and effective executive function, which has been linked to physical activity and physical fitness.
- Executive function and brain health underlie academic performance. Basic cognitive functions related to attention and memory facilitate learning and these functions are enhanced by physical activity and higher aerobic fitness.
- Both single sessions and chronic participation in physical activity benefit cognitive and brain health and academic performance. Children who participate in vigorous or moderate-intensity physical activity benefit the most.
- Given the importance of time on task to learning, students should be provided with frequent physical activity breaks that are developmentally appropriate.
- Although presently understudied, physically active lessons offered in the classroom may increase time on task and attention to task in the classroom setting.

Although academic performance stems from a complex interaction between intellect and contextual variables, health is a vital moderating factor in a child's ability to learn. The idea that healthy children learn better is empirically supported and well accepted (Basch, 2010), and multiple studies have confirmed that health benefits are associated with physical activity, including cardiovascular and muscular fitness, bone health, psychosocial outcomes, and cognitive and brain health (Strong et al., 2005; see Chapter 3). The relationship of physical activity and physical fitness to cognitive and brain health and to academic performance is the subject of this chapter.

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

Before outlining the health benefits of physical activity and fitness, it is first important to note that many factors influence academic performance. Among these are socioeconomic status (SES) (Sirin, 2005), family education (Kim et al., 2003), and parental involvement (Fan and Chen, 2001), and a host of other demographic factors. A valuable predictor of student academic performance is a parent having clear expectations for academic success by the child. Additionally, attendance is another factor that is related to academic performance (Stanca, 2006; Baxter et al., 2011). Because children must be present to learn the desired content, attendance has been confirmed as having a significant impact on academic performance, and therefore should be measured when considering the factors related to academic performance.

State-mandated academic achievement testing has had the unintended consequence of reducing opportunities for children to be physically active during the school day and beyond. In addition to a general shifting of time in school away from physical education to allow for more time on academic subjects, some children are withheld from physical education classes or recess to participate in remedial or enriched learning experiences designed to increase academic performance (Pellegrini and Bohn, 2005; see Chapter 5). Yet little evidence supports the notion that more time allocated to subject matter will translate into better test scores. Indeed, 11 of 14 correlational studies of physical activity during the school day demonstrate a positive relationship to academic performance (Rasberry et al., 2011) Overall, a rapidly growing body of work suggests that time spent engaged in physical activity is related not only to a healthier body, but also to a healthier mind (Hillman et al., 2008).

Children respond faster and with greater accuracy to a variety of cognitive tasks after participating in a session of physical activity (Tomporowski, 2003; Budde et al., 2008; Hillman et al., 2009; Pesce et al., 2009; Ellemberg and St-Louis-Deschênes, 2010). A single bout of moderate-intensity physical activity has been found to increase neural and behavioral concomitants associated with the allocation of attention to a specific cognitive task (Hillman et al., 2009; Pontifex et al., in press). And when children who participated in 30 minutes of aerobic physical activity were compared with children who watched television for the same amount of time, the former children cognitively outperformed the latter (Ellemberg and St-Louis-Desêhenes, 2010). Visual task switching data among 69 overweight and inactive children did not yield differences between cognitive performance post–treadmill walking and sitting (Tomporowski et al., 2008).

When physical activity is used as a break from academic learning time, post-engagement effects include, better attention (Greico et al., 2009; Bartholomew and Jowers, 2011), increased on-task behaviors (Mahar et al., 2006), and improved academic performance (Donnelly and Lambourne, 2011). Comparisons between first grade students housed in a classroom with stand-sit desks, where the child could stand at his/her discretion, and classrooms containing traditional furniture, determined that children were highly likely to stand thus leading to significantly higher energy expenditure over those who were seated (Benden et al., 2011). More importantly, teachers can offer physical activity breaks as part of a supplemental curriculum or simply as a way to reset student attention during a lesson (Kibbe et al., 2011), and when provided with minimal training, can efficaciously produce vigorous or moderate energy expenditure in students (Stewart et al., 2004). Further, after-school physical activity programs have demonstrated the ability to improve cardiovascular endurance, and this increase in aerobic fitness has been shown to mediate improvements in academic performance (Fredericks et al., 2006), as well as the allocation of neural resources underlying performance on a working memory task (Kamijo et al., 2011).

PHYSICAL FITNESS AND PHYSICAL ACTIVITY: RELATION TO ACADEMIC PERFORMANCE

Over the past three decades, several reviews and meta-analyses have described the relationship among physical fitness, physical activity, and cognition (broadly defined as all mental processes). The majority of these reviews have focused on the relationship between academic performance and physical fitness, as previously defined in Chapter 3 as a physiological trait, commonly defined in terms of cardiorespiratory capacity (e.g., maximal oxygen consumption). More recently, reviews have attempts to describe the effects of an acute or single bout of physical activity, as a behavior, on academic performance. These reviews have focused on brain health in older adults (Colcombe and Kramer, 2003) as well as the effects of acute physical activity on cognition in adults (Tomporowski, 2003). Some have considered age as part of the meta-analytic analysis (Etnier et al., 1997, 2006). Although more recently reviews that focus on research conducted in children have emerged (Sibley and Etnier, 2003) examining the effects of physical activity, participation in sports, and academic performance (Trudeau and Shephard, 2008, 2010; Singh et al., 2012); physical activity and mental and cognitive health (Biddle and Asare, 2011); and physical activity, nutrition, and academic performance (Burkhalter and Hillman, 2011). The findings of most of these reviews align with the conclusions presented in a meta-analytic review conducted by Fedewa and Ahn (2011). The studies reviewed by Fedewa and Ahn include experimental/quasi-experimental as well as cross-sectional and correlational designs, with the experimental designs yielding the highest effect sizes. The strongest relationships were found between aerobic fitness and achievement in mathematics, followed by IQ and reading performance. The range of cognitive performance measures, participant characteristics, and types of research design all mediated the relationship among physical activity, fitness, and academic performance (Fedewa and Ahn, 2011). With regard to physical activity interventions, which were carried out both within and beyond the school day, those involving small groups of peers (around 10 youth of a similar age) were associated with the greatest gains in academic performance.

The number of peer-reviewed publications on this topic is growing exponentially. Further evidence of the growth of this line of inquiry is its increased global presence. Positive relationships among physical activity, physical fitness, and academic performance have been found among students from Kuwait (Adelalim et al., 2012), Turkish elementary-age children (Aktop, 2010), 6- to 12-year-old Portuguese children (Barrigas and Fragoso, 2010), and children in the Netherlands (Singh et al., 2012) and Taiwan (Chih and Chen, 2011). However, broadly speaking many of these studies show small to moderate effects and suffer from poor research designs (Biddle and Asare, 2011; Singh et al., 2012).

Basch (2010) conducted a comprehensive review of how children's health and health disparities influence academic performance and learning. The author's report draws on empirical evidence suggesting that education reform will be ineffective unless children's health is made a priority. Basch concludes that schools may be the only place where health inequities can be addressed, and that if children's basic health needs are not met, they will struggle to learn regardless of the effectiveness of the instructional materials used. More recently, Efrat (2011) conducted a review of physical activity, fitness, and academic performance to examine the achievement gap. He discovered that only seven studies had included socioeconomic status as variable, despite its known relationship to education (Sirin, 2005).

Physical Fitness as a Learning Outcome of Physical Education and Its Relation to Academic Performance

Achieving and maintaining a healthy level of aerobic fitness, as defined using criterion-referenced standards from the National Health and Nutrition Examination Survey (NHANES) (Welk et al., 2011), is a desired learning outcome of physical education programming. Regular participation in physical activity also is a national learning standard for physical education, a standard intended to facilitate the establishment of habitual and meaningful engagement in physical activity (NASPE, 2004). Yet although physical fitness and participation in physical activity are established as learning outcomes in all 50 states, there is little evidence to suggest that children actually achieve and maintain these standards (see Chapter 2).

Statewide and national datasets containing data on youth physical fitness and academic performance have increased access to student-level data on this subject, (Grissom, 2005; Cottrell et al., 2007; Carlson et al., 2008; Chomitz et al., 2008 Wittberg et al., 2010; Van Dusen et al., 2011). Early research in South Australia focused on quantifying the benefits of physical activity and physical education during the school day; the benefits noted included increased physical fitness, decreased body fat, and reduced risk for cardiovascular disease (Dwyer et al., 1979, 1983). Even today, Dwyer and colleagues are among the few scholars who regularly include in their research measures of physical activity intensity in the school environment, which is believed to be a key reason why they are able to report differentiated effects are reported of different intensities. A longitudinal study in Trois Rivieres, Quebec, Canada, tracked how academic performance of children from grades 1 through 6 was related to student health, motor skills, and time spent in physical education. The researchers concluded that additional time dedicated to physical education did not inhibit academic performance (Shephard et al., 1984; Shephard, 1986; Trudeau and Shephard, 2008).

Longitudinal follow-up investigating the long-term benefits of enhanced physical education experiences is encouraging, but largely inconclusive. In a study examining the effects of daily physical education during elementary school on physical activity during adulthood, 720 men and women completed the Quebec Health Survey (Trudeau et al., 1999). Findings suggest that physical education was associated with physical activity in later life for females but not males (Trudeau et al., 1999); most of the associations were significant but weak (Trudeau et al., 2004). Adult body mass index (BMI) at age 34 was related to childhood BMI at ages 10-12 in females but not in males (Trudeau et al., 2001). Longitudinal studies such as those conducted in Sweden and Finland also suggest that physical education experiences may be related to adult engagement in physical activity (Glenmark, 1994; Telama et al., 1997). From an academic performance perspective, longitudinal data on men who enlisted for military service imply that cardiovascular fitness at age 18 predicted cognitive performance in later life (Aberg et al., 2009), thereby supporting the idea of offering physical education and of physical activity opportunities well into emerging adulthood through secondary and postsecondary education.

Castelli and colleagues (2007) investigated younger children (in 3rd and 5th grades) and the differential contributions of the various subcomponents of the FITNESSGRAM. Specifically, they examined the individual contributions of aerobic capacity, muscle strength, muscle flexibility, and body composition to performance in mathematics and reading on the Illinois Standardized Achievement Test among a sample of 259 children. Their findings corroborate those of the California Department of Education (Grissom, 2005), indicating a general relationship between fitness and achievement test performance. When the individual components of the FITNESSGRAM were decomposed, the researchers determined that only aerobic capacity was related to test performance. Muscle strength and flexibility showed no relationship, while an inverse association of BMI with test performance was observed, such that higher BMI was associated with lower test performance. Although Baxter (2011) confirmed the importance of attending school in relation to academic performance, through the use of fourth grade student recall, correlations with BMI were not significant.

State-mandated implementation of the coordinated school health model requires all schools in Texas to conduct annual fitness testing using the FITNESSGRAM among students in grades 3-12. In a special issue of the *Research Quarterly for Exercise and Sport* (2010), multiple articles describe the current state of physical fitness among children in Texas; confirm the associations among school performance levels, academic achievement, and physical fitness (Welk et al., 2010; Zhu et al., 2010); and demonstrate the ability of qualified physical education teachers to administer physical fitness tests (Zhu et al., 2010). Also using data from Texas schools, Van Dusen and colleagues (2011) found that cardiovascular fitness had the strongest association with academic performance, particularly in mathematics over reading. Unlike previous research, which demonstrated a steady decline in fitness by developmental stage (Duncan et al., 2007); this study found that cardiovascular fitness did decrease, but not significantly (Van Dusen et al., 2011). Aerobic fitness, then, may be important to academic performance, as there may be a dose-response relationship (Van Dusen et al., 2011).

Using a large sample of students in grades 4-8, Chomitz and colleagues (2008) found that the likelihood of passing both mathematics and English achievement tests increased with the number of fitness tests passed during physical education class, and the odds of passing the mathematics achievement tests were inversely related to higher body weight. Similar to the findings of Castelli and colleagues (2007), socioeconomic status and demographic factors explained little of the relationship between aerobic fitness and academic performance; however socioeconomic status may be an explanatory variable for students of low fitness (London and Castrechini, 2011). In sum, numerous cross-sectional and correlational studies demonstrate small to moderate positive or null associations between physical fitness,[1] particularly aerobic fitness, and academic performance.[2] Moreover, the findings may support a dose-response association, suggesting that the more components of physical fitness (e.g., cardiovascular endurance, strength, muscle endurance) considered acceptable for the specific age and gender are present, the greater is the likelihood of successful academic performance. From a public health and policy standpoint, the

[1] Grissom, 2005; Cottrell et al., 2007; Edwards et al, 2009; Eveland-Sayers et al., 2009; Cooper et al., 2010; Welk et al., 2010; Wittberg et al., 2010; Zhu et al., 2010; Van Dusen et al., 2011.
[2] Castelli et al, 2007; Chomitz et al., 2008; Roberts et al., 2010; Welk et al., 2010; Chih and Chen, 2011; London and Castrechini, 2011; Van Dusen et al., 2011.

conclusions they support are limited by few causal inferences, a lack of data confirmation, and inadequate reliability because the data often are collected by nonresearchers or through self-report methods. It may also be noted that this research includes no known longitudinal studies and few randomized controlled trials (examples are included later in the chapter in the discussion of the developing brain).

Physical Activity, Physical Education, and Academic Performance

In contrast with the correlational data presented above for physical fitness, more information is needed on the direct effects of participation in physical activity programming and physical education classes on academic performance. Habitual physical activity refers to movement requiring large muscle groups that is quantified in terms of intensity (how hard the participant engages, as measured by heart rate, or energy expenditure) and the duration of the physical activity. Accordingly, the physical activity training or programs will be discussed in relation to academic performance in this section.

In a meta-analysis, Sibley and Etnier (2003) found a positive relationship between physical activity and cognition in school-age youth (aged 4-18), suggesting that physical activity, as well as physical fitness, may be related to cognitive outcomes during development. Participation in physical activity was related to cognitive performance in eight measurement categories (perceptual skills, IQ, achievement, verbal tests, mathematics tests, memory, developmental level/academic readiness, and other), with results indicating a beneficial relationship of physical activity to all cognitive outcomes except memory (Sibley and Etnier, 2003). Since that meta-analysis, however, several papers have reported robust relationships between aerobic fitness and different aspects of memory in children (e.g., Chaddock et al., 2010a, 2011; Kamijo et al., 2011; Monti et al., 2012). Regardless, the comprehensive review of Sibley and Etnier (2003) was important because it helped bring attention to an emerging literature suggesting that physical activity may benefit cognitive development, even as it also demonstrated the need for further study to better understand the multifaceted relationship between physical activity and cognitive and brain health.

The regular engagement in physical activity during physical education programming can also be related to academic performance, especially when the class is taught by physical education teacher. Several other studies provide additional support for the above-noted findings. The Sports, Play, and Active Recreation (SPARK) study examined the effects of a 2-year health-related physical education program on academic performance in children (Sallis et al., 1999). In an experimental design, seven elementary schools were randomly assigned to one of three conditions: (1) a specialist condition in which certified physical education teachers delivered the SPARK curriculum, (2) a trained teacher condition in which classroom teachers implemented the curriculum, and (3) a control condition in which classroom teachers implemented the local physical education curriculum. No significant differences by condition were found for mathematics testing; however, reading scores were significantly higher in the specialist condition relative to control condition (Sallis et al., 1999), while language scores were significantly lower in the specialist condition than in the other two conditions. The authors conclude that spending time in physical education with a specialist did not have a negative effect on academic performance. Shortcomings of this research include the amount of data loss from pre- to posttest; the use of results of second-grade testing that exceeded the national average in performance as baseline data; and the use of norm-referenced rather than criterion-based testing.

In seminal research conducted by Gabbard and Barton (1979), six different conditions of physical activity (no activity 20, 30, 40, and 50 minutes; and posttest no activity) were completed by 106 second graders during physical education. Each physical activity session was followed by 5 minutes of rest and the completion of 36 math problems. The authors found a potential threshold effect whereby only the 50-minute condition improved mathematical performance, with no differences by gender.

A longitudinal study of the kindergarten class of 1998-1999, using data from the Early Childhood Longitudinal Study, investigated the association between enrollment in physical education and academic achievement (Carlson et al., 2008). Higher amounts of physical education were correlated with better academic performance in mathematics among females, but this finding did not hold true for males.

Ahamed and colleagues (2007) found in a cluster randomized trial that after 16 months of a classroom-based physical activity intervention, there was no significant difference between the treatment and control groups in performance on the standardized Cognitive Abilities Test, Third Edition (CAT-3). Others have found, however, that coordinative exercise (Budde et al., 2008) or bouts of vigorous physical activity during free time (Coe et al., 2006) contribute to higher levels of academic performance. Specifically, Coe and colleagues (2006) examined the association of enrollment in physical education and self-reported vigorous or moderate-intensity physical activity outside school with performance in core academic courses and on the Terra Nova Standardized Achievement Test among more than 200 sixth-grade students. Their findings indicate that academic performance was unaffected by enrollment in physical education classes, which were found to average only 19 minutes of vigorous or moderate-intensity physical activity. When time spent engaged in vigorous or moderate-intensity physical activity outside of school was considered, however, a significant positive relation to academic performance emerged, with more time engaged in vigorous or moderate-intensity physical activity relating to better grades, but not test scores (Coe et al., 2006).

Studies of participation in sports and academic achievement have found positive associations (Mechanic and Hansell, 1987; Dexter, 1999; Crosnoe, 2002; Eitle and Eitle, 2002; Stephens and Schaben, 2002; Eitle, 2005; Miller et al., 2005; Fox et al., 2010; Ruiz et al., 2010); higher grade point averages (GPAs) in season than out of season (Silliker and Quirk, 1997); a negative association between cheerleading and science performance (Hanson and Kraus, 1998); and weak and negative associations between the amount of time spent participating in sports and performance in English-language class among 13-, 14-, and 16-year old students (Daley and Ryan, 2000). Other studies, however, have found no association between participation in sports and academic performance (Fisher et al., 1996). The findings of these studies need to be interpreted with caution as many of their designs failed to account for the level of participation by individuals in the sport (e.g., amount of playing time, type and intensity of physical activity engagement by sport). Further, it is unclear whether policies required students to have higher GPAs to be eligible for participation. Offering sports opportunities is well justified regardless of the cognitive benefits, however, given that adolescents may be less likely to engage in risky behaviors when involved in sports or other extracurricular activities (Page et al., 1998; Elder et al., 2000; Taliaferro et al., 2010), that participation in sports increases physical fitness, and that affiliation with sports enhances school connectedness.

Although a consensus on the relationship of physical activity to academic achievement has not been reached, the vast majority of the available evidence suggests that the relationship is either positive or neutral. The meta-analytic review by Fedewa and Ahn (2011) suggests that interventions entailing aerobic physical activity have the greatest impact on academic performance; however, all types of physical activity, except those involving flexibility alone, contribute to enhanced academic performance, as do interventions that use small groups (about 10 students) rather than, individuals or large groups. Regardless of the strength of the findings, the literature indicates that time spent engaged in physical activity is beneficial to children because it has not been found to detract from academic performance, and in fact can improve overall health and function (Sallis et al., 1999; Hillman et al., 2008; Tomporowski et al., 2008; Trudeau and Shephard, 2008; Rasberry et al., 2011).

Single Bouts of Physical Activity

Beyond formal physical education, evidence suggests that multicomponent approaches are a viable means of providing physical activity opportunities for children across the school curriculum (see also Chapter 6). Although health-related fitness lessons taught by certified physical education teachers result in greater student fitness gains relative to such lessons taught by other teachers (Sallis, 1999), non–physical education teachers are capable of providing opportunities to be physically active within the classroom (Kibbe et al., 2011). Single sessions or bouts of physical activity have independent merit, offering immediate benefits that can enhance the learning experience. Studies have found that single bouts of physical activity result in improved attention (Hillman et al., 2003, 2009; Pontifex et al., in press), better working memory (Pontifex et al., 2009), and increased academic learning time and reduced off-task behaviors (Mahar et al., 2006; Bartholomew and Jowers, 2011). Yet, single bouts of physical activity have differential effects, as very vigorous exercise has been associated with cognitive fatigue and even cognitive decline in adults (Tomporowski, 2003). As seen in Figure 4-1, high levels of effort, arousal, or activation can influence perception, decision making, response preparation, and actual response. To comprehend the underlying constructs and differential effects of single bouts of physical activity on cognitive performance, see Tomporowski (2003).

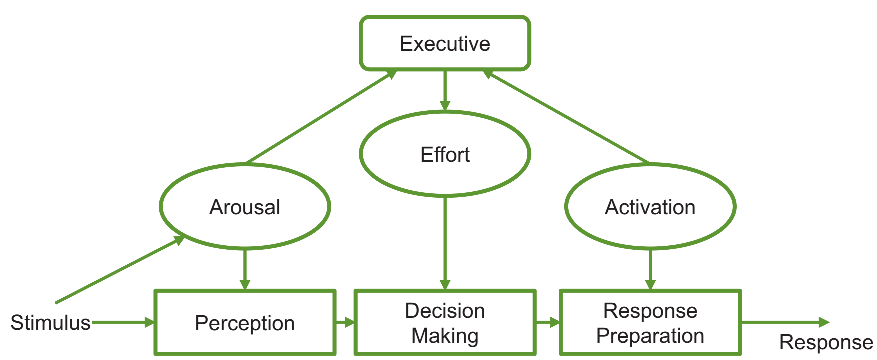

FIGURE 4-1 Information processing: Diagram of a simplified version of Sanders' (1983) cognitive-energetic model of human information processing (adapted from Jones and Hardy, 1989).
SOURCE: Tomporowski, 2003. Reprinted with permission.

For children, classrooms are busy places where they must distinguish relevant information from distractions that emerge from many different sources occurring simultaneously. A student must listen to the teacher, adhere to the classroom procedures, focus on a specific task, hold and retain information, and make connections between novel information and previous experiences. Hillman and colleagues (2009) demonstrated that a single bout of moderate-intensity walking (60 percent of maximum heart rate) resulted in significant improvements in performance on a task requiring attentional inhibition (e.g., the ability to focus on a single task). These findings were accompanied by changes in neuroelectric measures underlying the allocation of attention (see Figure 4-2), and significant improvements on the reading subtest of the Wide Range Achievement Test. No such effects were observed following a similar duration of quiet rest. These findings were later replicated and extended to demonstrate benefits for both mathematics and reading performance in healthy children and those diagnosed with attention deficit hyperactivity disorder (Pontifex et al., 2013). Further replications of these findings demonstrated that a single bout of moderate-intensity exercise using a treadmill improved performance on a task of attention and inhibition, but similar benefits were not derived from moderate-intensity exercise that involved exergaming (O'Leary et al., 2011). It was also found that such benefits were derived following cessation of, but not during, the bout of exercise (Drollette et al., 2012). The applications of such empirical findings within the school setting remain unclear.

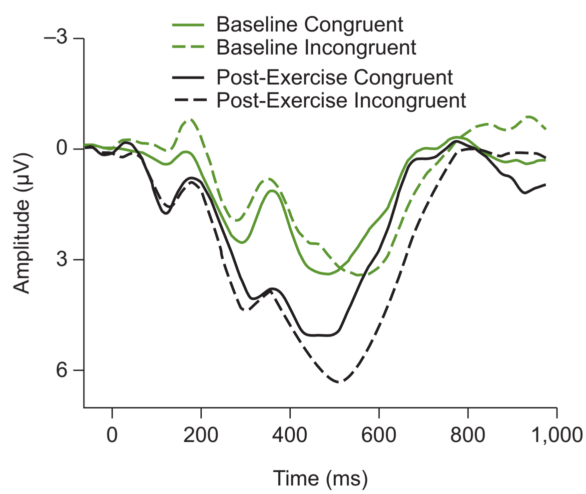

FIGURE 4-2 Effects of a single session of exercise in preadolescent children.
SOURCE: Hillman et al., 2009. Reprinted with permission.

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

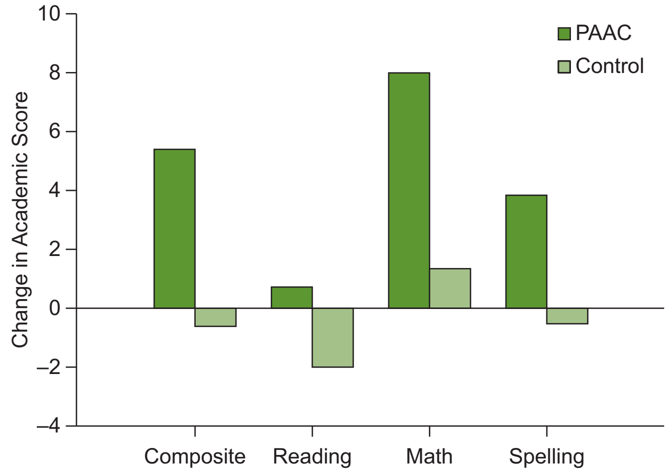

FIGURE 4-3 Change in academic scores from baseline after physically active classroom lessons in elementary schools in northeast Kansas (2003-2006).
NOTE: All differences between the Physical Activity across the Curriculum (PAAC) group (n = 117) and control group (n = 86) were significant (p <0.01).
SOURCE: Donnelly et al., 2009. Reprinted with permission.

It is important to note that cognitive tasks completed before, during, and after physical activity show varying effects, but the effects are always positive compared with sedentary behavior. In a study carried out by Drollette and colleagues (2012), 36 preadolescent children completed two cognitive tasks a flanker task to assess attention and inhibition and a spatial n-back task to assess working memory before, during, and after seated rest and treadmill walking conditions. The children sat or walked on different days for an average of 19 minutes. The results suggest that the physical activity enhanced cognitive performance for the attention task but not for the task requiring working memory. Accordingly, although more research is needed, it has been suggested by the authors that the acute effects of exercise may be selective to certain cognitive processes (i.e., attentional inhibition) while unrelated to others (e.g., working memory). Indeed, data collected using a task-switching paradigm (i.e., a task designed to assess multitasking and requiring the scheduling of attention to multiple aspects of the environment) among 69 overweight and inactive children did not show differences in cognitive performance following acute bouts of treadmill walking or sitting (Tomporowski et al., 2008). Thus, findings to date indicate a robust relationship of acute exercise to transient improvements in attention, but appear inconsistent for other aspects of cognition.

Academic Learning Time and On- and Off-Task Behaviors

Excessive time on task, inattention to task, off-task behavior, and delinquency are important considerations in the learning environment given the importance of academic learning time to academic performance. These behaviors are observable and of concern to teachers as they detract from the learning environment. Systematic observation by trained observers may yield important insight regarding the effects of short physical activity breaks on these behaviors. Indeed, systematic observations of student behavior have been used as an alternative means of measuring academic performance (Mahar et al., 2006; Greico et al., 2009).

After the development of classroom-based physical activities, called Energizers, teachers were trained in how to implement such activities in their lessons at least twice per week (Mahar et al., 2006). Measurements of baseline physical activity and on-task behaviors were collected in two third-grade and two fourth-grade classes, using pedometers and direct observation. The intervention included 243 students, while 108 served as controls by not engaging in the Energizers activities. A subgroup of 62 third and fourth graders was observed for on-task behavior in the classroom following the physical activity. Children who participated in the Energizers activities took more steps during the school day than those who did not; they also increased their on-task behaviors by more than 20 percent over baseline measures.

A systematic review of a similar in-class, academically oriented physical activity plan, Take 10!, was conducted to identify the effects of its implementation after it had been in use for 10 years (Kibbe et al., 2011). The findings suggest that children who experienced Take 10! in the classroom engaged in moderate to vigorous physical activity (6.16 to 6.42 METs) and had lower BMIs than those who did not. Further, children in the Take 10! classrooms had better fluid intelligence (Reed et al., 2010), and higher academic achievement scores (Donnelly et al., 2009).

Some have expressed concern that introducing physical activity into the classroom setting may be distracting to students. Yet, in one study, it was sedentary students who demonstrated a decrease in time on-task, while active students returned to the same level of on-task behavior after an active learning task (Greico et al., 2009). Among the 97 third-grade students in this study, a small but nonsignificant increase in on-task behaviors was seen immediately following these active lessons (Greico et al., 2009). Additionally, these improvements were not mediated by BMI. In sum, although presently understudied, physically active lessons may increase time on task and attention to task in the classroom setting. Given the complexity of the typical classroom, the strategy of including content-specific lessons that incorporate physical activity may be justified.

Recess

It is recommended that every child have 20 minutes of recess each day and that this time be outdoors whenever possible, in a safe activity (NASPE, 2006). Consistent engagement in recess can help students refine social skills, learn social mediation skills surrounding fair play, obtain additional minutes of vigorous or moderate-intensity physical activity that contribute toward the recommend 60 minutes or more per day, and have an opportunity to express their imagination through free play (Pellegrini and Bohn, 2005; also see Chapter 6). When children participate in recess before lunch, additional benefits accrue, such as less food waste, increased incidence of appropriate behavior in the cafeteria during lunch, and greater student readiness to learn upon returning to the classroom after lunch (Getlinger et al., 1996; Wechsler et al., 2001). To examine the effects of engagement in physical activity during recess on classroom behavior, Barros and colleagues (2009) examined data from the Early Childhood Longitudinal Study on 10,000 8- to 9-year old children. Teachers provided the number of minutes of recess as well as a ranking of classroom behavior (ranging from misbehaves frequently to behaves exceptionally well). Results indicate that children, who had at least 15 minutes of recess were more likely to exhibit appropriate behavior in the classroom (Barros et al., 2009). In another study, 43 fourth-grade students were randomly assigned to 1 or no days of recess to examine the effects on classroom behavior (Jarrett et al., 1998). The researchers concluded that on-task behavior was better among the children who had recess. A moderate effect size (= 0.51) was observed. In a series of studies examining kindergartners' attention to task following 20-minute recess, increased time on task was observed during learning centers and story reading (Pellegrini et al., 1995). Despite these positive findings centered on improved attention, it is important to note that few of these studies actually measured the intensity of the physical activity during recess.

From a slightly different perspective, survey data from 547 Virginia elementary school principals suggest that time dedicated to student participation in physical education, art, and music did not negatively influence academic performance (Wilkins et al., 2003). Thus, the strategy of reducing time spent in physical education to increase academic performance may not have the desired effect. The evidence on in-school physical activity supports the provision of physical activity breaks during the school day as a way to increase fluid intelligence, time on task, and attention. However, it remains unclear what portion of these effects can be attributed to a break from academic time and what portion is a direct result of the specified demands/characteristics of the physical activity.

THE DEVELOPING BRAIN, PHYSICAL ACTIVITY, AND BRAIN HEALTH

The study of brain health has grown beyond simply measuring behavioral outcomes such as task performance and reaction time (e.g., cognitive processing speed). New technology has emerged that has allowed scientists to understand the impact of lifestyle factors on the brain from the body systems level down to the molecular level. A greater understanding of the cognitive components that subserve academic performance and may be amenable to intervention has thereby been gained. Research conducted in both laboratory and field settings has helped define this line of inquiry and identify some preliminary underlying mechanisms.

The Evidence Base on the Relationship of Physical Activity to Brain Health and Cognition in Older Adults

Despite the current focus on the relationship of physical activity to cognitive development, the literature base is larger on the association of physical activity with brain health and cognition during aging. Much can be learned about how physical activity affects childhood cognition and scholastic achievement through this work. Despite earlier investigations into the relationship of physical activity to cognitive aging (see Etnier et al., 1997, for a review), the field was shaped by the findings of Kramer and colleagues (1999), who examined the effects of aerobic fitness training on older adults using a randomized controlled design. Specifically, 124 older adults aged 60 and 75 were randomly assigned to a 6-month intervention of either walking (i.e., aerobic training) or flexibility (i.e., non-aerobic) training. The walking but not the flexibility group showed improved cognitive performance measured as a shorter response time to the presented stimulus. Results from a series of tasks that tapped different aspects of cognitive control indicated that engagement in physical activity is a beneficial means of combating cognitive aging (Kramer et al., 1999).

Cognitive control, or executive control, is involved in the selection, scheduling, and coordination of computational processes underlying perception, memory, and goal-directed action. These processes allow for the optimization of behavioral interactions within the environment through the flexible modulation of the ability to control attention (MacDonald et al., 2000; Botvinick et al., 2001). Core cognitive processes that make up cognitive control or executive control include inhibition, working memory, and cognitive flexibility (Diamond, 2006), processes that are mediated by networks that involve the prefrontal cortex. Inhibition (or inhibitory control) refers to the ability to override a strong internal or external pull so as to act appropriately within the demands imposed by the environment (Davidson et al., 2006). For example, one exerts inhibitory control when one stops speaking when the teacher begins lecturing. Working memory refers to the ability to represent information mentally, manipulate stored information, and act upon the information (Davidson et al., 2006). In solving a difficult mathematical problem, for example, one must often remember the remainder. Finally, cognitive flexibility refers to the ability to quickly and flexibly switch perspectives, focus attention, and adapt behavior for the purposes of goal-directed action (Blair et al., 2005; Davidson et al., 2006; Diamond, 2006). For example, one must shift attention from the teacher who is teaching a lesson to one's notes to write down information for later study.

Based on their earlier findings on changes in cognitive control induced by aerobic training, Colcombe and Kramer (2003) conducted a meta-analysis to examine the relationship between aerobic training and cognition in older adults aged 5580 using data from 18 randomized controlled exercise interventions. Their findings suggest that aerobic training is associated with general cognitive benefits that are selectively and disproportionately greater for tasks or task components requiring greater amounts of cognitive control. A second, more recent meta-analysis (Smith et al., 2010) corroborates the findings of Colcombe and Kramer (2003) , indicating that aerobic exercise is related to attention, processing speed, memory, and cognitive control; however, it should be noted that smaller effect sizes were observed, likely a result of the studies included in the respective meta-analyses. In older adults, then, aerobic training selectively improves cognition.

Hillman and colleagues (2006) examined the relationship between physical activity and inhibition (one aspect of cognitive control) using a computer-based stimulus-response protocol in 241 individuals aged 15-71. Their results indicate that greater amounts of physical activity are related to decreased response speed across task conditions requiring variable amounts of inhibition, suggesting a generalized relationship between physical activity and response speed. In addition, they found physical activity to be related to better accuracy across conditions in older adults, while no such relationship was observed for younger adults. Of interest, this relationship was disproportionately larger for the condition requiring greater amounts of inhibition in the older adults, suggesting that physical activity has both a general and selective association with task performance (Hillman et al., 2006).

With advances in neuroimaging techniques, understanding of the effects of physical activity and aerobic fitness on brain structure and function has advanced rapidly over the last decade. In particular, a series of studies (Colcombe et al., 2003, 2004, 2006; Kramer and Erickson 2007; Hillman et al., 2008) of older individuals has been conducted to elucidate the relation of aerobic fitness to the brain and cognition. Normal aging results in the loss of brain tissue (Colcombe et al., 2003) with markedly larger loss evidenced in the frontal, temporal, and parietal regions (Raz, 2000). Thus, cognitive functions subserved by these brain regions (such as those involved in cognitive control and aspects of memory) are expected to decay more dramatically than other aspects of cognition.

Colcombe and colleagues (2003) investigated the relationship of aerobic fitness to gray and white matter tissue loss using magnetic resonance imaging (MRI) in 55 healthy older adults aged 55-79. They observed robust age-related decreases in tissue density in the frontal, temporal, and parietal regions using voxel-based morphometry, a technique used to assess brain volume. Reductions in the amount of tissue loss in these regions were observed as a function of fitness

(Colcombe et al., 2003). Given that the brain structures most affected by aging also demonstrated the greatest fitness-related sparing, these initial findings provide a biological basis for fitness-related benefits to brain health during aging.

In a second study, Colcombe and colleagues (2006) examined the effects of aerobic fitness training on brain structure using a randomized controlled design with 59 sedentary healthy adults aged 60-79. The treatment group received a 6-month aerobic exercise (i.e., walking) intervention, while the control group received a stretching and toning intervention that did not include aerobic exercise. Results indicated that gray and white matter brain volume increased for those who received the aerobic fitness training intervention. No such results were observed for those assigned to the stretching and toning group (Colcombe et al., 2006). Specifically, those assigned to the aerobic training intervention demonstrated increased gray matter in the frontal lobes, including the dorsal anterior cingulate cortex, the supplementary motor area, the middle frontal gyrus, the dorsolateral region of the right inferior frontal gyrus, and the left superior temporal lobe (Colcombe et al., 2006). White matter volume changes also were evidenced following the aerobic fitness intervention, with increases in white matter tracts being observed within the anterior third of the corpus callosum (Colcombe et al., 2006). These brain regions are important for cognition, as they have been implicated in the cognitive control of attention and memory processes. These findings suggest that aerobic training not only spares age-related loss of brain structures but also may in fact enhance the structural health of specific brain regions.

In addition to the structural changes noted above, research has investigated the relationship between aerobic fitness and changes in brain function. That is, aerobic fitness training has also been observed to induce changes in patterns of functional activation. Functional MRI (fMRI) measures, which make it possible to image activity in the brain while an individual is performing a cognitive task, have revealed that aerobic training induces changes in patterns of functional activation. This approach involves inferring changes in neuronal activity from alteration in blood flow or metabolic activity in the brain. In a seminal paper, Colcombe and colleagues (2004) examine the relationship of aerobic fitness to brain function and cognition across two studies with older adults. In the first study, 41 older adult participants (mean age ~66) were divided into higher- and lower- fitness groups based on their performance on a maximal exercise test. In the second study, 29 participants (aged 58-77) were recruited and randomly assigned to either a fitness training (i.e., walking) or control (i.e., stretching and toning) intervention. In both studies, participants were given a task requiring variable amounts of attention and inhibition. Results indicated that fitness (study 1) and fitness training (study 2) were related to greater activation in the middle frontal gyrus and superior parietal cortex; these, regions of the brain are involved in attentional control and inhibitory functioning, processes entailed in the regulation of attention and action (Colcombe et al., 2004). These changes in neural activation were related to significant improvements in performance on the cognitive control task of attention and inhibition.

Taken together, the findings across studies suggest that an increase in aerobic fitness, derived from physical activity, is related to improvements in the integrity of brain structure and function, and may underlie improvements in cognition across tasks requiring cognitive control. Although developmental differences exist, the general paradigm of this research can be applied to early stages of the life span, and some early attempts to do so have been made, as described below. Given the focus of this chapter on childhood cognition, it should be noted that this section has provided only a brief and arguably narrow look at the research on physical activity and cognitive aging. Considerable work has detailed the relationship of physical activity to other aspects of adult cognition using behavioral and neuroimaging tools (e.g., Boecker, 2011). The interested reader is referred to a number of review papers and meta-analyses describing the relationship of physical activity to various aspects of cognitive and brain health (Etnier et al., 1997; Colcombe and Kramer, 2003; Tomporowski, 2003; Thomas et al., 2012).

Child Development, Brain Structure, and Function

Certain aspects of development have been linked with experience, indicating an intricate interplay between genetic programming and environmental influences. Gray matter, and the organization of synaptic connections in particular, appear to be at least partially dependent upon experience (NRC/IOM, 2000; Taylor, 2006), with the brain exhibiting a remarkable ability to reorganize itself in response to input from sensory systems, other cortical systems, or insult (Huttenlocher and Dabholkar, 1997). During typical development, experience shapes the pruning process through the strengthening of neural networks that support relevant thoughts and actions and the elimination of unnecessary or redundant connections. Accordingly, the brain responds to experience in an adaptive or "plastic" manner, resulting in the efficient and effective adoption of thoughts, skills, and actions relevant to one's interactions within one's environmental surroundings. Examples of neural plasticity in response to unique environmental interaction have been demonstrated in human neuroimaging studies of participation in music (Elbert et al., 1995; Chan et al., 1998; Münte et al., 2001) and sports (Hatfield and Hillman, 2001; Aglioti et al., 2008), thus supporting the educational practice of providing music education and opportunities for physical activity to children.

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

Recent advances in neuroimaging techniques have rapidly advanced understanding of the role physical activity and aerobic fitness may have in brain structure. In children, a growing body of correlational research suggests differential brain structure related to aerobic fitness. Chaddock and colleagues (2010 a,b) showed a relationship among aerobic fitness, brain volume, and aspects of cognition and memory. Specifically, Chaddock and colleagues (2010a) assigned 9- to 10-year-old preadolescent children to lower- and higher-fitness groups as a function of their scores on a maximal oxygen uptake (VO_2max) test, which is considered the gold-standard measure of aerobic fitness. They observed larger bilateral hippocampal volume in higher-fit children using MRI, as well as better performance on a task of relational memory. It is important to note that relational memory has been shown to be mediated by the hippocampus (Cohen and Eichenbaum, 1993; Cohen et al., 1999). Further, no differences emerged for a task condition requiring item memory, which is supported by structures outside the hippocampus, suggesting selectivity among the aspects of memory that benefit from higher amounts of fitness. Lastly, hippocampal volume was positively related to performance on the relational memory task but not the item memory task, and bilateral hippocampal volume was observed to mediate the relationship between fitness and relational memory (Chaddock et al., 2010a). Such findings are consistent with behavioral measures of relational memory in children (Chaddock et al., 2011), and neuroimaging findings in older adults (Erickson et al., 2009, 2011), and support the robust nonhuman animal literature demonstrating the effects of exercise on cell proliferation (van Praag et al., 1999) and survival (Neeper et al., 1995) in the hippocampus.

In a second investigation (Chaddock et al., 2010b), higher- and lower- fitness children (aged 9-10) underwent an MRI to determine whether structural differences might be found that relate to performance on a cognitive control task that taps attention and inhibition. The authors observed differential findings in the basal ganglia, a subcortical structure involved in the interplay of cognition and willed action. Specifically, higher-fitness children exhibited greater volume in the dorsal striatum (i.e., caudate nucleus, putamen, globus pallidus) relative to lower fitness children, while no differences were observed in the ventral striatum. Such findings are not surprising given the role of the dorsal striatum in cognitive control and response resolution (Casey et al., 2008; Aron et al., 2009), as well as the growing body of research in children and adults indicating that higher amounts of fitness are associated with better control of attention, memory, and cognition (Colcombe and Kramer, 2003; Hillman et al., 2008; Chang and Etnier, 2009). Chaddock and colleagues (2010b) further observed that higher-fitness children exhibited increased inhibitory control and response resolution, and that higher basal ganglia volume was related to better task performance. These findings indicate that the dorsal striatum is involved in these aspects of higher-order cognition and that fitness may influence cognitive control during preadolescent development. It should be noted that both studies described above were correlational in nature, leaving open the possibility that other factors related to fitness and/or the maturation of subcortical structures may account for the observed group differences.

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

Other research has attempted to characterize fitness-related differences in brain function using fMRI and event-related brain potentials (ERPs), which are neuroelectric indices of functional brain activation in the electroencephalographic time series. To date, few randomized controlled interventions have been conducted. Notably, Davis and colleagues (2011) conducted one such intervention lasting approximately 14 weeks that randomized 20 sedentary, overweight preadolescent children into an after-school physical activity intervention or a non-activity control group fMRI data collected during an anti-saccade task, which requires inhibitory control, indicated increased bilateral activation of the prefrontal cortex and decreased bilateral activation of the posterior parietal cortex following the physical activity intervention, relative to the control group (Davis et al., 2011). Such findings illustrate some of the neural substrates influenced by participation in physical activity. Two additional correlational studies (Voss et al., 2011; Chaddock et al., 2012) compared higher- and lower-fitness preadolescent children and found differential brain activation and superior task performance as a function of fitness. That is, Chaddock et al. (2012) observed increased activation in prefrontal and parietal brain regions during early task blocks, and decreased activation during later task blocks in higher-fitness relative to lower-fitness children. Given that higher-fitness children outperformed lower-fitness children on the aspects of the task requiring the greatest amount of cognitive control, the authors reason that the higher-fitness children were more capable of adapting neural activity to meet the demands imposed by tasks that tapped higher-order cognitive processes such as inhibition and goal maintenance. Voss and colleagues (2011) used a similar task to vary cognitive control requirements and found that higher-fitness children out-performed their lower-fitness counterparts, and that such differences became more pronounced during task conditions requiring the upregulation of control. Further, several differences emerged across various brain regions that together make up the network associated with cognitive control. Collectively, these differences suggest that higher-fitness children are more efficient in the allocation of resources in support of cognitive control operations.

Other imaging research has examined the neuroelectric system (i.e., ERPs) to investigate which cognitive processes occurring between stimulus engagement and response execution are influenced by fitness. Several studies (Hillman et al., 2005, 2009; Pontifex et al., 2011) have examined the P3 component of the stimulus-locked ERP and demonstrated that higher-fitness children have larger-amplitude and shorter-latency ERPs relative to their lower-fitness peers. Classical theory suggests that P3 relates to neuronal activity associated with revision of the mental representation of the previous event within the stimulus environment (Donchin, 1981). P3 amplitude reflects the allocation of attentional resources when working memory is updated (Donchin and Coles, 1988) such that P3 is sensitive to the amount of attentional resources allocated to a stimulus (Polich and Heine, 1996; Polich, 1997). P3 latency generally is considered to represent stimulus evaluation and classification speed (Kutas et al., 1977; Duncan-Johnson, 1981), and thus may be considered a measure of stimulus detection and evaluation time (Magliero et al., 1984; Ila and Polich, 1999). Therefore, the above findings suggest that higher-fit children allocate greater attentional resources and have faster cognitive processing speed relative to lower-fitness children (Hillman et al., 2005; 2009), with additional research suggesting that higher-fit children also exhibit greater flexibility in the allocation of attentional resources, as indexed by greater modulation of P3 amplitude across tasks that vary in the amount of cognitive control required (Pontifex et al., 2011). Given that higher-fitness children also demonstrate better performance on cognitive control tasks, the P3 component appears to reflect the effectiveness of a subset of cognitive systems that support willed action (Hillman et al., 2009; Pontifex et al., 2011).

Several ERP studies (Hillman et al., 2009; Pontifex et al., 2011) have focused on aspects of cognition involved in action monitoring. That is, the error-related negativity (ERN) component was investigated in higher- and lower-fitness children to determine whether differences in evaluation and regulation of cognitive control operations were influenced by fitness level. The ERN component is observed in response-locked ERP averages. It is often elicited by errors of commission during task performance, and is believed to represent either the detection of errors during task performance (Gehring et al., 1993; Holroyd and Coles, 2002) or more generally the detection of response conflict (Botvinick et al., 2001; Yeung et al., 2004), which may be engendered by errors in response production. Several studies have reported that higher-fit children exhibit smaller ERN amplitude during rapid-response tasks (i.e., instructions emphasizing speed of responding [Hillman et al., 2009]) and more flexibility in the allocation of these resources during tasks entailing variable cognitive control demands, as evidenced by changes in ERN amplitude for higher-fitness children and no modulation of ERN in lower-fit children (Pontifex et al., 2011). Collectively, this pattern of results suggests that children with lower levels of fitness allocate fewer attentional resources during stimulus engagement (P3 amplitude) and exhibit slower cognitive processing speed (P3 latency), but increased activation of neural resources involved in the monitoring of their actions (ERN amplitude). Alternatively, higher-fit children allocate greater resources to environmental stimuli and demonstrate less reliance on action monitoring (increasing resource allocation only to meet the demands of the task). Under more demanding task conditions, the strategy of lower-fitness children appears to fail since they perform more poorly under conditions requiring the upregulation of cognitive control.

Finally, only one randomized controlled trial published to date has used ERPs to assess neurocognitive function in children. Kamijo and colleagues (2011) studied performance on a working memory task before and after a 9-month physical activity intervention compared with a wait-list control group. They observed better performance following the physical activity intervention during task conditions that required the upregulation of working memory relative to the task condition requiring lesser amounts of working memory. Further, increased activation of the contingent negative variation (CNV), an ERP component reflecting cognitive and motor preparation, was observed at posttest over frontal scalp sites in the physical activity intervention group. No differences in performance or brain activation were noted for the wait-list control group. These findings suggest an increase in cognitive preparation processes in support of a more effective working memory network resulting from prolonged participation in physical activity (Kamijo et al., 2011). For children in a school setting, regular participation in physical activity as part of an after-school program is particularly beneficial for tasks that require the use of working memory.

Adiposity and the Risk for Metabolic Syndrome as It Relates to Cognitive Health

A related and emerging literature that has recently been popularized investigates the relationship of adiposity to cognitive and brain health and academic performance. Several reports (Datar et al., 2004; 2006; Judge and Jahns, 2007; Gable et al., 2012) on this relationship are based on large-scale datasets derived from the Early Child Longitudinal Study. Further, nonhuman animal research has been used to elucidate the relationships between health indices and cognitive and brain health (see Figure 4-4 for an overview of these relationships). Collectively, these studies observed poorer future academic performance among children who entered school overweight or moved from a healthy weight to overweight during the course of development. Corroborating evidence for a negative relationship between adiposity and academic performance may be found in smaller but more tightly controlled studies. As noted above, Castelli and colleagues (2007) observed poorer performance on the mathematics and reading portions of the Illinois Standardized Achievement Test in third- and fifth-grade students as a function of higher BMI, and Donnelly and colleagues (2009) used a cluster randomized trial to demonstrate that physical activity in the classroom decreased BMI and improved academic achievement among preadolescent children.

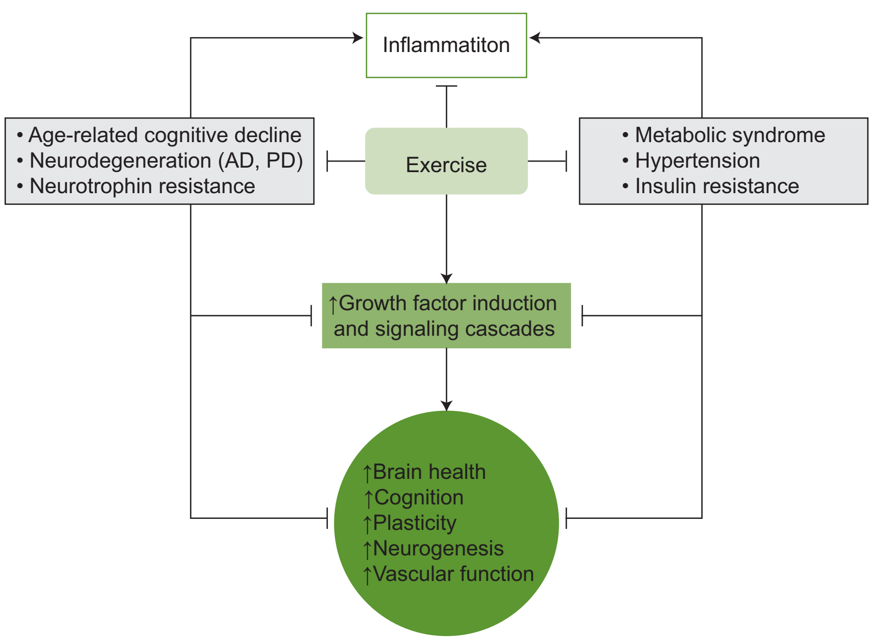

FIGURE 4-4 Relationships between health indices and cognitive and brain health.
SOURCE: Cotman et al., 2007. Reprinted with permission.

Recently published reports describe the relationship between adiposity and cognitive and brain health to advance understanding of the basic cognitive processes and neural substrates that may underlie the adiposity-achievement relationship. Bolstered by findings in adult populations (e.g., Debette et al., 2010; Raji et al., 2010; Carnell et al., 2011), researchers have begun to publish data on preadolescent populations indicating differences in brain function and cognitive performance related to adiposity (however, see Gunstad et al. [2008] for an instance in which adiposity was unrelated to cognitive outcomes). Specifically, Kamijo and colleagues (2012a) examined the relationship of weight status to cognitive control and academic achievement in 126 children aged 7-9 years. The children completed a battery of cognitive control tasks, and their body composition was assessed using dual X-ray absorptiometry (DXA). The authors found that higher BMI and greater amounts of fat mass (particularly in the midsection) were related to poorer performance on cognitive control tasks involving inhibition, as well as lower academic achievement (Kamijo et al., 2012a). In follow-up studies, Kamijo and colleagues (2012b investigated whether neural markers of the relationship between adiposity and cognition may be found through examination of ERP data. These studies compared healthy-weight and obese children, and found a differential distribution of the P3 potential (i.e., less frontally distributed) and larger N2 amplitude (Kamijo et al., 2012b; in press), as well as smaller ERN magnitude (Kamijo et al., in press), in obese children during task conditions that required greater amounts of inhibitory control. Taken together, above results suggest that obesity is associated with less effective neural processes during stimulus capture and response execution. As a result, obese children perform tasks more slowly (Kamijo et al., 2012a) and are less accurate (Kamijo et al., in press, 2012b) in response to tasks requiring variable amounts of cognitive control. Although these data are correlational, they provide a basis for further study using other neuroimaging tools (e.g., MRI, fMRI), as well as a rationale for the design and implementation of randomized controlled studies that would allow for causal interpretation of the relationship of adiposity to cognitive and brain health. The next decade should provide a great deal of information on this relationship.

LIMITATIONS

Despite the promising findings described in this chapter, it should be noted that the study of childhood physical activity, aerobic fitness, and adiposity to cognitive and brain health and academic performance is in its early stages. As such, most studies have sought study designs that afford correlation rather than causation. In fact, to date, there have only been two randomized controlled trials (Davis et al., 2011; Kamijo et al., 2011) that have been published in the literature. However, several others are currently ongoing, and it was initially necessary to provide evidence through correlational studies prior to investing the effort, time, and funding required for more demanding causal studies. Given that the evidence base has grown exponentially in the last ten years through correlational studies, and causal evidence has mounted through adult populations and non-human animal studies, the next step will be to increase the amount of causal evidence available in school age children.

Such an approach will require further consideration of demographic factors that may moderate the physical activity–cognition relationship. For instance, SES has a unique relationship with physical activity (Estabrooks et al., 2003) and cognitive control (Mezzacappa, 2004). Although many studies have attempted to control for SES (see Hillman et al., 2009; Kamijo et al., 2011, 2012a,b, in press; Pontifex et al., 2011), further inquiry into its relationship with physical activity, adiposity, and cognition is warranted to determine whether it may serve as a potential mediator or moderator for the observed relationships. A second demographic factor that warrants further consideration is gender. Most studies have not described gender differences when reporting on the physical activity–cognition literature. However, studies of adiposity and cognition have suggested that such a relationship may exist (see Datar and Sturm, 2006). Additionally, consideration for age is further warranted. That is, most studies examine a relatively narrow age range, consisting of a few years. Such an approach is often necessary due to maturation and the need to develop comprehensive assessment tools to match the various stages of development. However, such an approach has led to little understanding of how the physical activity–cognition relationship may change throughout the course of maturation.

Finally, few attempts have been made to translate the promising laboratory findings to the real world. Although a number of studies have described the relationship between physical activity, fitness, and adiposity to standardized measures of academic performance, few attempts have been made to observe the relationship within the context of the educational environment. Standardized tests, although necessary to gauge knowledge, may not be the most sensitive measures for (the process of) learning. Future research will need to better translate the promising laboratory findings to the “real world” to determine the value of this relationship in ecologically valid settings.

SUMMARY

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

Both habitual and single bouts of physical activity contribute to enhanced academic performance. Findings indicate a robust relationship of acute exercise to increased attention, with evidence emerging for a relationship between participation in physical activity and disciplinary behaviors, time on task, and academic performance. Specifically, higher-fit children allocate greater resources to a given task and demonstrate less reliance on environmental cues or teacher prompting.

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5
Approaches to Physical Education in Schools

Key Messages

- Because it is guaranteed to reach virtually all children, physical education is the only sure opportunity for nearly all school-age children to access health-enhancing physical activities.
- High-quality physical education programs are characterized by (1) instruction by certified physical education teachers, (2) a minimum of 150 minutes/week (30 minutes per day) for children in elementary schools and 225 minutes/week (45 minutes per day) for students in middle and high schools, and (3) tangible standards for student achievement and for high school graduation.
- Students are more physically active on days on which they have physical education.
- Quality physical education has strong support from both parents and child health professional organizations.
- Several models and examples demonstrate that physical education scheduled during the school day is feasible on a daily basis.
- Substantial discrepancies exist in state mandates regarding the time allocated for physical education.
- Disparities in access to quality physical education exist, particularly for Hispanic students and those of lower SES backgrounds.
- Nearly half of school administrators (44 percent) reported cutting significant time from physical education and recess to increase time spent in reading and mathematics since the passage of the No Child Left Behind Act.
- Standardized national-level data on offering of and participation, performance, and extent of engagement in vigorous or moderate-intensity physical activity are insufficient to allow assessment of the current status and trends in physical education in the United States.
- Systematic research is needed on personal, curricular, and policy barriers to successful physical education.
- The long-term impact of physical education has been understudied and should be a research priority to support the development of evidence-based policies.

Physical education is a formal content area of study in schools that is standards based and encompasses assessment based on standards and benchmarks. It is defined in Chapter 1 as “a planned sequential K-12 standards-based program of curricula and instruction designed to develop motor skills, knowledge, and behaviors of healthy active living, physical fitness, sportsmanship, self-efficacy, and emotional intelligence." As a school subject, physical education is focused on teaching school-aged children the science and methods of physically active, healthful living (NASPE, 2012). It is an avenue for engaging in developmentally appropriate physical activities designed for children to develop their fitness, gross motor skills, and health (Sallis et al., 2003; Robinson and Goodway, 2009; Robinson, 2011). This chapter (1) provides a perspective on physical education in the context of schooling, (2) elaborates on the importance of physical education to child development, (3) describes the consensus on the characteristics of quality physical education programs, (4) reviews current national, state, and local educational policies that affect the quality of physical education, and (5) examines barriers to quality physical education, and solutions for overcoming them.

PHYSICAL EDUCATION IN THE CONTEXT OF SCHOOLING

Physical education became a subject matter in schools (in the form of German and Swedish gymnastics) at the beginning of the 19th century (Hackensmith, 1966). Its role in human health was quickly recognized. By the turn of the 20th century, personal hygiene and exercise for bodily health were incorporated in the physical education curriculum as the major learning outcomes for students (Weston, 1962). The exclusive focus on health, however, was criticized by educator Dr. Thomas Wood (1913; Wood and Cassidy, 1930) as too narrow and detrimental to the development of the whole child. The education community subsequently adopted Wood's inclusive approach to physical education whereby fundamental movements and physical skills for games and sports were incorporated as the major instructional content. During the past 15 years, physical education has once again evolved to connect body movement to its consequences (e.g., physical activity and health), teaching children the science of healthful living and skills needed for an active lifestyle (NASPE, 2004).

In 1991, Sallis and McKenzie (1991) published a landmark paper stating that physical education is education content using a, "comprehensive but physically active approach that involves teaching social, cognitive, and physical skills, and achieving other goals through movement" (p. 126). This perspective is also emphasized by Siedentop (2009) that physical education is education through the physical. Sallis and McKenzie (1991) stress two main goals of physical education: (1) prepare children and youth for a lifetime of physical activity, and (2) engage them in physical activity during physical education. These goals represent the lifelong benefits of health-enhancing physical education that enable children and adolescents to become active adults throughout their lives.

Physical Education as Part of Education

In institutionalized education, the main goal has been developing children's cognitive capacity in the sense of learning knowledge in academic disciplines. This goal dictates a learning environment in which seated learning behavior is considered appropriate and effective, and is rewarded. Physical education as part of education provides the only opportunity for all children to learn about physical movement and engage in physical activity. As noted, its goal and place in institutionalized education have changed from the original focus on teaching hygiene and health to educating children about the many forms and benefits of physical movement, including sports and exercise. With a dramatic expansion of content beyond the original Swedish and German gymnastics programs of the 19th century, physical education has evolved to become a content area with diverse learning goals that facilitate the holistic development of children (NASPE, 2004).

To understand physical education as a component of the education system, it is important to know that the education system in the United States does not operate with a centralized curriculum. Learning standards are developed by national professional organizations such as the National Association for Sport and Physical Education (NASPE) and/or state education agencies (SEAs) rather than by the federal Department of Education; all curricular decisions are made locally by school districts or individual schools in compliance with state standards. Physical education is influenced by this system, which leads to great diversity in policies and curricula. According to NASPE and the American Heart Association (2010), although most states have begun to mandate physical education for both elementary and secondary schools, the number of states that allow waivers/exemptions from or substitutions for physical education increased from 27 and 18 in 2006 to 32 and 30 in 2010, respectively. These expanded waiver and substitution policies (discussed in greater detail later in the chapter) increase the possibility that students will opt out of physical education for nonmedical reasons.

Curriculum Models

Given that curricula are determined at the local level in the United States, encompassing national standards, state standards, and state-adopted textbooks that meet and are aligned with the standards, physical education is taught in many different forms and structures. Various curriculum models are used in instruction, including Movement Education, Sport Education, and Fitness Education. In terms of engagement in physical activity, two perspectives are apparent. First, programs in which Fitness Education curricula are adopted are effective at increasing in-class physical activity (Lonsdale et al., 2013). Second, in other curriculum models, physical activity is considered a basis for students' learning skill or knowledge that the lesson is planned for them to learn. A paucity of nationally representative data is available with which to demonstrate the relationship between the actual level of physical activity in which students are engaged and the curriculum models adopted by their schools.

Movement Education

Movement has been a cornerstone of physical education since the 1800s. Early pioneers (Francois Delsarte, Liselott Diem, Rudolf von Laban) focused on a child's ability to use his or her body for self-expression (Abels and Bridges, 2010). Exemplary works and curriculum descriptions include those by Laban himself (Laban, 1980) and others (e.g., Logsdon et al., 1984). Over time, however, the approach shifted from concern with the inner attitude of the mover to a focus on the function and application of each movement (Abels and Bridges, 2010). In the 1960s, the intent of Movement Education was to apply four movement concepts to the three domains of learning (i.e., cognitive, psychomotor, and affective). The four concepts were *body* (representing the instrument of the action); *space* (where the body is moving); *effort* (the quality with which the movement is executed); and *relationships* (the connections that occur as the body moves—with objects, people, and the environment [Stevens-Smith, 2004]). The importance of movement in physical education is evidenced by its inclusion in the first two

NASPE standards for K-12 physical education (NASPE, 2004) (see Box 5-7 later in this chapter).

These standards emphasize the need for children to know basic movement concepts and be able to perform basic movement patterns. It is imperative for physical educators to foster motor success and to provide children with a basic skill set that builds their movement repertoire, thus allowing them to engage in various forms of games, sports, and other physical activities (see also Chapter 3).

Sport Education

One prevalent physical education model is the Sport Education curriculum designed by Daryl Siedentop (Siedentop, 1994; Siedentop et al., 2011). The goal of the model is to "educate students to be players in the fullest sense and to help them develop as **competent, literate,** and **enthusiastic** sportspersons" (Siedentop et al., 2011, p. 4; emphasis in original). The model entails a unique instructional structure featuring sport seasons that are used as the basis for planning and teaching instructional units. Students are organized into sport organizations (teams) and play multiple roles as team managers, coaches, captains, players, referees, statisticians, public relations staff, and others to mimic a real professional sport organization. A unit is planned in terms of a sport season, including preseason activity/practice, regular-season competition, play-offs and/or tournaments, championship competition, and a culminating event (e.g., an award ceremony or sport festivity). Depending on the developmental level of students, the games are simplified or modified to encourage maximum participation. In competition, students play the roles noted above in addition to the role of players. A Sport Education unit thus is much longer than a conventional physical education unit. Siedentop and colleagues (2011) recommend 20 lessons per unit so that all important curricular components of the model can be implemented.

Findings from research on the Sport Education model have been reviewed twice. Wallhead and O'Sullivan (2005) report that evidence is insufficient to support the conclusion that use of the model resulted in students' developing motor skills and fitness and learning relevant knowledge; some evidence suggests that the model leads to stronger team cohesion, more active engagement in lessons, and increased competence in game play. In a more recent review, Hastie and colleagues (2011) report on emerging evidence suggesting that the model leads to improvement in cardiorespiratory fitness (only one study), and mixed evidence regarding motor skill development, increased feeling of enjoyment in participation in physical education, increased sense of affiliation with the team and physical education, and positive development of fair play values. The only study on in-class physical activity using the model showed that the model contributed to only 36.6 percent activity at the vigorous or moderate-intensity levels (Parker and Curtner-Smith, 2005). Hastie and colleagues (2011) caution, however, that because only 6 of 38 studies reviewed used an experimental or quasi-experimental design, the findings must be interpreted with extreme caution. The model's merits in developing motor skill, fitness, and desired physical activity behavior have yet to be determined in studies with more rigorous research designs.

Fitness Education

Instead of focusing exclusively on having children move constantly to log in activity time, a new curricular approach emphasizes teaching them the science behind why they need to be physically active in their lives. The curriculum is designed so that the children are engaged in physical activities that demonstrate relevant scientific knowledge. The goal is the development and maintenance of individual student fitness. In contrast with the Movement Education and Sport Education models, the underlying premise is that physical activity is essential to a healthy lifestyle and that students' understanding of fitness and behavior change results from engagement in a fitness education program. The conceptual framework for the model is designed around the health-related components of cardiorespiratory fitness, muscular strength and endurance, and flexibility. A recent meta-analysis (Lonsdale et al., 2013) suggests that physical education curricula that include fitness activities can significantly increase the amount of time spent in vigorous or moderate-intensity physical activity.

Several concept-based Fitness Education curriculum models exist for both the middle school and senior high school levels. They include Fitness for Life: Middle School (Corbin et al., 2007); Personal Fitness for You (Stokes and Schultz, 2007); Get Active! Get Fit! (Stokes and Schultz, 2009); Personal Fitness: Looking Good, Feeling Good (Williams et al., 2005); and Foundations of Fitness (Rainey and Murray, 2005). Activities in the curriculum are designed for health benefits, and the ultimate goal for the student is to develop a commitment to regular exercise and physical activity. It is assumed that all children can achieve a health-enhancing level of fitness through regular engagement in vigorous or moderate-intensity physical activity.

Randomized controlled studies on the impact of a science-based fitness curriculum in 15 elementary schools showed that although the curriculum allocated substantial lesson time to learning cognitive knowledge, the students were more motivated to engage in physical activities than students in the 15 control schools experiencing traditional physical education (Chen et al., 2008), and they expended the same amount of calories as their counterparts in the control schools (Chen et al., 2007). Longitudinal data from the study reveal continued knowledge growth in the children that strengthened their understanding of the science behind exercise and active living (Sun et al., 2012). What is unclear, however, is whether the enthusiasm and knowledge gained through the curriculum will translate into the children's life outside of physical education to help them become physically active at home.

To incorporate standards and benchmarks into a Fitness Education model, a committee under the auspices of NASPE (2012) developed a comprehensive Instructional Framework for Fitness Education in Physical Education. It is suggested that through this proposed framework, fitness education be incorporated into the existing physical education curriculum and embedded in the content taught in all instructional units. The entire framework, highlighted in Box 5-1, can be viewed at http://www.aahperd.org/naspe/publications/upload/Instructional-Framework-for-Fitness-Education-in-PE-2012-2.pdf.

BOX 5-1
Instructional Framework for Fitness Education in Physical Education

Technique: Demonstrate competency in techniques needed to perform a variety of moderate to vigorous physical activities.

- Technique in developing cardiovascular fitness.
- Technique when developing muscle strength and endurance activities.
- Technique in developing flexibility.
- Safety techniques.

Knowledge: Demonstrate understanding of fitness concepts, principles, strategies and individual differences needed to participate and maintain a health-enhancing level of fitness.

- Benefits of physical activity/dangers of physical inactivity.
- Basic anatomy and physiology.
- Physiological responses to physical activity.
- Components of health-related fitness.
- Training principles (overload, specificity, progression) and workout elements.
- Application of FITT principle. Factors that influence physical activity choices.

Physical activity: Participate regularly in fitness-enhancing physical activity.

- Physical activity participation (e.g., aerobic, muscle strength and endurance, bone strength, flexibility, enjoyment/social/personal meaning).
- Create an individualized physical activity plan.
- Self-monitor physical activity and adhere to a physical activity plan.

Health-related fitness: Achieve and maintain a health-enhancing level of health-related fitness.

- Physical fitness assessment (including self-assessment) and analysis.
- Setting goals and create a fitness improvement plan.
- Work to improve fitness components.
- Self-monitor and adjust plan.
- Achieve goals.

Responsible personal and social behaviors: Exhibit responsible personal and social behaviors in physical activity settings.

- Social interaction/respecting differences.
- Self-management.
- Personal strategies to manage body weight.
- Stress management.

Values and advocates: Value fitness-enhancing physical activity for disease prevention, enjoyment, challenge, self-expression, self-efficacy and/or social interaction; and allocate energies toward the production of healthy environments.

- Value physical activity.
- Advocacy.
- Fitness careers.
- Occupational fitness needs.

Nutrition: Strive to maintain healthy diet through knowledge, planning and regular monitoring.

- Basic nutrition and benefits of a healthy diet.
- Healthy diet recommendations.
- Diet assessment.
- Plan and maintain a healthy diet.

Consumerism: Access and evaluate fitness information, facilities, products and services.

- Differentiate between fact and fiction regarding fitness products.
- Make good decisions about consumer products.

SOURCE: NASPE, 2012. Reprinted with permission.

Emergence of Active Gaming in Fitness Education

Today, active gaming and cell phone/computer applications are a part of physical activity for both youth and adults. Accordingly, fitness education in school physical education programs is being enhanced through the incorporation of active video games, also known as exergaming. Examples of active gaming programs with accompanying equipment include Konami Dance Dance Revolution (DDR), Nintendo Wii, Gamebikes, Kinect XBOX, Xavix, and Hopsports, to name a few. These active games have been incorporated into school wellness centers as high-tech methods of increasing student fitness levels to supplement the traditional modes for attaining vigorous or moderate-intensity physical activity (Greenberg and Stokes, 2007). Bailey and McInnis (2011) compared selected active games with treadmill walking and found that each game—DDR, LightSpace (Bug Invasion), Nintendo Wii (Boxing), Cyber Trazer (Goalie Wars), Sportwall, and Xavix (J-Mat)—raised energy expenditure above that measured at rest. Mean metabolic equivalent (MET) values for each game were comparable to or higher than those measured for walking on a treadmill at 3 miles per hour. Graf and colleagues (2009), studying boys and girls aged 10-13, found that both Wii boxing and DDR (level two) elicited energy expenditure, heart rate, perceived exertion, and ventilatory responses that were comparable to or greater than those elicited by moderate-intensity walking on a treadmill. Similar results were found by Lanningham-Foster and colleagues (2009) among 22 children aged 10-14 and adults in that energy expenditure for both groups increased significantly when playing the Wii over that expended during all sedentary activities. Staiano and colleagues (2012) explored factors that motivated overweight and obese African American high school students to play Wii during school-based physical activity opportunities. They found greater and more sustained energy expenditure over time and noted that players' various intrinsic motivations to play also influenced their level of energy expenditure. Mellecker and McManus (2008) determined that energy expenditure and heart rate were greater during times of active play than in seated play. Fawkner and colleagues (2009) studied 20 high school-age girls and found that dance simulation games provided an opportunity for most subjects to achieve a moderate-intensity level of physical activity. The authors conclude that regular use of the games aids in promoting health through physical activity. Haddock and colleagues (2009) conducted ergometer tests with children aged 7-14 and found increased oxygen consumption and energy expenditure above baseline determinations. Maddison and colleagues (2007, 2009), studying children aged 10-14, found that active video game playing led to significant increases in energy expenditure, heart rate, and activity counts in comparison with baseline values. They conclude that playing these games for short time periods is comparable to light- to moderate-intensity conventional modes of exercise, including walking, skipping, and jogging. Mhurchu and colleagues (2008) also conclude that a short-term intervention involving active video games is likely to be an effective means of increasing children's overall level of physical activity. Additionally, Sit and colleagues (2010), studying the effects of active gaming among 10-year-old children in Hong Kong, found them to be significantly more physically active while playing interactive games compared with screen-based games.

Exergaming appears to increase acute physical activity among users and exergaming is being used in school settings because it is appealing to students. Despite active research in the area of exergaming and physical activity however, its utility to increase acute and habitual physical activity specifically in the physical education setting has yet to be confirmed. Further, studies conducted in nonlaboratory and nonschool settings have been mixed (Baranowski et al., 2008). Moreover, any physical activity changes that do occur may not sufficient to stimulate physiologic changes. For example, White and colleagues (2009) examined the effects of Nintendo Wii on physiological changes. Although energy expenditure was raised above resting values during active gaming, the rise was not significant enough to qualify as part of the daily 60 minutes or more of vigorous or moderate-intensity exercise recommended for children.

While collecting data on the effects of Nintendo Wii on 11-year-olds in New Zealand, White and colleagues (2009) found that active video games generated higher energy expenditure than both resting and inactive screen watching. They determined, however, that active gaming is a "low-intensity" physical activity. Therefore, it may be helpful in reducing the amount of sedentary behavior, but it should not be used as a replacement for more conventional modes of physical activity. Sun (2012) found that active gaming can increase student motivation to engage in physical activity, but the motivation may decrease as a result of prolonged exposure to the same games. This study also found that exergaming lessons provided less physical activity for children than the regular, conventional physical education. For inactive children, however, the exergaming environment is conducive to more active participation in the game-based physical activities than in the conventional physical education (Fogel et al., 2010). Finally, Sheehan and Katz (2012) found that the use of active gaming added to postural stability among school-age children, an important component of motor skill development.

From the research cited above, as well as ongoing research being conducted by the Health Games Research Project funded by the Robert Wood Johnson Foundation, active gaming is promising as a means to providing an opportunity for young children to become more physically active to meet the recommended 60 or more minutes of vigorous or moderate-intensity physical activity per day. Different types of games may influence energy expenditure differentially while others may serve solely as a motivation. Selected games also appear to hold greater promise for increasing energy expenditure, while others invite youth to be physically active through motivational engagement. The dynamic and evolving field of active gaming is a promising area for future research as more opportunities arise to become physically active throughout the school environment.

Other Innovative Programs

It could also be noted that while several evidence-based physical education programs such as the Coordinated Approach to Child Health (CATCH) and Sports, Play, and Active Recreation for Kids (SPARK), are being implemented in schools, many innovative programs have also been implemented nationwide which are motivating and contributes to skill attainment, while engaging in activities that are fun and fitness oriented. These programs include watersports, involving sailing, kayaking, swimming, canoeing, and paddle boarding; adventure activities such as Project Adventure; winter sports, such as snow skiing and snow shoeing; and extreme sports, such as in-line skating, skate boarding, and cycling.

Differences among Elementary, Middle, and High Schools

Instructional opportunities vary within and among school levels as a result of discrepancies in state policy mandates. Although the time to be devoted to physical education (e.g., 150 minutes per week for elementary schools and 225 minutes per week for secondary schools) is commonly included in most state mandates, actual time allocation in school schedules is uncertain and often left to the discretion of local education officials.

With respect to content, in both elementary and secondary schools, physical activity is an assumed rather than an intended outcome except in the Fitness Education model. The goals of skill development and knowledge growth in physical education presumably are accomplished through participation in vigorous or moderate-intensity physical activity. Data are lacking, however, to support the claim that physical activity offered to further the attainment of skills and knowledge is of vigorous or moderate intensity and is of sufficient duration for children to reap health benefits.

Children in Nontraditional Schools

Research on physical education, physical activity, and sport opportunities in nontraditional school settings (charter schools, home schools, and correctional facilities) is extremely limited. Two intervention studies focused on charter schools addressed issues with Mexican American children. In the first (Johnston et al., 2010), 10- to 14-year-old children were randomly assigned to either an instructor-led intervention or a self-help intervention for 2 years. The instructor-led intervention was a structured daily opportunity for the students to learn about nutrition and to engage in structured physical activities. The results indicate that the children in the instructor-led intervention had lost more weight at the end of the intervention than those in the self-help condition. In the second study (Romero, 2012), 11- to 16-year-old Mexican American children from low-income families participated in a 5-week, 10-lesson hip-hop dance physical activity intervention. In comparison with data collected prior to the intervention, the children reported greater frequency of vigorous or moderate-intensity physical activity, lower perceived community barriers to physical activity, and stronger self-efficacy for physical activity. Collectively, the results of these two studies suggest that a structured physical activity intervention can be effective in enhancing and enriching physical activity opportunities for Mexican American adolescents in charter schools.

Research on physical activity among home-schooled children is also limited. The only study found was published in 2004 (Welk et al., 2004). It describes differences in physical fitness, psychosocial correlates of physical activity, and physical activity between home-schooled children and their public school counterparts aged 9-16. No significant differences were found between the two groups of children on the measures used, but the researchers did note that the home-schooled children tended to be less physically active.

Research on physical education/physical activity in juvenile correction institutions is equally scarce. Munson and colleagues (1985, 1988) conducted studies on the use of physical activity programs as a behavior mediation intervention strategy and compared its impact on juvenile delinquents' behavior change with that of other intervention strategies. They found that physical activity did not have a stronger impact than other programs on change in delinquent behavior.

Fitness Assessment

All states except Iowa have adopted state standards for physical education. However, the extent to which students achieve the standards is limited since no accountability is required.

An analysis of motor skill competency, strategic knowledge, physical activity, and physical fitness among 180 fourth- and fifth-grade children demonstrated that the physical education standards in force were difficult to attain (Erwin and Castelli, 2008). Among the study participants, fewer than a half (47 percent) were deemed motor competent, 77 percent demonstrated adequate progress in knowledge, only 40 percent were in the Healthy Fitness Zone on all five components of the FITNESSGRAM® fitness assessment, and merely 15 percent engaged in 60 or more minutes of physical activity each day. Clearly most of the children failed to meet benchmark measures of student performance for this developmental stage. This evidence highlights the need for additional physical activity opportunities within and beyond physical education to enhance opportunities for students to achieve the standards.

Relationships among these student-learning outcomes were further decomposed in a study of 230 children (Castelli and Valley, 2007). The authors determined that aerobic fitness and the number of fitness test scores in the Healthy Fitness Zone were the best predictors of daily engagement in physical activity relative to factors of gender, age, body mass index (BMI), motor skill competency, and knowledge. However, in-class engagement in physical activity was best predicted by aerobic fitness and motor skill competence, suggesting that knowledge and skills should not be overlooked in a balanced physical education curriculum intended to promote lifelong physical activity.

As an untested area, student assessment in physical education has been conducted on many indicators other than learning outcomes. As reported in a seminal study (Hensley and East, 1989), physical education teachers base learning assessment on participation (96 percent), effort (88 percent), attitude (76 percent), sportsmanship (75 percent), dressing out (72 percent), improvement (68 percent), attendance (58 percent), observation of skills (58 percent), knowledge tests (46 percent), skills tests (45 percent), potential (25 percent), and homework (11 percent). These data, while several years old, show that most learning assessments in physical education fail to target relevant learning objectives such as knowledge, skills, and physical activity behavior. The development of teacher-friendly learning assessments consistent with national and/or state standards is sorely needed.

Fitness assessment in the school environment can serve multiple purposes. On the one hand, it can provide both teacher and student with information about the student's current fitness level relative to a criterion-referenced standard, yield valid information that can serve as the basis for developing a personal fitness or exercise program based on current fitness levels, motivate students to do better to achieve a minimum standard of health-related fitness where deficiencies exist, and possibly assist in the identification of potential future health problems. On the other hand, an overall analysis of student fitness assessments provides valuable data that can enable teachers to assess learner outcomes in the physical education curriculum and assess the present curriculum to determine whether it includes sufficient fitness education to allow students to make fitness gains throughout the school year. Fitness assessment also provides a unique opportunity for schools to track data on students longitudinally. The ultimate goal of assessing student fitness in the school environment should be to educate students on the importance of maintaining a physically active lifestyle throughout the life span.

When administering fitness assessment in the school setting, caution is essential to ensure confidentiality of the results. The results and their interpretation should be shared with students and parents/guardians to have the greatest impact. To ensure the greatest benefits from fitness assessment, NASPE (2010) developed a position statement on "Appropriate Uses of Fitness Measurement." Table 5-1 outlines appropriate and inappropriate practices related to fitness testing in schools and other educational settings.

TABLE 5-1 Appropriate and Inappropriate Practices Related to Fitness Testing in Schools and Other Educational Settings

Appropriate Practice	**Inappropriate Practice**
In elementary school, motor skills are the focus of instruction, with health-related fitness components being integrated into the curriculum and lessons focused on fitness education.	Health-related fitness is rarely integrated into instruction. Students fail to understand the benefits of health-related fitness and know little about how to develop a fitness plan.
Fitness testing is used to set individual goals as part of fitness education. At the secondary level, students use fitness test data to design and apply a personal fitness plan.	Fitness testing is conducted without meaningful understanding, interpretation, and application.
Physical educators use fitness assessment as part of the ongoing process of helping students understand, enjoy, improve, and maintain their physical fitness and well-being (e.g., students set fitness goals for improvement that are revisited during the school year).	Physical educators use fitness test results to assign a grade.
Children are physically prepared to participate in fitness testing.	Children are required to participate in fitness testing without proper preparation.

SOURCE: IOM, 2012 (adapted from NASPE, 2009a,b,c).

When fitness assessment becomes part of a quality physical education program teaching and learning strategies will guide all students to acquire the knowledge and skills necessary to maintain and improve their personal health-related fitness as part of their commitment to lifelong healthy lifestyles. Teachers who incorporate fitness education as thread throughout all curricula will make the greatest impact in engaging and motivating students to participate in vigorous or moderate-intensity physical activity in order to maintain and/or improve their personal health-related fitness. For example, the development of the Presidential Youth Fitness Program with the use of a criterion-referenced platform provides students with the educational benefits of fitness assessment knowledge (Box 5-3). The emergence of one national fitness assessment, FITNESSGRAM®, along with professional development and recognition protocols further supports fitness education in the school environment.

BOX 5-2
Presidential Youth Fitness Program

The Presidential Youth Fitness Program, launched in September 2012, is a comprehensive program that provides training and resources to schools for assessing, tracking, and recognizing youth fitness. The program promotes fitness testing as one component of a comprehensive physical education curriculum that emphasizes regular physical activity. The program includes a health-related fitness assessment, professional development, and motivational recognition. A key to the program's success is helping educators facilitate a quality fitness assessment experience. The Presidential Youth Fitness Program was developed in partnership with the Cooper Institute, the Centers for Disease Control and Prevention, the American Alliance for Health, Physical Education, Recreation and Dance, and the Amateur Athletic Union.

The implementation of the Presidential Youth Fitness Program aligns with the Institute of Medicine (IOM) report *Fitness Measures and Health Outcomes in Youth,* the result of a study whose primary purpose was to evaluate the relationship between fitness components and health and develop recommendations for health-related fitness tests for a national youth survey (IOM, 2012b). The report includes guidance on fitness assessments in the school setting. The report confirms that the Fitnessgram, used in the Presidential Youth Fitness Program, is a valid, reliable, and feasible tool for use in schools to measure health-related fitness. Use of the Fitnessgram represents a transition from the current test, which focuses on *performance* rather than *health* and is based on *normative* rather than *criterion referenced data, to a criterion-referenced, health-related fitness assessment instrument.* Accompanying the assessment, as part of a comprehensive program includes education and training, through professional development, awards, and recognition.

Online Physical Education

Online physical education is a growing trend. Fully 59 percent of states allow required physical education credits to be earned through online courses. Only just over half of these states require that the online courses be taught by state-certified physical education teachers. Daum and Buschner (2012) report that in general, online physical education focuses more on cognitive knowledge than physical skill or physical activity, that many online courses fail to meet national standards for learning and physical activity guidelines, and that the teachers are not concerned about students' accountability for learning.

Although online courses differ from traditional in-school physical education courses in the delivery of instruction, the standards and benchmarks for these courses must mirror those adopted by each individual state especially when the course is taken to meet high school graduation requirements. NASPE (2007a, p. 2) recommends that all physical education programs include "opportunity to learn, meaningful content, appropriate instruction, and student and program assessment." If an online physical education program meets these standards, it may be just as effective as a face-to-face program. Online physical education can be tailored to each student's needs, and it helps students learn how to exercise independently. The full NASPE Position Statement on online physical education can be found at http://www.ncpublicschools.org/docs/curriculum/healthfulliving/resources/onlinepeguidelines.pdf. The physical education policy of one online school the Florida Virtual School, is presented in Box 5-3.

BOX 5-3
Florida Virtual School's Physical Education Policy

Sections 1001.11(7) and 1003.453(2) of the Florida Statutes require that every school district have a current version of its Physical Education Policy on the district website. This document satisfies that requirement.

Florida law defines "physical education" to mean:

> "…the development or maintenance of skills related to strength, agility, flexibility, movement, and stamina, including dance; the development of knowledge and skills regarding teamwork and fair play; the development of knowledge and skills regarding nutrition and physical fitness as part of a healthy lifestyle; and the development of positive attitudes regarding sound nutrition and physical activity as a component of personal well-being.
>
> Florida Virtual School courses are designed to develop overall health and well-being through structured learning experiences, appropriate instruction, and meaningful content. FLVS provides a quality Physical Education program in which students can experience success and develop positive attitudes about physical activity so that they can adopt healthy and physically active lifestyles. Programs are flexible to accommodate individual student interests and activity levels in a learning environment that is developmentally appropriate, safe, and supportive."

SOURCE: Excerpted from the Florida Virtual School website (http://www.flvs.net/myFLVS/student-handbook/Pages/Policies/PEPolicy.aspx)

Online physical education provides another option for helping students meet the standards for physical education if they lack room in their schedules for face-to-face classes, need to make up credit, or are just looking for an alternative to the traditional physical education class. On the other hand, online courses may not be a successful mode of instruction for students with poor time management or technology skills. According to Daum and Buschner (2012) online learning is changing the education landscape despite the limited empirical research and conflicting results on its effectiveness in producing student learning. Through a survey involving 45 online high school physical education teachers, the authors found that almost three-fourths of the courses they taught failed to meet the national guidelines for secondary schools, of 225 minutes of physical education per week. Most of the courses required physical activity three days per week, while six courses required no physical activity. The teachers expressed support, hesitation, and even opposition toward online physical education (Daum and Buschner, 2012).

SCHEDULING DECISIONS

Lesson scheduling is commonly at the discretion of school principals in the United States. The amount of time dedicated to each subject is often mandated by Federal or State Statutes. Local education agencies or school districts have the latitude to make local decisions that go beyond these federal or state mandates. Often the way courses are scheduled to fill the school day is determined by the managerial skills of the administrator making the decisions or based on a computerized program that generates individual teacher schedules.

Successful curriculum change requires supportive scheduling (see Kramer and Keller [2008] for an example of curriculum reform in mathematics). More research is needed on the effects of scheduling of physical education. In one such attempt, designed to examine the impact of content and lesson length on caloric expenditure in middle school physical education, Chen and colleagues (2012) found that a lesson lasting 45-60 minutes with sport skills or fitness exercises as the major content would enable middle school students to expend more calories than either shorter (30-40 minutes) or longer (65-90 minutes) lessons. The evidence from such research can be used to guide allocation of the mandated weekly amount of physical education (150 minutes for elementary schools, 225 minutes for secondary schools) to achieve optimal health benefits for youth. For additional discussion of scheduling, please see Figure 5-2 and the chapter section on solutions for overcoming barriers.

IMPORTANCE OF PHYSICAL EDUCATION TO CHILD DEVELOPMENT

As discussed in Chapter 3, there is a direct correlation between regular participation in physical activity and health in school-age children, suggesting that physical activity provides important benefits directly to the individual child (HHS, 2008). Physical activity during a school day may also be associated with academic benefits (Chapter 4) and children’s social and emotional well-being (HHS, 2008; Chapter 3). Physical education, along with other opportunities for physical activity in the school environment (discussed in Chapter 6), is important for optimal health and development in school-age children. It may also serve as a preventive measure for adult conditions such as heart disease, high blood pressure, and type 2 diabetes.

Little has been learned about the short- and long-term effectiveness of physical education in addressing public health issues (Pate et al., 2011). Because the learning objectives of physical education have not included improvement in health status as a direct measure, indirect measures and correlates have been used as surrogates. However, some promising research, such as that conducted by Morgan and colleagues (2007), has demonstrated that students are more physically active on days when they participate in physical education classes. Further, there is no evidence of a compensatory effect such that children having been active during physical education elect not to participate in additional physical activity on that day. Accordingly, quality physical education contributes to a child’s daily accumulation of physical activity and is of particular importance for children who are overweight or who lack access to these opportunities in the home environment (NASPE, 2012).

Unlike other physical activity in school (e.g., intramural or extramural sports), physical education represents the only time and place for *every child* to learn knowledge and skills related to physical activity and to be physically active during the school day. It also is currently the only time and place for all children to engage in vigorous or moderate-intensity physical activity safely because of the structured and specialist-supervised instructional environment. It is expected that children will be using the skills and knowledge learned in physical education in other physical activity opportunities in school, such as active recess, active transportation, and intramural sports. For these reasons, physical education programming has been identified as the foundation on which multicomponent or coordinated approaches incorporating other physical activity opportunities, can be designed and promoted. Coordinated approaches in one form or another have existed since the early 1900s, but it was not until the 21st century that physical education was acknowledged as the foundation for these approaches. The Centers for Disease Control and Prevention [CDC] (2010), the National Association of State Boards of Education (NASBE, 2012 ["Fit, Healthy, and Ready to Learn"]) and NASPE (2004, 2010) all support this view because physical education provides students with the tools needed to establish and maintain a physically active lifestyle throughout their lifespan. As discussed in Chapter 3, research on motor skill development has provided evidence linking physical skill proficiency levels to participation in physical activity and fitness (Stodden et al., 2008, 2009). Exercise psychology research also has identified children's perceived skill competence as a correlate of their motivation for participation in physical activity (Sallis et al., 2000). When school-based multicomponent interventions include physical activities experienced in physical education that are enjoyable and developmentally appropriate, such coordinated efforts are plausible and likely to be effective in producing health benefits (Corbin, 2002). Accordingly, two of the Healthy People 2020 objectives for physical activity in youth relate to physical education: "PA-4: Increase the proportion of the Nation's public and private schools that require daily physical education for *all students*" and "PA-5: Increase the proportion of adolescents who participate in daily school physical education."[1]

The importance of physical education in developing a child on physical, cognitive, and social aspects has been acknowledged by many federal, state, and local health and education agencies. Many private entities throughout the country likewise have offered their support for and recommendations for a strengthening physical education. For example, the Institute of Medicine (2012a), in its report *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation*, points to the need to strengthen physical education to ensure that all children engage in 60 minutes or more of physical activity per school day. Similarly, the National Physical Activity Plan (2010), developed by a group of national organizations at the forefront of public health and physical activity, comprises a comprehensive set of policies, programs, and initiatives aimed at increasing physical activity in all segments of schools. The plan is intended to create a national culture that supports physically active lifestyles, in order to achieve its vision that "one day, all Americans will be physically active and they will live, work, and play in environments that facilitate regular physical activity." To accomplish this ultimate goal, the plan calls for improvement in the quantity and quality of physical education for students from prekindergarten through 12th grade through significant policy initiatives at the federal and state levels that guide and fund physical education and other physical activity programs. Specifically, the plan prescribes seven specific tactics shown in Box 5-4.

[1]Available online at http://www.healthypeople.gov/2020/topicsobjectives2020/pdfs/PhysicalActivity.pdf.

BOX 5-4
National Physical Activity Plan: Strategy 2

The National Physical Activity Plan's Strategy 2 is as follows:

> Strategy 2: Develop and implement state and school district policies requiring school accountability for the quality and quantity of physical education and physical activity programs.
>
> Tactics:
>
> 1. Advocate for binding requirements for PreK-12 standards-based physical education that address state standards, curriculum time, class size, and employment of certified, highly qualified physical education teachers in accordance with national standards and guidelines, such as those published by the National Association for Sport and Physical Education (NASPE).
>
> 2. Advocate for local, state and national standards that emphasize provision of high levels of physical activity in physical education (e.g. 50 percent of class time in vigorous or moderate-intensity physical activity).
>
> 3. Enact federal legislation, such as the FIT Kids Act, to require school accountability for the quality and quantity of physical education and physical activity programs.
>
> 4. Provide local, state and national funding to ensure that schools have the resources (e.g., facilities, equipment, appropriately trained staff) to provide high-quality physical education and activity programming. Designate the largest portion of funding for schools that are under-resourced. Work with states to identify areas of greatest need.
>
> 5. Develop and implement state-level policies that require school districts to report on the quality and quantity of physical education and physical activity programs.
>
> 6. Develop and implement a measurement and reporting system to determine the progress of states toward meeting this strategy. Include in this measurement and reporting system data to monitor the benefits and adaptations made or needed for children with disabilities.
>
> 7. Require school districts to annually collect, monitor, and track students' health-related fitness data, including Body Mass Index.

SOURCE: National Physical Activity Plan, 2010.

Medical professional associations, such as the American Cancer Society (ACS), American Diabetes Association (ADA), and American Heart Association (AHA), have long acknowledged the importance of physical education and have endorsed policies designed to strengthen it. A position statement on physical education from the ACS Cancer Action Network, ADA, and AHA (2012) calls for support for quality physical education and endorses including physical education as an important part of a student's comprehensive, well-rounded education program because of its positive impact on lifelong health and well-being. Further, physical education policy should make quality the priority while also aiming to increase the amount of time physical education is offered in schools.

Recently, private-sector organizations—such as the NFL through its Play60 program—have been joining efforts to ensure that youth meet the guideline of at least 60 minutes of vigorous or moderate-intensity physical activity per day. One such initiative is Nike's (2012) *Design to Move: A Physical Activity Action Agenda*, a framework for improving access to physical activity for all American children in schools. Although the framework does not focus exclusively on physical education, it does imply the important role of physical education in the action agenda (see Box 5-5).

BOX 5-5
Nike's Design to Move: A Physical Activity Action Agenda

1. **Universal access:** Programs that are effective for every child, including those who face the most barriers to participating in physical activity.
2. **Age appropriate:** Physical activities and tasks that are systematically designed for a child's physical, social and emotional development, as well as his or her physical and emotional safety, are a non-negotiable component of good program design.
3. **Dosage and duration:** Maximum benefit for school-aged children and adolescents comes from group-based activity for at least 60 minutes per day that allows for increased mastery and skill level over time.
4. **Fun:** Create early positive experiences that keep students coming back for more, and let them have a say in what "fun" actually is.
5. **Incentives and motivation:** Focus on the "personal best" versus winning or losing.
6. **Feedback to kids**: Successful programs build group and individual goal-setting and feedback into programs.
7. **Teaching, coaching, and mentorship:** Teachers of physical education, coaches and mentors can make or break the experience for students. They should be prepared through proper training and included in stakeholder conversations. A well-trained physical activity workforce shares a common commitment and principles to promote physical activity among children. Great leaders create positive experiences and influence all learners.

SOURCE: Nike, 2012.

Finally, in response to First Lady Michelle Obama's Let's Move initiative, the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) launched the Let's Move In School initiative, which takes a holistic approach to promotion of physical activity in schools. The purpose of the initiative is to help elementary and secondary schools launch the Comprehensive School Physical Activity Program (CSPAP), which is focused on strengthening physical education and promoting all opportunities for physical activity in school. The CSPAP in any given school is intended to accomplish two goals: (1) "provide a variety of school-based physical activity opportunities that enable all students to participate in at least 60 minutes of moderate-to-vigorous physical activity each day"; and (2) "provide coordination among the CSPAP components to maximize understanding, application, and practice of the knowledge and skills learned in physical education so that all students will be fully physically educated and well-equipped for a lifetime of physical activity" (AAHPERD, 2012). The five CSPAP components, considered vital for developing a physically educated and physically active child, are physical education, physical activity during school, physical activity before and after school, staff involvement, and family and community involvement (AAHPERD, 2012). Schools are allowed to implement all or selected components.

An AAHPERD (2011) survey indicated that 16 percent of elementary schools, 13 percent of middle schools, and 6 percent of high schools (from a self-responding nationwide sample, not drawn systematically) had implemented a CSPAP since the program was launched. Although most schools sampled (90 percent) provided physical education, the percentage declined through middle school and high school, such that only 44 percent of high schools provided physical education to seniors. In most schools (92 percent), classes were taught by teachers certified to teach physical education.

More than 76 percent of elementary schools provided daily recess for children, and 31 percent had instituted a policy prohibiting teachers from withholding children from participating in recess for disciplinary reasons. In 56 percent of elementary schools that had implemented a CSPAP, physical activity was encouraged between lessons/classes; in 44 percent, it was integrated into academic lessons; and in 43 percent, the school day started with physical activity programs.

The percentage of schools that offered intramural sports clubs to at least 25 percent of students declined from 62 percent of middle schools to 50 percent of high school for males, and from 53 to 40 percent, respectively, for females. Interscholastic sports were offered in 89 percent of high schools. Among them, approximately 70 percent involved at least 25 percent of the male student population participating and 58 percent involved at least 25 percent of the female student population participating. Sixty-five percent of high schools had cut policies, which could limit the enrollment of students in interscholastic sports.

CHARACTERISTICS OF QUALITY PHYSICAL EDUCATION PROGRAMS

As noted, a high-quality physical education program can help youth meet the guideline of at least 60 minutes of vigorous or moderate intensity physical activity per day. This increase in physical activity should be balanced with an appropriate attention to skills development and to national educational standards for quality physical education (Box 5-6). In a recent literature review from Bassett and colleagues (2013) found that physical education contributes to children's achieving an average of 23 minutes of vigorous or moderate-intensity physical activity daily. However, the time spent in vigorous or moderate-intensity physical activity could be increased by 6 minutes if the physical education curriculum were to incorporate a standardized curriculum such as SPARK (discussed in detail below) (Bassett et al., 2013). Thus, it is possible for physical education to contribute to youth's meeting at least half (30 minutes) of their daily requirement for vigorous or moderate-intensity physical activity. To help children grow holistically, however, physical education needs to achieve other learning goals when children are active. To this end, physical education programs must possess the quality characteristics specified by NASPE (2007b; 2009b,c) (see Box 5-6). Designing and implementing a physical education program with these characteristics in mind should ensure that the time and curricular materials of the program enable students to achieve the goals of becoming knowledgeable exercisers and skillful movers who value and adopt a physically active, healthy lifestyle.

BOX 5-6
NASPE's Characteristics of a High-Quality Physical Education Program

Opportunity to learn

- All students are required to take physical education
- Instructional periods total 150 minutes per week (elementary) and 225 minutes per week
- (middle and secondary school)
- Physical education class size consistent with that of other subject areas
- Qualified physical education specialist provides a developmentally appropriate program
- Adequate and safe equipment and facilities

Meaningful content

- Written, sequential curriculum for grades P-12, based on state and/or national standards for physical education
- Instruction in a variety of motor skills designed to enhance the physical, mental, and
- social/emotional development of every child
- Fitness education and assessment to help children understand, improve and/or maintain physical well-being
- Development of cognitive concepts about motor skill and fitness
- Opportunities to improve emerging social and cooperative skills and gain a multicultural perspective
- Promotion of regular amounts of appropriate physical activity now and throughout life

Appropriate instruction

- Full inclusion of all students
- Maximum practice opportunities for class activities
- Well-designed lessons that facilitate student learning
- Out of school assignments that support learning and practice
- Physical activity not assigned as or withheld as punishment
- Regular assessment to monitor and reinforce student learning

Student and program assessment

- Assessment is an ongoing, vital part of the physical education program
- Formative and summative assessment of student progress
- Student assessments aligned with state/national physical education standards and the written physical education curriculum
- Assessment of program elements that support quality physical education
- Stakeholders periodically evaluate the total physical education program effectiveness

SOURCE: Adapted from NASPE, 2009c.

Findings from research on effective physical education support these characteristics as the benchmarks for quality programs. In an attempt to understand what effective physical education looks like, Castelli and Rink (2003) conducted a mixed-methods comparison of 62 physical education programs that had a high percentage of students achieve the state physical education learning standards with programs whose students did not achieve the standards. Comprehensive data from student performance, teacher surveys, and onsite observations demonstrated that highly effective physical education programs were housed in cohesive, longstanding departments that experienced more facilitators (e.g., positive policy, supportive administration) than inhibitors (e.g., marginalized status as a subject matter within the school). Further, effective programs made curricular changes prior to the enactment of state-level policy, while ineffective programs waited to make changes until they were told to do so. The teachers in ineffective programs had misconceptions about student performance and in general, lower expectations of student performance and behavior.

Examples of Evidence-Based Physical Education Curricular Programs

Two large-scale intervention studies—SPARK and CATCH—are illustrated in this section as examples to show what can be structured to increase in-class vigorous or moderate-intensity physical activity.

The aim of SPARK, a research-based based curriculum, is to improve the health, fitness, and physical activity levels of youth by creating, implementing, and evaluating programs that promote lifelong wellness. Each SPARK program "fosters environmental and behavioral change by providing a coordinated package of highly active curriculum, on-site teacher training, extensive follow-up support, and content-matched equipment focused on the development of healthy lifestyles, motor skills and movement knowledge, and social and personal skills" (SPARK, 2013).

Research supports the use of SPARK as a platform for improving the quality of physical activity instruction in schools. The SPARK curriculum has demonstrated the ability to improve student activity levels, increase the number of minutes of vigorous or moderate-intensity physical activity for students and provide sustainable and positive change in a school district (Schieffer and Thomas, 2012). In one study, researchers found that, "the children were positive about this specific curriculum. This is gratifying because one of the goals of the program was to engender positive feeling in the students toward physical activity" (McKenzie et al., 1994, p. 213). In another study, a SPARK intervention is credited with exposing students to an increase in motor skill drills, which in turn led to a higher level of manipulative motor skill acquisition (McKenzie et al., 1998). As a result of improved activity levels, students who participated in the SPARK curriculum improved their times in the 1-mile run and sit-up tests (Sallis et al., 1997). Finally, classroom System for Observing Fitness Instruction Time (SOFIT) observations revealed that students in SPARK classes increased their time spent in vigorous or moderate-intensity physical activity per class from 17.8 to up to 40.2 minutes compared to students in non-SPARK classes, who engaged in 17.8 minutes of vigorous or moderate intensity physical activity per class. Teachers involved in the SPARK intervention offered increased levels of fitness promotion and provided students with an increased amount of general instruction and increased minutes of attention per week (McKenzie et al., 1997; Myers-Schieffer and Thomas, 2012).

The CATCH program teaches children in grades K-8 how to be healthy throughout their lifetimes by a coordinated approach that involves engaging the community, families, and educators to work together. The goal of CATCH is to impact children's health behaviors positively, improve the school health environment, and influence and change school health policies and practices in order to reduce and eliminate health risk factors and risk-related behaviors of students (Perry et al., 1990). CATCH physical education significantly increases the physical activity levels of students during physical education class, and provides a wide range of learning experiences for students of all abilities.

CATCH began as a clinical trial from 1991 to 1994 in four regional sites: Tulane University in New Orleans, the University of California in San Diego, the University of Minnesota in Minneapolis, and the University of Texas in Houston. The participants were elementary school children, enrolled in grades three through five, and including children from multi-ethnic backgrounds. Upon completion of the main trial, CATCH had succeeded in producing positive and lasting changes in children's behaviors; including decreasing fat consumption, and increasing physical activity (Luepker et al., 1996) with the changes being maintained for 3 years post-intervention (Nader et al., 1999).

National Standards

Because physical education is part of the curriculum in schools, program quality should be judged only by whether and to what extent children have learned and benefited from their physical education. In its landmark document on learning goals, *Moving into the Future: National Standards for Physical Education*, NASPE (2004) proposes six student learning standards specifying both conceptual and behavioral characteristics that a physically educated person must possess and display (see Box 5-7). These characteristics encompass knowledge, skill, behavior, and confidence critical to the development and maintenance of health and to the enjoyment of a physically active, healthful lifestyle.

BOX 5-7
Standards for a Physically Educated Person

Standard 1: Demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities.
Standard 2: Demonstrates understanding of movement concepts, principles, strategies, and tactics as they apply to the learning and performance of physical activities.
Standard 3: Participates regularly in physical activity.
Standard 4: Achieves and maintains a health-enhancing level of physical fitness.
Standard 5: Exhibits responsible personal and social behavior that respects self and others in physical activity settings.
Standard 6: Values physical activity for health, enjoyment, challenge, self-expression, and/or social interaction.

SOURCE: NASPE, 2004.

Certified Physical Education Specialists as Main Teaching Force

If standards are the gauge for quality, teachers make the difference in a particular school in terms of the extent to which students can achieve the standards. Research has made clear that certified physical education specialists can provide more and longer opportunities for students to meet physical activity guidelines compared with classroom teachers trained to teach physical education (McKenzie et al., 2001). Moreover, when teachers are taught strategies to encourage vigorous or moderate physical activity in physical education class, a significant increase in physical activity can be expected (Lonsdale et al., 2013). The role of certified physical education specialists in health-enhancing physical education has become increasingly critical (McKenzie, 2007). The evidence is unequivocal regarding the need for a continued effort to train physical education specialists and the need for schools to continue to employ them as the main teaching force designing and implementing health-enhancing physical education programs to the fullest extent.

Aside from serving as the instructional leader for physical education, the physical education specialist can also serve as an expert resource for classroom teachers in the implementation of classroom physical activity breaks and recess. Their expertise in the delivery of age-appropriate activity will assist ensuring that students are receiving activities that are fun and engaging. Additionally, as the catalyst for a healthy school environment, the physical education specialist can also assist in the design and delivery of intramural programs delivered before and after school, as well as serve as a community outreach specialist for onsite activity partnerships. For physical education specialists interested in a more formal role as a physical activity leader at their school, NASPE has developed a Director of Physical Activity certification program.

It is a common notion of society that to maintain the quality of education, schools should hire teachers certified to teach in the subject matter areas in which they are licensed. Unfortunately, in the United States, not all physical education classes are taught by certified physical educators. Indeed, 68 percent of elementary schools allow classroom teachers (generalists) to teach physical education (NASPE, 2012). Certification or licensure of middle school/junior high school and high school physical education teachers is required in only 82 percent and 90 percent of the states (NASPE, 2012), respectively. Only 37 states (72 percent) have a requirement for professional development and continuing education hours/credit for a physical education teacher to maintain or renew their certification with renewal time ranging from 5 years to 3 years (NASPE, 2012). Twenty-eight states (55 percent) allow temporary/emergency certificates to teach physical education that are valid for 1 to 3 years (NASPE, 2012). The basic requirements for emergency certification include a bachelor’s degree in teaching or in any area except physical education. Only 31 states (60 percent) support physical education teachers going through the national board certification process and only 1 state, New York, requires each school district to have a licensed physical educator serving as a physical education coordinator (NASPE, 2012).

Pre-Service Education for Teachers

Teaching physical education to children effectively and safely requires specific knowledge about children and their physical/mental development, body composition (anatomy) and functions (physiology and biomechanics), and motor skill development and acquisition. In addition, teaching physical education requires substantial knowledge and skill in pedagogy—the science and art of teaching. Box 5-8 below shows the NASPE standards for beginning physical education teachers who have completed a bachelor’s teacher training program and those teachers who have completed advanced (master’s-level) training.

BOX 5-8
National Association for Sport and Physical Education Standards for Beginning Physical Education Teachers

Initial Standards

1. *Scientific and theoretical knowledge*: Physical education teacher candidates know and apply discipline-specific scientific and theoretical concepts critical to the development of physically educated individuals.
2. *Skill-based and fitness-based competence*: Physical education teacher candidates are physically educated individuals with the knowledge and skills necessary to demonstrate competent movement performance and health-enhancing fitness as delineated in the NASPE K – 12 Standards.
3. *Planning and implementation*: Physical education teacher candidates plan and implement developmentally appropriate learning experiences aligned with local, state and national standards to address the diverse needs of all students.
4. *Instructional delivery and management*: Physical education teacher candidates use effective communication and pedagogical skills and strategies to enhance student engagement and learning.
5. *Impact on student learning*: Physical education teacher candidates use assessments and reflection to foster student learning and inform decisions about instruction.
6. *Professionalism*: Physical education teacher candidates demonstrate dispositions essential to becoming effective professionals.

Advanced Standards

1. *Professional knowledge*: Advanced physical education teacher candidates come to understand disciplinary content knowledge, the application of content knowledge to teaching physical education, and modes of inquiry that form the bases for physical education programs and instruction.
2. *Professional practice*: Advanced physical education teacher candidates (AC) use content knowledge and pedagogical content knowledge (PCK) to design and conduct appropriate learning experiences that facilitate and enhance the growth of learners.
3. *Professional leadership*: Advanced physical education teacher candidates are continuous, collaborative learners who further their own professional development and use their abilities to contribute to the profession.

SOURCE: NASPE, 2009a. *National Standards and Guidelines for Physical Education Teacher Education*. Champaign, IL: Human Kinetics.

These standards are accompanied by measurement rubrics (unacceptable, acceptable, and target, with target being exemplary) developed jointly by NASPE and the National Council for Accreditation of Teacher Education (NCATE) for evaluating physical education teacher education programs across the country (the 50 states, the District of Columbia, and Puerto Rico). NCATE identified a total of 133 physical education teacher education programs as "nationally recognized." The committee was unable to determine how many programs nationwide have met the minimum standards (not at the nationally recognized level) or reliable information on the total number of physical education teacher education programs. A web search using the term "physical education" resulted in two different but relatively reliable statistics: 720 (College Board, 2013) and 1,945 (Peterson's, 2013). But the data sources did not distinguish between physical education teaching majors and other kinesiology concentrations (e.g., sport medicine, exercise physiology/fitness). Statistics on the number of physical education teacher education programs and their quality based on the NASPE standards are needed.

The current wave of effort to curb physical inactivity among youth has begun to influence teacher education programs. According to a national survey study (Kulinna et al., 2010), current teacher candidates believe that helping K-12 students become physically active and fit is the first priority of physical education, followed by helping them actualize their own goals, develop motor skills, and become responsible. These data appear to suggest that physical education teacher education programs are beginning to turn from a traditionally sport- and skill- centered model to a more comprehensive, physical activity- and health-centered model. This change is important in that the role of both current and future physical education teachers extends beyond merely teaching their classes to advancing public health goals (McKenzie, 2007).

In many universities, however, teacher education programs in physical education have either been reduced or eliminated because of the decline in physical education requirements, which has resulted in a decrease in the number of physical education teachers being employed. Concomitantly, physical education teacher education programs are experiencing an unprecedented crisis. A recent report indicates that in school year of 2008-2009, only 23 doctorate-granting kinesiology departments offered doctoral programs that were training future teacher educators (Boyce and Rikard, 2011a). A total of 140 doctoral students were receiving training offered by 114 professors (including part-time), and 11 percent of those professors were planning to retire. Boyce and Rikard (2011a) report that in the past 13 years, there were 479 doctoral students graduated, as physical education teacher educators—36.8 each year on average—89 percent of whom were able to find positions in colleges and universities. During the same period, 61 positions were open, only 39 of which were filled (64 percent), with an applicant pool of 38 candidates with earned degrees and 13 who completed the doctoral coursework but did not complete the dissertation research (Boyce and Rikard, 2011b). Clearly there is a shortage of physical education teacher educators in higher education institutions. Because of a lack of national tracking data on physical education graduates, the extent to which the teacher educator shortage has impacted and will impact the need to supply quality physical education teachers to the nation is unclear.

Professional Development

In all educational settings, professional development for teachers and administrators is a continuous process of acquiring new knowledge and skills that relate to an educator's profession or academic subject area, job responsibilities, or work environment. Professional development is essential for improving classroom instruction and student achievement (Ball and Cohen, 1999; Cohen and Hill, 2000). Through a variety of delivery methods, professional development activities may include credit or noncredit courses, classroom or online venues, workshops, seminars, teleconferences, and webinars, with the ultimate goal of improving the delivery of instruction to enhance student achievement.

Yoon and colleagues (2007) assert that a strong link exists among professional development, teacher learning and practice, and student achievement. Figure 5-1, which aligns with the research on effective professional development (Kennedy, 1998; Loucks-Horsley and Matsumoto, 1999; Cohen and Hill, 2000; Garet et al., 2001; Fishman et al., 2003; Guskey and Sparks, 2004) illustrates how (1) professional development enhances teacher knowledge and skills, (2) better knowledge and skills improve classroom teaching; and (3) improved teaching raises student achievement.

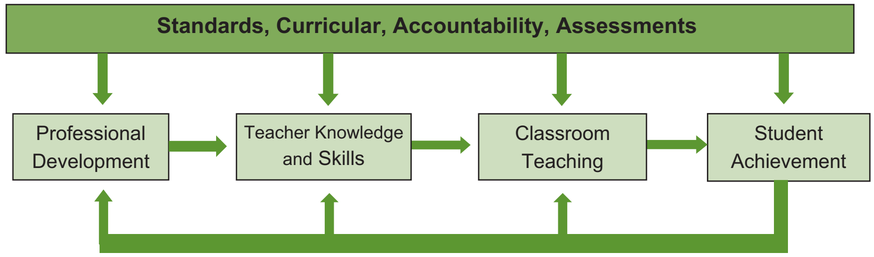

FIGURE 5-1 Logic model of the impact of professional development on student achievement.

The most impactful statement of government policy on the preparation and professional development of teachers was the 2002 reauthorization of the Elementary and Secondary Education Act (Whitehurst, 2002) known as the No Child Left Behind Act. While Title I of the act places highly-qualified classroom teachers in the classroom, Title II addresses the same goal by funding professional development for teachers. The importance of quality professional development is well documented in the act.

Professional development, according to the No Child Left Behind Act, should be offered to improve teachers' knowledge of the subject matter they teach, strengthen their classroom management skills, advance their understanding and implementation of effective teaching strategies, and build their capabilities to address disparities in education. The act states that high quality professional development programs should have the characteristics listed in Box 5-9.

BOX 5-9
Characteristics of a High Quality Professional Development Programs

1) It is sustained, intensive, and content-focused to have a positive and lasting impact on classroom instruction and teacher performance.
2) It is aligned with and directly related to state academic content standards, student achievement standards, and assessments.
3) It improves and increases teachers' knowledge of the subjects they teach.
4) It advances teachers' understanding of effective instructional strategies founded on scientifically based research.
5) It is regularly evaluated for effects on teacher effectiveness and student achievement. Intensive and focused in-service training.

SOURCE: NCLB, 2002.

Although there is substantial literature on professional development, only a few high-quality studies relate teachers' professional development experiences to student outcomes. Recommendations for high-quality professional development tend to emphasize the importance of intense, content-focused experiences, as well as opportunities for peer collaboration and structured induction experiences for new teachers. Several authors, Wiley and Yoon (1995) and Kennedy (1998) suggest that teaching practice and student achievement are likely to improve when professional development is focused on academic content and curriculum that are aligned with standards-based reform.

Kulinna (2012) used Guskey's (2004) Model of Teacher Change to determine whether students' physical activity and BMI changed after their teacher underwent a 1-year professional development program. Significant increases in students' physical activity levels were found, but no significant changes were found in BMI. Looking at the effect of professional development on changes in behavior among physical education teachers, Martin and colleagues (2008) found that, following a variety of professional development experiences and follow-up sessions, teachers showed increases in their efficacy in attaining motor skill objectives, physical activity and fitness knowledge objectives, and personal and social objectives. These results lend support to the value of professional development in enhancing teachers' perceptions of self-efficacy for teaching the curriculum. McCaughtry and colleagues (2006) explored the factors that make teacher professional development successful and what success might mean in terms of teachers' instructional practices and feelings about change. Results indicated that after they completed professional development, the resources they had gained enabled them to improve their instruction by teaching more content, maximizing student learning opportunities, teaching diverse learners, teaching to development, and increasing classroom safety.

Learning Forward (formerly known as the National Staff Development Council) provides research-based guidelines to assist districts in aligning local professional development programs with qualitative standards. Its Standards for Professional Learning were revised in 2011 and are guided by the relationship between professional learning and student results (see Box 5-10). According to Learning Forward (2012):

- When professional learning is standards based, it has greater potential to change what educators know, are able to do, and believe.
- When educators' knowledge, skills, and dispositions change, they have a broader repertoire of effective strategies to use in adapting their practices to meet performance expectations and student learning needs.
- When educator practices improve, students have a greater likelihood of achieving results.
- When student results improve, the cycle repeats for continuous improvement.
- Professional learning standards provide a foundation upon which to design professional learning experiences at the district or school level that will assist educators in acquiring the necessary knowledge, skills, and tools.

BOX 5-10
The Standards for Professional Learning

Learning communities: Professional learning that increases educator effectiveness and results for all students occurs within learning communities committed to continuous improvement, collective responsibility and goal alignment.

Leadership: Professional learning that increases educator effectiveness and results for all students requires skillful leaders who develop capacity, advocate, and create support systems for professional learning.

Resources: Professional learning that increases educator effectiveness and results for all students requires prioritizing, monitoring, and coordinating resources for educator learning.

Data: Professional learning that increases educator effectiveness and results for all students uses a variety of sources and types of student, educator, and system data to plan, assess, and evaluate professional learning.

Learning designs: Professional learning that increases educator effectiveness and results for all students integrates theories, research, and models of human learning to achieve its intended outcomes.

Implementation: Professional learning that increases educator effectiveness and results for all students applies research on change and sustains support for implementation of professional learning for long-term change.

Outcomes: Professional learning that increases educator effectiveness and results for all students aligns its outcomes with educator performance and student curriculum standards.

SOURCE: Learning Forward, 2012.

As a recognized means of providing physical education teachers with the tools necessary to enhance student achievement, quality professional development should be provided on a regular basis with follow-up support, along with a method for determining its effectiveness in meeting both curricular and pedagogical standards. Furthermore, to enhance the fitness achievement of students, school-based professional development should provide instruction on the integration of fitness testing into a curriculum, and should include training in protocols, the interpretation and communication of results, and the setting and achievement of fitness goals and recommendations for developing healthy living habits for both students and their parents (IOM, 2012a).

POLICIES THAT AFFECT THE QUALITY OF PHYSICAL EDUCATION

Instructional opportunities for physical activity and physical education are mandated by most states. In comparison with data prior to 2006, more states have developed mandates for physical education at both the elementary and secondary school levels. However, most mandates lack a specified time-allocation that ensures meeting the NASPE recommendation of 150 and 225 minutes per week for elementary and secondary schools, respectively (McCullick et al., 2012), despite the fact that physical education has been considered a cornerstone for developing schoolwide, multicomponent interventions to address the issue of physical inactivity in schools. Some obstacles to the implementation of quality physical activity are listed in Box 5-11.

BOX 5-11
Obstacles to Implementation of Quality Physical Education

1. Class periods dedicated to physical education are declining at all school levels.
2. Existing discrepancies between policy and implementation in specific time allocation contributing to a reduction of actual instructional time for physical education.
3. Potential shortage of physical education specialists to influence the design and maintenance of quality physical education programs.
4. Reductions in active learning time and opportunities in physical education contribute to potential student under achievement on national standards
5. Disparities may exist in instructional opportunities for children in nontraditional learning settings.

According to Title IX (Part A Sec 9101-11), core academic subjects include “English, reading or language arts, mathematics, science, foreign languages, civics and government, economics, arts, history, and geography.” If physical education were designated as a core academic subject, it would receive much-needed policy attention that would enhance its overall quality with respect to content offerings, instruction, and accountability. In support of the inclusion of physical education as a core subject, Senator Tom Udall (D-NM) reintroduced the Promoting Health for Youth Skills in Classrooms and Life (PHYSICAL) Act on February 27, 2013 to support and encourage the health and well-being of elementary and secondary school students.

With physical education not being considered a core subject, and amid growing concern regarding the increase in childhood obesity and physical inactivity, several national studies and reports have emphasized the importance of implementing state statutes, laws, and regulations both mandating time requirements for physical education and monitoring compliance. Although several national governmental, nongovernmental, private industry, and public health organizations have recommended specific day and time/minute requirements for physical education, however, no standardized state policy has emerged.

Analysis of State Statutes and Administrative Codes

In the United States, school policies about the curriculum and school-based activities are determined by local educational agencies (LEA) according to state laws governing educational activities. Decisions about what to teach, who to teach it, and how much resources to be provided are made by the state, county or district, and school administration. To better understand the status of state statutes, administrative codes, and policies impacting physical education in the schools, the committee analyzed NASBE’s *State Legislative Policy—Physical Education and*

Physical Activity (NASBE, 2012 [www.nasbe.org/healthy_schools]). Of importance to this analysis is the distinction made between state statutes and administrative codes, which accords with the definition proffered by Perna and colleagues (2012): "at the state level, the 2 primary official public policy levers referred to as 'codified law' used for developing school-based physical education policy are 1) statutory laws (laws enacted by the given State legislature; and 2) administrative laws (rule and regulations by state executive branch agencies, such as the Department of Education)" (p. 1594). A second point to note is that in descriptions of physical education graduation requirements, it is impossible to differentiate among "credit," "Carnegie unit," and "course" so as to determine the exact time requirements for graduation.

Using the NASBE database, the committee performed an overall analysis of policies on physical education and physical activity of the 50 states and the District of Columbia. The analysis revealed that 45 states (88 percent) mandate physical education; 22 states (23 percent) require it with mandatory minutes, while 25 states (49 percent) have no mandatory minutes and 4 (0.07 percent) leave the required number of minutes up to local decision makers. A majority of states allow for waivers or substitutions for physical education (see the discussion below). Fitness assessment is required in 15 states (29 percent) and other curricular assessments are required in 4 states (0.07 percent). Twenty-six states (53 percent) require physical education grades to be included in student's grade point average. Forty-three states (84 percent) required some degree of physical education for high school graduation, with a range of 0.5 credits to 3.75 credits. One state (0.02 percent) requires K-12 physical education, but does not require 4 years of physical education for high school graduation.

Although no federal policies requiring physical education presently exist, the above evidence shows that the majority of states overwhelmingly require physical education. However, the number of days and time required vary greatly by state and local school district, as does the amount of physical education required for high school graduation. Given the reduced time for physical activity in school through recess, without the implementation of stronger policies, schools have not only the opportunity but also the responsibility to nurture in youth the skills, knowledge, and confidence to develop and maintain a healthy lifestyle. The consensus among states indicated by the collective mandates of physical education, together with the discrepancies in specific policies, may suggest the need for general guidelines or a federal-level mandate that can serve to guide a collective effort to address the prevalence of childhood inactivity and obesity.

Policies That Support Physical Education

In addition to policies that directly require offering physical education in schools, other policies support physical education opportunities in schools. In 2004, the United States government issued a mandate, under the Child Nutrition and Women Infants and Children Reauthorization Act of 2004, requiring schools districts that receive funds under this act to establish local school wellness policies. These policies were to include provisions for physical activity and healthy eating, thus expanding the school's responsibility for providing physical activity to school-age children. The enactment of this mandates made schools "the central element in a community system that ensures that students participate in enough physical activity to develop healthy lifestyles" (Pate et al., 2006, p. 1215). Several government agencies and organizations have recommended embedding a specific number of days and minutes of physical education into each school's or school district's wellness policy. Although school districts are required to include goals for physical activity in their local school wellness policies, they are not required to address physical education specifically.

Policies That Hinder Physical Education

Some policies have contributed to the substantial reduction in the opportunities for school-age children to be physically active, such as by shortening or eliminating physical education classes. These reductions can be attributed to budget cuts and increased pressure for schools to meet academic standards imposed by the federal government.

No Child Left Behind Act

The No Child Left Behind (NCLB) Act of 2001 requires that states develop assessment and accountability measures to verify performance improvements in the subject areas of reading and mathematics (Pub. L. No. 107-110, Section 115). Specifically, federal funding is now dependent on schools making adequate progress in reading and mathematics. No Child Left Behind requires all public schools receiving federal funding to administer statewide standardized annual tests for all students. Schools that receive Title I funding through the Elementary and Secondary education Act of 1965 must make Adequate Yearly Progress (AYP) in test scores (e.g. each year, its fifth graders must do better on standardized tests than the previous year's fifth graders). If required improvements are not made, schools are penalized through decreased funding. If a school produces repeatedly poor results for two consecutive years, improvement plans are developed for the school. If a school does not make adequate progress for 5 consecutive years, a full restructuring of the school is mandated.

Under the act, physical education, music, and art are considered "nonessential" subjects and not a main focus of the school learning environment. In response to the act, schools have devoted more time in the school day to instruction in reading and mathematics. Since the act was passed, 62 percent of elementary schools and 20 percent of middle schools have increased instructional time in reading/language arts and mathematics (Center on Education Policy, 2008). Unfortunately, 44 percent of school administrators reported that these increases in instructional time for reading and mathematics were achieved at the expense of time devoted to physical education, recess, art, music and other subjects (Center on Education Policy, 2007, 2008) (see Table 5-2).

TABLE 5-2 Changes in Time Allocation in Elementary Schools Since 2001-2002

Subject	Percentage of all districts that increased time	Percentage of all districts that decreased time	Average increase (minute/week)	Average decrease (minutes/week)
English language arts	58		141	
Mathematics	45		89	
Social studies		36		76
Science		28		75
Arts and music		16		57
Recess		20		50
Physical education		9		40
Lunch		5		

SOURCE: Center on Education Policy, February 2007, District Survey, item 19 (revised TablesIT-2A, IT-16, and IT-17).

The emphasis on high-stakes testing and pressure for academic achievement in the core subjects has unintended consequences on other subjects throughout the school day. In developing master schedules, school site administrators have been forced to make difficult decisions regarding the allotment of time for "nonessential" subjects. The average reduction in instructional time in these "nonessential" subjects was 145 minutes per week. As discussed earlier, however, no evidence suggests that physical education and physical activity have a negative effect on student achievement or academic outcomes (CDC, 2010). On the contrary, positive academic-related outcomes (e.g., improved on-task classroom behavior, cognitive development, academic performance) have been associated with physical education and physical activity (see Chapter 4).

The Center on Education Policy (2007) conducted an analysis of 2006-2007 survey data from 349 school districts on the amount of time devoted to specific subjects to determine the impact of the No Child Left Behind Act. Shifts in instructional time toward English language arts (ELA) and mathematics and away from other subjects were relatively large in a majority of school districts that made these types of changes. Sixty-two percent of districts reported increasing time in elementary schools in English language arts and/or mathematics since 2001-2002. A higher proportion of urban districts (76 percent) than of rural districts (54 percent) reported such increases.

Districts that increased instructional time for English language arts and/or mathematics did so by 43 percent on average. Districts that also reduced instructional time in other subjects reported total reductions of 32 percent, on average. Eight out of 10 districts that reported increasing time for English language arts did so by at least 75 minutes per week, and more than half (54 percent) did so by 150 minutes or more per week. Among districts that reported adding time for mathematics, 63 percent added at least 75 minutes per week, and 19 percent added 150 minutes or more per week.

Most districts that increased time for English language arts or mathematics also reported substantial cuts in time for other subjects or periods, including social studies, science, art and music, physical education, recess, and lunch. Among the districts that reported both increasing time for English language arts or mathematics and reducing time in other subjects, 72 percent indicated that they reduced the time for one or more of these other subjects by a total of at least 75 minutes per week. For example, more than half (53 percent) of these districts cut instructional time by at least 75 minutes per week in social studies, and the same percentage (53 percent) cut time by at least 75 minutes per week in science (CEP, 2007).

Districts that reported an increase in instructional time for elementary school English language arts spent an average of 378 minutes per week on this subject before No Child Left Behind was enacted. After the act was passed, they spent 520 minutes per week. The average increase for English language arts was 141 minutes per week, or a 47 percent increase over level prior to the act (Center on Education Policy, 2007 [see district survey items 18 and 19 in table IT-18A]). Table 5-3 shows the specific amounts of time cut from various subjects in districts that reported decreases.

TABLE 5-3 Time Cut from Subjects or Periods in Districts Reporting Decreases in Instructional Time

Subject or Period	Average total instructional time pre-NCLB (minutes/week)	Average total instructional time post-NCLB (minutes/week)	Average decrease (minutes/week)	Average decrease as a percentage of total instructional time
Social studies	239	164	76	32
Science	226	153	75	33
Arts and music	154	100	57	35
Physical education	115	75	40	35
Recess	184	144	50	28
Lunch	*	*	*	*
One or more subjects listed	461	318	145	32

NOTE: *Sample size was too small to allow reporting of data on minutes per week; NCLB = No Child Left Behind.
SOURCE: Center on Education Policy, 2007, District Survey items 18 and 19 (table IT-18B).

Districts with at least one school identified as "in need of improvement" under the act were far more likely than districts not in need of improvement to decrease time in certain subjects so as to devote more time to English language arts and mathematics (78 versus 57 percent). For example, 51 percent of districts with a school in needs of improvement reported decreased time in social studies, compared with 31 percent of districts with no school in need of improvement (CEP, 2007).

Exemptions from Physical Education Requirements

The 2012 *Shape of a Nation Report* includes documentation of the multiple reasons students may be exempt from physical education classes. Thirty-three states permit school districts or schools to allow students to substitute other activities for physical education. The most common substitutions are Junior Reserve Officer Training Corps (JROTC), interscholastic sports, marching band, cheerleading, and, community sports. Twenty-eight states allow schools and school districts to grant exemptions/waivers from physical education time or credit requirements. Reasons for exemptions/waivers include health, physical disability, religious belief, and early graduation: six states leave the reasons to the local schools or school districts. Although it would seem reasonable that some substitution programs such as JROTC or cheerleading might accrue physical activity comparable to that from physical education, these programs do not necessarily offer students opportunities to learn the knowledge and skills needed for lifelong participation in health-enhancing physical activities. Research on the impact of exemptions/waivers from physical education is lacking. No evidence currently exists showing that students receive any portion of the recommended 60 minutes or more of vigorous or moderate-intensity physical activity through substituted activities sanctioned by their schools.

BARRIERS TO QUALITY PHYSICAL EDUCATION AND SOLUTIONS

Barriers other than the policies detailed above hinder efforts to improve and maintain high-quality physical education. This section reviews these barriers, along with some solutions for overcoming them.

Barriers

Morgan and Hanson (2008) classify barriers that hinder schools from implementing quality physical education programs as either being institutional (outside the teacher's control) or teacher-related (arising from teacher behavior). Table 5-4 lists institutional and teacher-related as well as student-related barriers identified by various authors.

TABLE 5-4 Barriers to the Delivery of Physical Education and Physical Activity Programs to Primary and Secondary School Students

Barrier	Primary Schools	Secondary Schools
Institutional	Access to and lack of facilities[1, 7] Lack of time[1, 7] Crowded curriculum[7] Funding[1, 7] Access to and lack of equipment[1] Support from other staff [1] Support from administration[1, 7] Access to professional development[7] PE/Sport not priorities in school[1, 5] Large class sizes[1, 7] Budget constraints[7] Insufficient infrastructure[5] Other teaching priorities[1, 5] Quality of facilities[1] Level of professional development[7] School executive attitudes toward PE [1] Insufficient number of PE staff[1, 5] Lack of performance measures for PE[5]	Access to and lack of facilities[6] Lack of time[2] Restricted curriculum[2] Funding[6] Ethos of PA for life within the school[2] Socioeconomic status of school[3] Time-tabling[6]
Teacher-Related	Lack of training and knowledge[4] Difficulty of providing safely planned and structured lessons[4] Gender stereotyping of activities[4] Poor planning[4] Perceptions of the value of PE[4] High level of accountability for other subjects[5] Confidence in teaching PE[7, 8, 12] Interest in/enthusiasm for PE[7] Personal school experiences in PE[7, 8] Attitudes toward PE[5] Expertise/qualifications[7, 8, 12]	Colleagues undervaluing activities[2] Ethos of performance/elitism of PE department or school as a whole[2]
Student-Related	Lack of student engagement[9] Expressed dislike for activity[9] Lack of intrinsic and extrinsic motivation[9] Intrapersonal barriers[11]	Student engagement[6] Lure of sedentary behavior[2] Low fitness levels therefore potentially lower ability[2] Socioeconomic status of student[3] Levels of encouragement and motivation[3] Peer support[3,10] Peer pressure[10] Intrapersonal barriers[11] Lack of motivation/laziness[11]

NOTES: PA = physical activity; PE = physical education; Sport = sport education.
SOURCES: [1]Barroso, McCullum-Gomez, Hoelscher, Kelder, and Murray, 2005; [2]Boyle, Jones, and Walters, 2008; [3]Dagkas and Stathi, 2007; [4]DeCorby, Halas, Dixon, Wintrup, and Janzen, 2005; [5]Dwyer et al., 2003; [6]Dwyer et al., 2006; [7]Morgan and Hansen, 2008; [8]Morgan and Bourke, 2005; [9]Mowling, Brock, Eiler and Rudisill, 2004; [10]Salvy et al., 2009; [11]Sherar, Gyurcsik, Humbert, Dyck, Fowler-Kerry and Baxter-Jones, 2009; [12]Xiang, Lowry, and McBride, 2002.

Dwyer and colleagues (2003) examined Toronto teachers' perspectives on why children were not engaged in daily physical education. They identified three categories of barriers: lower priority for physical education relative to other subjects; lack of performance measures for physical activity; and lack of sufficient infrastructure. Jenkinson and Benson (2010) surveyed 270 secondary school physical education teachers in Victoria, Australia and asked them to rank order the barriers they perceived to providing quality physical education. The results are shown in Table 5-5. The institutional barriers listed in this table are similar to those identified for U.S. schools in Table 5-4.

TABLE 5-5 Physical Education Teachers' Ranking of Barriers to Providing Quality Physical Education (PE) in Victorian State Secondary Schools

Barriers to providing quality PE (n=70)	**Rank order most ('10')to least ('1')important**	**Mean**	**SD**	**Barrier category**
Access to facilities	10	8.10	2.30	I
Access to suitable teaching spaces	9	7.95	2.15	I
Access to equipment	8	7.37	2.10	I
Timetabling	7	6.17	2.50	I
Support from other staff	6	5.15	2.56	I
Funding for the subject	5	4.74	2.43	I
Support from management and administration	4	4.17	2.30	I
Leadership from heads of department	3	4.15	2.59	I
Access to professional development that is appropriate	2	4.00	2.13	I
Access to professional development from school management or leadership team	1	3.17	2.19	I

NOTE: I = Institutional barrier.
SOURCE: Jenkinson, K.A., and Benson, A.C. (2010) "Barriers to Providing Physical Education and Physical Activity in Victorian State Secondary Schools," *Australian Journal of Teacher Education*: Vol. 35: Iss. 8, Article 1. Available at: http://ro.ecu.edu.au/ajte/vol35/iss8/1

Jenkinson and Benson (2010) also presented teachers with a list of barriers to student participation in physical education and physical activity in three categories: institutional, teacher related, and student related. The teachers were asked to rank the top five barriers they perceived. Results are presented in Table 5-6.

TABLE 5-6 Perceived Barriers to Student Participation in Physical Education and Physical Activity in Victorian State Secondary Schools: Physical Education Teachers' Ranking (from most ["5"] to least ["1"] influential)

Barriers INSIDE school (n = 73)	Ranking[a]	Influential barrier MOST LEAST 5	4	3	2	1	Percent of respondents ranking barrier in their top 5	Barrier Category[b]
Crowded curriculum	1	21	6	6	5	5	59	I
Lack of facilities	2	10	7	4	2	4	37	I
Difficulty engaging students	3	9	10	11	11	8	67	T
Students have low level of interest in PE[c] and PA[d]	4	7	11	5	5	5	45	S
Peer pressure	5	5	7	9	13	11	62	S
PE[c]/sport[e] not priorities in the school	5	5	6	5	3	9	38	I
Focus on too many traditional sports	6	4	1	4	5	1	21	I
Past negative experiences with PE[c]	7	3	6	6	6	5	37	S
Large class sizes	8	2	6	7	5	2	30	I
The school environment does not encourage PA[d]	9	2	0	0	0	3	6	I
Cost of subject	10	1	5	8	5	3	30	I
Staff use outdated teaching methods	11	1	2	2	2	2	12	T
PE[c]/sport[e] staff provide limited activity time	12	1	2	1	1	2	10	T
Semesterisation of units	13	1	1	0	1	3	8	I
Outdated curriculum	14	1	0	0	1	2	5	I
Lack of equipment	15	0	3	4	5	5	23	I

NOTE: [a]Ranking = based on most frequently ranked as number 1 barrier; [b]I = institutional barrier, T = teacher-related barrier, S = student-related barrier; [c]PE = physical education; [d]PA = physical activity; [e]Sport = sport education.
SOURCE:_Jenkinson, K.A., and Benson, A.C. (2010) "Barriers to Providing Physical Education and Physical Activity in Victorian State Secondary Schools," *Australian Journal of Teacher Education*: Vol. 35: Issue. 8, Article 1. Available at: http://ro.ecu.edu.au/ajte/vol35/iss8/1

Finally, Gallo and colleagues (2006) found that the greatest process barriers to assessing students in physical education were grading students on skill levels and abilities; time constraints class size; and record keeping; especially when assessing students on skills, cognitive knowledge and fitness.

Two key barriers to physical education identified in the studies summarized above are staffing and funding. These barriers reflect a lack of support structure in schools for quality physical education.

Staffing

As noted earlier in this chapter, physical education is short staffed. State mandates have placed pressures on the schools to preserve instructional resources for the core, high-stakes tested subject areas at the expense of noncore subjects. For example, when a state mandates a maximum class size of 20 students per teacher in all core-subjects, with noncompliance resulting in some form of penalty, an elementary school with an average of 25 students per teacher is forced to hire additional teachers in these subjects to meet the state mandate. Consequently, the school must shrink its teaching force in other noncore subjects, such as physical education, to balance its budget. If noncore classes are to be preserved, their class sizes must increase, with fewer teachers are serving more students. As a result, it becomes difficult to implement a quality program and physical educators perceive their administrator as undervaluing their programs.

Funding

According to the Government Accountability Office (GAO) Report *K-12 EDUCATION School-Based Physical Education and Sports Programs* (2012), school officials cite budget cuts and inadequate facilities as major challenges to providing physical education opportunities for students. Budget cuts have affected the ability to hire physical education teachers, maintain appropriate class sizes, and purchase sufficient equipment. As noted earlier, lack of equipment and limited access to facilities are cited as top barriers in the study by Jenkinson and Benson (2010) (Tables 5-5 and 5-6). Limited budgets have negative impact on a school's ability to purchase enough physical education equipment to engage all students in increasingly large class sizes, causes physical education teachers to abandon quality, evidence-based physical education programs and resort to large group games and "throw out the ball" activities. Students disengaged as a result of such practices may prefer sedentary activities to more active lifestyles. A survey by the Raslow Research Group (2010) found that the median physical education budget for physical education programs nationally was \$764 per school) (\$460 per elementary school; \$900 for middle schools; and \$1,370 per high school).

Solutions for Overcoming the Barriers

For many adolescents who have few options to be active outside of the school day, quality physical education becomes the only option for physical activity. For students in large urban communities, physical education classes serve as a safe environment in which to be physically active under adult supervision in a structured environment. For students with disabilities, in particular, physical education classes are one of the only outlet for physical activity. For these reasons, it is crucial to overcome the above barriers to quality physical education. Some school districts have found ways to do so and provide robust physical education programs.

The barrier of limited time during the school day can be overcome through creative scheduling that makes use of every minute of the day in a constructive manner. For example, Miami-Dade County Public Schools is the fourth largest school district in the United States in a large urban minority–majority community, with large budgetary shortfalls and attention in schools being diverted to academic requirements. Yet the district has always had daily physical education in its elementary schools taught by a certified physical education teacher. This is accomplished by scheduling physical education during the classroom teacher's planning time. In addition, students also receive school board–mandated recess for either 20 minutes, two times per week or 15 minutes, three times per week.

Figures 5-2 shows examples of elementary teacher schedules that demonstrate how 150 minutes of time for physical education can be successfully incorporated into any master schedule. The first example is for a traditional elementary school class, whereas the second is for a combination special education and disabilities (SPED)/Spanish-language class.

ANY Public Schools
Generic - Dual Language Schedule
2012-2013
Teacher Schedule

Teacher: Jan Doe (Mixed / SPED)

	Monday	Tuesday	Wednesday	Thursday	Friday
8:35-8:50					
8:50-9:05					
9:05-9:20			Reading/Language Arts		
9:20-9:35					
9:35-9:50	RECESS	SCIENCE	RECESS	SCIENCE	SCIENCE
9:50-10:05					
10:05-10:20	S.S./Writing	S.S./Writing	S.S./Writing	S.S./Writing	S.S./Writing
10:20-10:35	30 Mins (in Spanish)	30 Mins (in Spanish)	30 Mins (in Spanish)	30 Mins (in Spanish)	30 Mins (in Spanish)
10:35-10:50	SPANISH	ART	SPANISH	MUSIC	RECESS
10:50-11:05					
11:05-11:20					
11:20-11:35	LANGUAGE ARTS	LANGUAGE ARTS	LANGUAGE ARTS	LANGUAGE ARTS	LANGUAGE ARTS
11:35-11:50			Lunch		
11:50-12:05			11:35-12:05 pm		30 Min.
12:05-12:20	PE	PE	PE	PE	PE
12:20-12:35	30 Min.	30 Min.	30 Min.	30 Min.	30 Min.
12:35-12:50			MATHEMATICS		
12:50-1:05					
1:05-1:20					
1:20-1:35					
1:35-1:50					
1:50 - 2:05					90 Min.
2:05-2:20	Writing (Spanish)	Writing (Spanish)	EARLY DISMISSAL	Writing (Spanish)	Writing (Spanish)
2:20-2:35	30 Mins	30 Mins		30 Mins	30 Mins
2:35 - 2:50	Social Science	Social Science		Social Science	Social Science
2:50-3:05	30 Min.	30 Min.		30 Min.	30 Min.

FIGURE 5-2 Example of a schedule demonstrating time for 150 minutes per week of physical education.
NOTE: Sample is taken from a teacher schedule in a dual language (SPED)/Spanish-language elementary class.
SOURCE: Large Urban Public School District, Miami-Dade County Public Schools.

Other positive examples identified in the report *Physical Education Matters* (2007) include successful case studies from low-resource California schools. The report acknowledges, however, that advancing such opportunities will require policy changes at the state, district, and local levels. These changes include securing grant funds with which to implement high-tech physical education wellness centers, staff commitment to professional development, administrative support, making physical education a priority, community support, use of certified physical education teachers, and district support. Identifying the need to reform physical education guided by evidence-based findings the report concludes that (1) the curriculum matters, (2) class size matters, (3) qualified teachers matter, (4) professional development matters, and (5) physical environment matters. If programs are to excel and students are to achieve, the delivery of the curriculum must be activity-based; class sizes must be commensurate with those for other subject areas; highly qualified physical education specialists must be hired to deliver instruction, as opposed to classroom teachers; professional development in activity-focused physical education must be delivered; and school physical education facilities, such as playing fields and indoor gym space and equipment must be available.

A follow-up report, *Physical Education Matters: Success Stories from California Low Resource Schools that Have Achieved Excellent Physical Education Programs* (2008), notes that when funding from a variety of grant resources, including federal funding, became available, schools were able to transition to high-quality programs using innovative instructional strategies.

Those strategies included wellness centers and active gaming, which engaged students in becoming more physically active. Administrative support was found to be a key factor in turning programs around, as along with staff commitment and professional development. Having certified physical education teachers and making physical education a priority in the schools were other key factors. External factors further strengthened programs, including having school district support, having a physical education coordinator, and using state standards to provide accountability. Additional ways to overcome the barriers to quality physical education include scheduling time for physical education, ensuring reasonable class size, providing nontraditional physical education activities, making classes more active and fun for all students, and acknowledging the importance of role modeling and personal investment and involvement in physical activity participation in physical activity among staff.

Still another way to overcome the barriers to quality physical education is to assist administrative decision makers and policy makers in understanding the correlation between physical education and academic achievement (see Chapter 4). The report *Active Education: Physical Education, Physical Activity and Academic performance by Active Living Research* (Trost, 2009), cites the evidence that "children who are physically active and fit tend to perform better in the classroom and that daily physical education does not adversely affect academic performance. Schools can provide outstanding learning environments while improving children's health through physical education" (ALR, 2009, p. 1). The findings reported include the following:

- "In some cases, more time in physical education leads to improved grades and standardized test scores."
- "Physically active and fit children tend to have better academic achievement."
- "Evidence links higher levels of physical fitness with better school attendance and fewer disciplinary problems."
- "There are several possible mechanisms by which physical education and regular physical activity may improve academic achievement, including enhanced concentration skills and classroom behavior."
- "Additional research is needed to determine the impact of physical activity on academic performance among those children who are at highest risk for obesity in the United States, including black, Latino, American Indian and Alaska Native, and Asian-American and Pacific Islander children, as well as children living in lower-income communities" (ALR, 2009, p. 6).

SUMMARY

Physical education is a formal content area of study in schools, it is standards-based and it encompasses assessment according to standards and benchmarks. Selected curriculum-based physical education programs are illustrated to show the potential of high-quality physical education in developing children into active adults. These models provide the only opportunity for *all* school-age children to access health-enhancing physical activities. Curriculum models for physical education programs include Movement Education, which emphasizes the importance of fundamental motor skill competence as a prerequisite for physical activity engagement throughout the lifespan; Sport Education, which emphasizes helping students become skillful sport players in lifetime sports of their choosing, and Fitness Education which imparts physical fitness concepts to students through learning benefits and scientific principles of exercise with the goal of developing and maintaining individual fitness and positive lifestyle change. The emergence of a technology-focused fitness education curriculum and the new Presidential Youth Fitness Program will further provide further motivational opportunities for students to engage in lifelong physical activities.

Because quality physical education programs are standards based and assessed, high quality physical education program are characterized by (1) instruction by certified physical education teachers, (2) a minimum of 150 minutes/week for elementary schools and 225 minutes/week for middle and high schools, and (3) tangible standards for student achievement and for high school graduation. Quality professional development programs are an essential component for both novice and veteran teachers to ensure the continued delivery of quality physical education.

An analysis of datasets from NASPE, NASBE, and Bridging the Gap revealed that the implementation of supportive physical education policies varies from state to state and from school to school. Since passage of the No Child Left Behind Act in 2001, several studies and reports have identified a decline in physical education resulting from the shifting of time to academic subjects. Because physical education is not a high-stakes tested content area, the execution of the supportive policies often is hindered by other education priorities. Although the above analysis indicated that 30 states (74.5 percent) mandate physical education, most policies do not require specific amounts of instructional time, and more than half allowed for waivers or exemptions. In addition, an unintended consequence of the No Child Left Behind Act has been disparities in access to physical education and physical activity opportunities during the school day for students for Hispanic and those of lower socioeconomic status. In high school, relying on students to elect physical education after meeting the minimum required credit hours (one credit in all states but one) appears to be unfruitful.

Strengthening of school physical education has received support from the public, health agencies, and parents. Parents recently surveyed expressed favorable views of physical education. Specifically:

- A majority of parents (54–84 percent) believe that physical education is at least as important as other academic subjects (CDC, 2010).
- Ninety-one percent believe that there should be more physical education in schools (Harvard School of Public Health, 2003).
- Seventy-six percent of percent think that more school physical education could help control or prevent childhood obesity (NASPE, 2009a).
- Ninety-five percent of parents believe that regular daily physical activity helps children do better academically and should be a part of the school curriculum for all students in grades K-12 (NASPE, 2003).

Additionally, many public and private organizations have proposed initiatives aimed at developing a comprehensive school-based strategy centered on curriculum physical education. As the largest institution where children spend more than half of their waking hours on school days, schools can play a pivotal role in increasing students' physical activity levels by providing access for all to quality physical education, along with physical activities throughout the school environment, the subject of Chapter 7.

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6
Approaches to Physical Activity in Schools

Key Messages

- Data on sedentary behavior in school are insufficient to permit assessment of opportunities for and participation in sedentary activities in schools.
- Schools need to strive to reduce unnecessary opportunities for sedentary behavior.
- When embracing the advantages of technology for learning, schools need to be aware of its negative impact on students' physical activity behavior.
- Recess has been shown to be beneficial for academic achievement It is counterproductive to withhold recess or replace it with classroom activities as a punishment.
- Several models and examples demonstrate that scheduling multiple, daily recess periods during the school day is feasible.
- School-based sports and active transport provide opportunities for physical activity, but may not be accessible or attractive for all youth. These opportunities need to be reexamined to address disparities based on socioeconomic status, school location and resources, students' disabilities, or cultural/religious barriers.
- Nonsport after-school programs should include physical activity.
- Active transport to school can be a safe and effective way to increase students' daily physical activity, especially at schools where a large proportion of students live close to the school.
- Each community needs to examine systematically opportunities for community-based promotion of physical activity.
- Inviting students' families and other community members to participate in developing before- and after-school programs, including sports and active transport, will increase program sustainability.

It has been argued that while reversing the obesity epidemic is not solely the school's responsibility, the trend is unlikely to change without schools' assistance (Siedentop, 2009). Schools are an ideal venue for the implementation of healthy behaviors because they serve more than 56 million youth in the United States; because youth spend such a large amount of time in school; and because schools already have the access, personnel, equipment, and space to implement physical activity programming.

Physical activity opportunities in schools take the form primarily of formal instruction in physical education for all students and sport-based athletics for the talented and interested. Although physical education is a required school subject, the classes may occur infrequently, and children taking them often accrue only low levels of physical activity (Simons-Morton et al., 1994). According to Tudor-Locke and colleagues (2006), physical education programs typically provide only 8-11 percent of a student's daily recommended physical activity. However, a meta-analysis of the literature revealed that physical education can help children achieve up to 40 percent of the recommended 60 or more minutes of daily vigorous or moderate-intensity physical activity per day (Bassett et al., 2013).

Mahar (2011) states that children's physical activity levels are directly related to the opportunities they have to be active. Schools have the potential to influence the physical activity behaviors of their students through various opportunities in addition to physical education (e.g. recess periods, classroom physical activity breaks, active transport to and from school) (van Landeghem, 2003). Furthermore, children are sedentary for much of the school day and emerging evidence suggests that long periods of inactivity should be avoided. Thus, it is essential for the school setting to provide opportunities outside of physical education for school-age children to be physically activity throughout the school day.

This chapter reviews the status and trends of sedentary behavior in schools and describes opportunities for physical activity in the school environment other than physical education, including classroom activity breaks, recess, intra- and extramural sports, active transport, and after-school programs. Also reviewed are policies that may affect these opportunities, as well as barriers to and enablers of the opportunities. Chapter 7 examines the evidence on the effectiveness of these physical activity opportunities.

SEDENTARISM IN SCHOOLS

The committee did not identify a widely recognized definition of sedentarism, a new word in the English language but that exists in other languages to describe sedentary behaviors, sedentary activities, a sedentary lifestyle, or physical inactivity. Bernstein and colleagues (1999) describe sedentarism in terms of energy expenditure, while Ricciardi (2005) define it in terms of what it is not, that is, it is not engaging in physical activity. Probably the most commonly accepted definition would be time spent other than in sleep, or in vigorous, or moderate- or light-intensity physical activity. The word sedentarism also is used to describe the status of a person or a population with high levels of sedentary behaviors or a sedentary lifestyle.

Sedentarism can be categorized as (1) recreational sedentarism, which refers mainly to media use or "screen time," but can also include more traditional sedentary activities such as recreational reading or having a conversation while sitting; and (2) nonrecreational sedentarism, which refers to school work or other types of work that occur while sitting, but also to other sedentary activities that are necessary to perform daily tasks, such as motorized transportation or eating a meal. Most of the public health interest in sedentarism has focused on decreasing recreational sedentarism, especially screen time, but increasing interest is being focused on ways to alter sedentary work so it can be performed while engaging in light physical activity or even while standing. Standing desks and treadmill desks are becoming popular for adults in the workplace, and many schools are seeking creative ways to integrate light physical activity into traditionally sedentary school work. Such efforts are important given the amount of sedentary time entailed in schoolwork. In Australia, for example, 42 percent of non-screen sedentary time is school-related (Olds et al., 2010).

Such efforts to address non-recreational sedentarism are just emerging and much research and innovations are needed to move these efforts forward. On the other hand, significant research already exists on decreasing recreational sedentarism, especially among children, to treat or prevent obesity. Today, 46 percent of U.S. children aged 6-11 fail to meet the recommendation of less than 2 hours of recreational sedentarism (screen time) per day (Fakhouri et al., 2013). In addition to the non-recreational sedentarism that occurs while children sit to perform school work, significant recreational sedentarism takes place on the way to school, and in school during breaks, recess, lunch, and after-school programs. Data are not available on the extent to which recreational sedentarism occurs on school grounds and on whether recreational sedentarism in school should be an important public health target as it already is outside of school. What is known, however, is that "eight- to eighteen-year-olds spend more time with media than in any other activity besides (maybe) sleeping—an average of more than 7½ hours a day, seven days a week" (Rideout et al., 2010, p. 1).

One of the lessons of pediatric obesity research is that behavioral approaches designed to increase physical activity are different from those designed to decrease recreational sedentarism and have different effects on behavior and health. Using behavioral economic theory, Epstein and colleagues (1995) demonstrated that monitoring and encouraging children to decrease recreational sedentarism was more successful in treating obesity than either promoting physical activity, or targeting both physical activity and sedentarism at the same time. Furthermore, the children randomized to the intervention targeting only sedentarism increased their liking of vigorous or moderate-intensity physical activity, while liking of moderate-intensity physical activity decreased among those randomized to physical activity promotion; changes in liking among those in the combined intervention group were between those in the other two groups. The importance of targeting a decrease in sedentarism was further highlighted when Robinson (1999) published the first successful school-based obesity prevention intervention that targeted only sedentarism, with no behavioral intervention focused on physical activity promotion or dietary changes. Since then, several randomized trials have confirmed the causal link between recreational sedentarism and childhood obesity (Tremblay, 2011). Despite this evidence, however, the approach of specifically targeting sedentarism has received only limited attention. While academic research has focused on using school as a setting to teach students how to decrease sedentarism outside of school, this approach has not translated into widespread policies or curricula. Such efforts may be particularly important as sedentarism appears to track among individuals from childhood to adulthood (Gordon-Larsen et al., 2004; Nelson et al., 2006).

Of interest, a large nationally representative survey found that, "contrary to the public perception that media use displaces physical activity, those young people who are the heaviest media users report spending similar amounts of time exercising or being physically active as other young people their age who are not heavy media users" (Rideout et al., 2010, p.12). The question was, "Thinking just about yesterday, how much time did you spend being physically active or exercising, such as playing sports, working out, dancing, running, or another activity?" This finding suggests that media use does not displace vigorous or moderate-intensity physical activity but more likely displaces light-intensity physical activity, school work, and sleep. Light-intensity physical activity, including playing or even just standing is more difficult to measure than vigorous or moderate-intensity physical activity, but its positive health impact is increasingly being recognized. The finding of this survey also suggests that promotion of vigorous or moderate-intensity physical activity may not decrease sedentarism, but rather replace light-intensity physical activity. Therefore, the optimal way to promote an overall increase in physical activity (including light-intensity physical activity) may be to use behavioral approaches to decrease sedentarism, as has been shown in behavioral research (Epstein et al., 1995; Robinson, 1999).

One of the challenges to monitoring sedentarism is the fact that children and adolescents frequently multitask. As noted earlier, Rideout and colleagues (2010) found that U.S. youth aged 8-18 spent more than 7.5 hours per day using recreational media; 29 percent of this time was spent multitasking, resulting in a total media exposure of almost 10.5 hours per day. This figure represents an overall increase in sedentarism since 1999, when the corresponding figures were 6.2 hours and 7.3 hours per day, respectively. Television content still dominated sedentary time, accounting for 4.3 hours per day. Computer use for school work (not included in these totals) averaged about 16 minutes, while computer use for recreational purposes totaled 1.3 hour per day. On a typical day, 70 percent of youth went online for any purpose, including 57 percent at home, 20 percent at school, and 14 percent elsewhere. It is unknown whether all online activities at school were related to schoolwork.

In addition to displacing physical activity and schoolwork, recreational media use exposes youth to "a constant stream of messages" that shapes their perception of what is normative, including food choices, physical appearance, physical activity, and even sedentarism itself (Rideout et al., 2010). Usually, these perceived norms are not in line with healthy or academically productive behaviors, and cannot be countered by the best efforts of parents and teachers. As a consequence, compared with those who used recreational media the least, "heavy users" tended to have lower school grades, and to report that they were getting in trouble "a lot," unhappy, sad, or bored (Rideout et al., 2010). Furthermore, in the face of rapidly advancing technology, parents and teachers are not always fully aware of the many ways in which media and marketing are part of youth's lives. In addition to television and desktop computers, laptops, tablets, and cell phones often follow children and adolescents into the school bus, class, recess, and after-school activities unless such access is limited by policy, providing increasing opportunities to be sedentary on school grounds. In 2009, an average of 20 percent of media consumption, more than 2 hours per day, occurred with mobile devices, some of this media use likely occurring on school grounds. This figure probably has increased since then. Rideout and colleagues (2010) note that children whose parents make an effort to limit media use spend less time consuming media, but whether this holds true for limits on recreational sedentarism in the school setting is unknown.

Both recreational and non-recreational sedentarism in schools needs to be monitored separately from physical activity. Specific school policies, based on updated knowledge of media use, need to focus on decreasing recreational sedentarism in school and integrating prevention of recreational sedentarism outside of school into the educational curriculum. Because media use among youth already is significantly higher than recommended, schools should not provide students with increased opportunities for sedentarism, such as television sets in classrooms, the cafeteria, or after-school programs; access to social networks and recreational media on school computers; or the ability to use cell phones anywhere and at any time on school grounds or school transportation.

Research is needed to explore sedentarism and media use in schools more systematically so that evidence-based school policies to decrease these behaviors can be implemented to increase overall, including light-intensity, physical activity. In particular, surveys of media use are needed to document the amount of recreational sedentarism taking place in the school setting, where, in contrast with the home setting, public health policy can potentially be implemented.

OPPORTUNITIES TO INCREASE PHYSICAL ACTIVITY IN THE SCHOOL ENVIRONMENT

School physical activity programs are needed so that schools can ensure that they are providing students with 60 minutes or more of vigorous or moderate-intensity physical activity per day. Physical activity programs are neither equivalent to nor a substitute for physical education, and both can contribute meaningfully to the development of healthy, active children (NASPE, AHA, 2012). The former are behavioral programs, whereas the latter are instructional programs. Box 6-1 presents the *Healthy People 2020* objectives for non–physical education physical activity opportunities in school settings.

BOX 6-1
Healthy People 2020 Objectives for Non–Physical Education Physical Activity Opportunities in School Settings

- Increase the number of States that require regularly scheduled elementary school recess.
- Increase the proportion of school districts that require regularly scheduled elementary school recess.
- Increase the proportion of school districts that require or recommend elementary school recess for an appropriate period of time.
- 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).
- Increase the proportion of trips of 1 mile or less made to school by walking by children and adolescents aged 5 to 15 years.
- Increase the proportion of trips of 2 miles or less made to school by bicycling by children and adolescents aged 5 to 15 years.

SOURCE: HHS, 2012.

The following sections describe various non–physical education opportunities for physical activity in the school environment the discussion includes relevant policies, barriers, and enablers.

Classroom Activity Breaks

An emerging strategy for increasing daily participation in physical activity in schools is the implementation of structured, classroom-based physical activity breaks. Classroom physical activity includes all activity regardless of intensity, performed in the classroom during normal classroom time. It includes activity during academic classroom instruction as well as breaks from instruction specifically designed for physical activity. It also includes time spent learning special topics (e.g., art, music) even if not taught by the usual classroom teacher. It excludes physical education and recess even if conducted in the classroom by the usual classroom teacher. It also excludes physical activity breaks during lunchtime. Although some discussions of schooltime activity breaks include such breaks during lunchtime (Turner and Chaloupka, 2012) the committee views lunchtime physical activity as more akin to activity during recess and before and after school than to physical activity during normal academic classroom time. Although a number of programs specifically designed to increase the volume of students' physical activity during usual classroom time exist, the committee found no information about changes in such programs over time at the population level.

A typical break consists of 10-15 minutes of activities focused on vigorous or moderate-intensity physical activity. This strategy has been found to be effective in significantly increasing physical activity levels of school-age children (Ernst and Pangrazi, 1999; Scruggs et al., 2003; Mahar et al., 2006). Bassett and colleagues (2013) found that classroom activity breaks provide school-age children with up to 19 minutes of vigorous or moderate-intensity physical activity and the sustained use of such breaks was shown to decrease body mass index (BMI) in students over a period of 2 years (Donnelly et al., 2009). The effectiveness of classroom physical activity breaks is discussed further in Chapter 7.

An example of an effective school-based physical activity program is Take 10!® Kibbe and colleagues (2011) provide consistent evidence that the Take 10! program has been effective in increasing physical activity levels among a variety of samples of children enrolled in kindergarten through fifth grade in various countries. Likewise, Mahar and colleagues (2006) found that with the implementation of 10 minute physical activity breaks called "Energizers," students increased their time on task while averaging approximately 782 more steps in a day. Another example, supported by the Robert Wood Johnson Foundation Center to Prevent Childhood Obesity (2012) is Jammin Minute, realistic and effective "bridge" tool for increasing children's physical activity until schools have sufficient resources to develop more comprehensive physical education programs. Jammin' Minute has important implications for advocates and policymakers, as well as administrators and teachers, seeking ways to make school environments healthier for children. At the same time, it should be emphasized that, while the benefits of small increases in physical activity during the school day need to be recognized, the ultimate goal of policymakers and advocates should be ensuring that all schools have comprehensive physical education programs (see Chapter 5).

Another program, Texas I-CAN!, helped teachers incorporate physical activity by modifying lesson plans to include more active activities, thereby increasing vigorous or moderate-intensity physical activity by 1,000 steps per day (Bartholomew and Jowers, 2011). It was found that these curriculum-based activities improved time on-task immediately following the breaks, especially in children that were overweight; these students went from being on task 58 percent of the time on typical instruction days, to being on task 93 percent of the time after the breaks (Grieco et al., 2009).

These findings emphasize the effectiveness and feasibility of providing classroom-based, structured opportunities for physical activity. Breaks in the classroom provide an additional opportunity for physical activity throughout the school day with minimal planning, no equipment, and a short amount of time required; they can also incorporate learning opportunities for students. It should be noted that the literature tends to focus on the effect of classroom physical activity breaks on elementary school rather than secondary school students.

For classroom-based physical activity breaks to become a priority, will be important to provide evidence that such breaks do not detract from academic achievement. Chapter 4 provides an extensive review of the evidence showing that physical activity in general has positive effects on academic performance. With respect to classroom-based physical activity, the Centers for

Disease Control and Prevention (2010) reviewed studies examining the association between such activity and academic performance in elementary school-age children. Eight of nine published studies reviewed found positive effects on such outcomes as academic achievement and classroom behavior; only one study found no relationship (Ahamed et al., 2007), but that study also found that the breaks did increase physical activity levels and did not adversely affect academic achievement. Donnelly and Lambourne (2011) provide further support for the link between physical activity and positive cognitive and academic outcomes in elementary school-age children. In addition, studies in elementary school-age children have found an increase in on-task behavior in the classroom after participation in a physical activity break (Jarrett et al., 1998; Mahar et al., 2006; Mahar, 2011; see also Chapter 4). For example, Mahar and colleagues (2006) found that time on-task increased by 8 percent ($p < 0.017$) with the implementation of a 10 minute break. They also found that the 20 percent of students who were off task improved the most in time on task. Similar results were found in Georgia, where fourth graders exhibited significantly less fidgeting behaviors and significantly better on-task behaviors on days when activity breaks were conducted (Jarrett et al., 1998). Finally, a meta-analysis by Erwin and colleagues (2012) found that breaks increase the frequency of physical activity behaviors and have positive learning outcomes. It should be noted that the effect and benefits of classroom-based physical activity breaks in preschool populations have not been thoroughly investigated.

Policies That Affect Classroom Physical Activity Breaks

Classroom physical activity breaks are a relatively new approach to promoting physical activity during the school day. Consequently, research on policies that support or hinder the use of this approach is sparse. For this approach to become more prevalent, however, supportive policies will be necessary, an observation supported by the fact that just one in four U.S. public elementary schools offered children and youth physical activity breaks apart from physical education and recess during the 2009-2011 school years (Bridging the Gap, 2012). Research clearly demonstrates the important role of state laws and school district policies in promoting physical activity opportunities in schools. For example, schools are more likely to meet physical education recommendations when state laws and school district policies mandate a specific amount of time for physical education classes (Slater et al., 2012; also see Chapter 5). Currently, few if any school districts require that physical activity opportunities be provided throughout the school day or within the classroom (Chriqui et al., 2010). Therefore, research is needed to identify strategies for implementing classroom-based activity breaks and providing teachers with the skills and confidence necessary to engage students in these activities. In addition, questions remain about the optimal duration, timing, and programming (e.g., types of activities) for physical activity breaks (Bridging the Gap, 2012).

Barriers to Classroom Physical Activity Breaks

One factor that influences classroom physical activity breaks is competition for time during the school day, arising from the need for schools to meet the academic requirements of the No Child Left Behind Act (see Chapter 5). As discussed above and in Chapter 4, however, the literature clearly supports that classroom physical activity breaks are not only beneficial in promoting physical activity in children and youth, but also can occur in the classroom without compromising learning and in fact improve academic performance and related classroom behaviors. In addition, research has shown that using innovative curriculum change, such as Physical Activity Across the Curriculum (Donnelly et al., 2009), can increase daily physical activity and improve academic performance. Additionally, schools often have a scarcity of resources related to staffing, teacher training, funding, champions, and/or facilities for physical activity. Dwyer and colleagues (2003), for example, document the lack of facilities and equipment for physical activity breaks. As a result of these barriers, it has been found that, although teachers see the importance of physical activity breaks for children health and development, they infrequently integrate movement into the classroom (Parks et al., 2007).

From the literature, classroom physical activity breaks appears to be heavily implemented in early childhood and elementary classrooms (CDC, 2010). Few if any classroom physical activity breaks appear to occur in middle and high school settings. The lack of physical activity breaks for this age group may be due to the increased academic demands of testing, along with difficulty in implementing breaks that target these older students. However, classroom-based physical activity curricula are emerging at a rapid rate. Programs available for purchase include Active and Healthy Schools™ activity break cards, Promoting Physical Activity and Health in the Classroom activity cards, Energizers, and Take 10!. Other resources for classroom physical activity breaks are available at no cost to schools, such as Jammin Minute, ABS for Fitness© Activity Bursts in the Classroom, Game On! The Ultimate Wellness Challenge, and approximately 50 others. These resources can be found through the Alliance for a Healthier Generation at www.healthiergeneration.org. They provide an excellent starting point for teachers and are flexible enough to be modified to meet the needs of specific classrooms.

Space is another concern for classroom teachers, who must consider the safety of students. The classroom (e.g., desks and tables) needs to be arranged to provide adequate open space for students to move during activity breaks. Figure 6-1 shows the activity area/space available in a traditionally organized classroom. Figures 6-2 and 6-3 show how the classroom can be arranged to optimize the space for movement and physical activity.

FIGURE 6-1 Traditional layout of a classroom with limited space for physical activity breaks.
SOURCE: Erwin, 2011. Reprinted with permission from Heather Erwin.

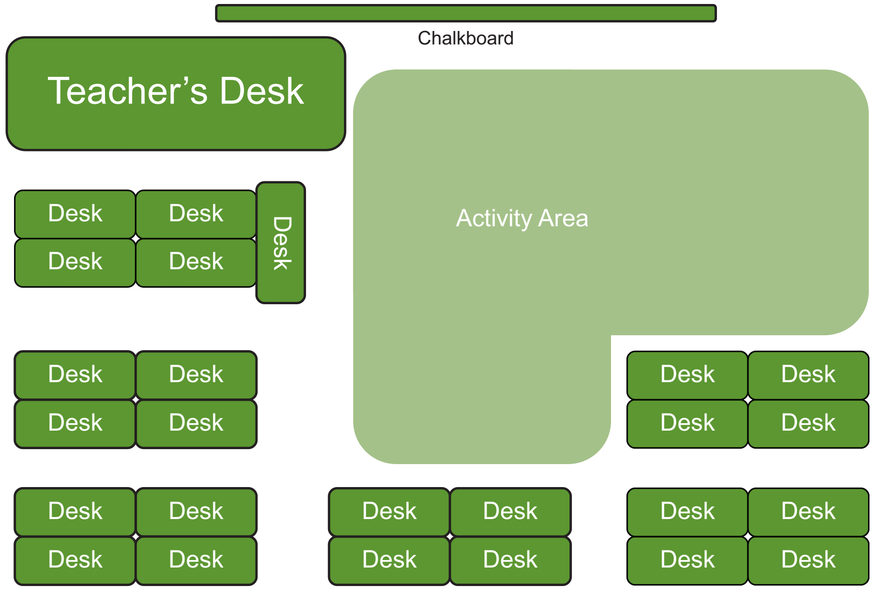

FIGURE 6-2 One classroom layout designed to accommodate physical activity breaks.
SOURCE: Erwin, 2011. Reprinted with permission from Heather Erwin.

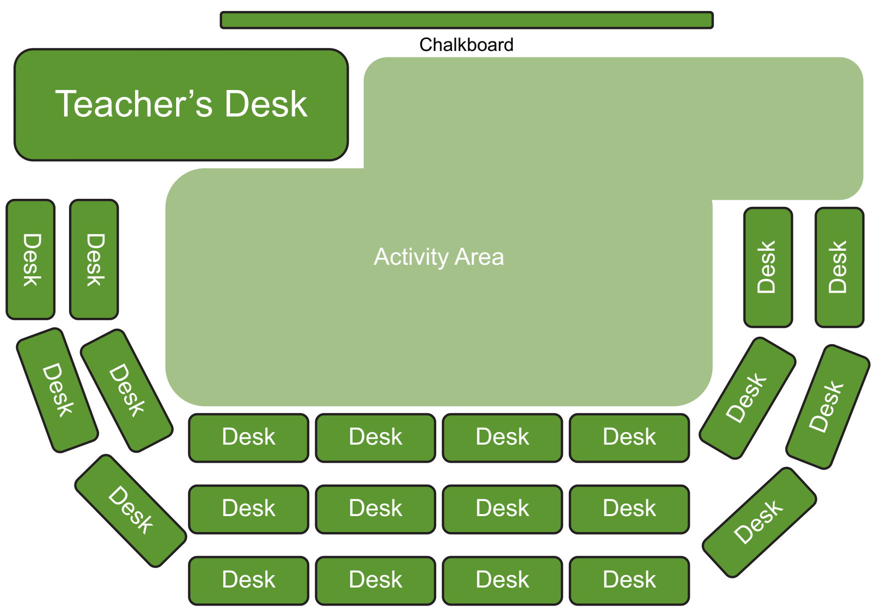

FIGURE 6-3 Another classroom layout designed to accommodate physical activity breaks.
SOURCE: Erwin, 2011. Reprinted with permission from Heather Erwin.

Recess

One of the most common forms of physical activity break during the school day is recess. Children can accumulate up to 40 percent of their daily physical activity time during recess (Ridgers et al., 2006). Recess, according to Pellegrini and colleagues (1995), is the time of day set aside for students to take a break from their class work; engage in play with their peers; and take part in independent, unstructured activities. Recess is most common in elementary schools and is rare during the secondary years.

While separate and distinct from physical education, recess is an essential component of the total educational experience for elementary-age children (Ramstetter et al., 2010). In addition to providing children the opportunity to engage in physical activity, develop healthy bodies, and develop an enjoyment of movement, it also provides them with a forum in which they are able to practice life skills including conflict resolution, problem solving, communicating with language, cooperation, respect for rules, taking turns, and sharing. It also serves as a developmentally appropriate outlet for reducing stress in children (National Association for the Education of Young Children, 1998). Furthermore, recess facilitates attention and focus on learning in the classroom (NASPE, 2001). This dedicated period of time further allows children the opportunity to make choices, plan, and expand their creativity (National Association for the Education of Young Children, 1998). Indeed, the American Academy of Pediatrics (AAP) recently released a policy statement in support of recess and free play as "fundamental component[s] of a child's normal growth and development" (Council on School Health, 2013, p. 188).

The AAP further asserts that cognitive processing and academic performance depend on regular breaks from concentrated class work. The AAP believes that

- Recess is a complement to but not a replacement for physical education. Physical education is an academic discipline.
- Recess can serve as a counterbalance to sedentary time and contribute to the recommended 60 minutes or more of vigorous or moderate-intensity physical activity per day.
- Peer interactions during recess are a unique complement to the classroom. The lifelong skills acquired for communication, negotiation, cooperation, sharing, problem solving, and coping are not only foundations for healthy development but also fundamental measures of the school experience.

Decline of Recess

Since passage of the No Child Left Behind Act in 2001, several studies and reports across the literature have pointed to a decline in recess to make more time for academic subjects. Approximately 40 percent of schools in the United States have either eliminated or reduced recess in order to free up more time for academics (Robert Wood Johnson Foundation, 2010). See Table 6-1 for a summary of changes in recess time between 2001 and 2007 and also see the detailed discussion of time shifting in Chapter 5.

TABLE 6-1 Change in Recess Time, 2001-2007

	Districts with at least one school identified as "in need of improvement"	Districts with no schools identified as "in need of improvement"	Total
Percent decreasing recess time	22	19	20
Average decrease in recess (minutes per week)	60	47	50

SOURCE: Center on Education Policy, 2007.

The Recess Gap

In addition to the general decline in recess time, the Center for Public Education (2008) has identified a "recess gap" across school settings. This finding is supported by the results of a survey sponsored by the U.S. Department of Education and the National Center for Education Statistics (Parsad and Lewis, 2006), which collected information from a representative sample of 1,198 U.S. elementary schools on whether they scheduled any recess for each grade, typically grades 1 through 5 or 6. Respondents reported the number of days per week of scheduled recess, the number of times per day, and the total minutes per day for each elementary grade in 2005. The survey found that while most children, regardless of location, continue to get recess on a regular basis, children who attend high-minority, high-poverty, or urban schools are far more likely than other children to get no recess at all (Figure 6-4):

- The proportion of public elementary schools with any scheduled recess ranged from 87 to 93 percent across elementary grades.
- The proportion of public elementary schools with no scheduled recess ranged from 7 to 13 percent across elementary grades.
- Fourteen percent of elementary schools with a minority enrollment of at least 50 percent scheduled no recess for first graders, compared with 4 percent of schools with 21-49 percent minority enrollment, 5 percent of those with 6-20 percent minority enrollment, and 2 percent of those with less than 6 percent minority enrollment.
- Eighteen percent of elementary schools with a poverty rate over 75 percent (based on the proportion of students eligible for free or reduced-price lunch) provided first graders with no recess, compared with 3 percent of schools with a 50-74 percent poverty rate, 4 percent with a 35-49 percent poverty rate, and 4 percent with a less than 35 percent poverty rate.
- Fourteen percent of urban elementary schools did not offer recess to first graders, compared with 6 percent of schools on the urban fringe, 6 percent of those in towns, and 3 percent of rural schools.

The above patterns for first graders persisted through sixth grade: 24 percent of sixth graders in high-minority schools, 28 percent in high-poverty schools, and 24 percent in urban schools did not get recess, compared with 13 percent of sixth graders overall.

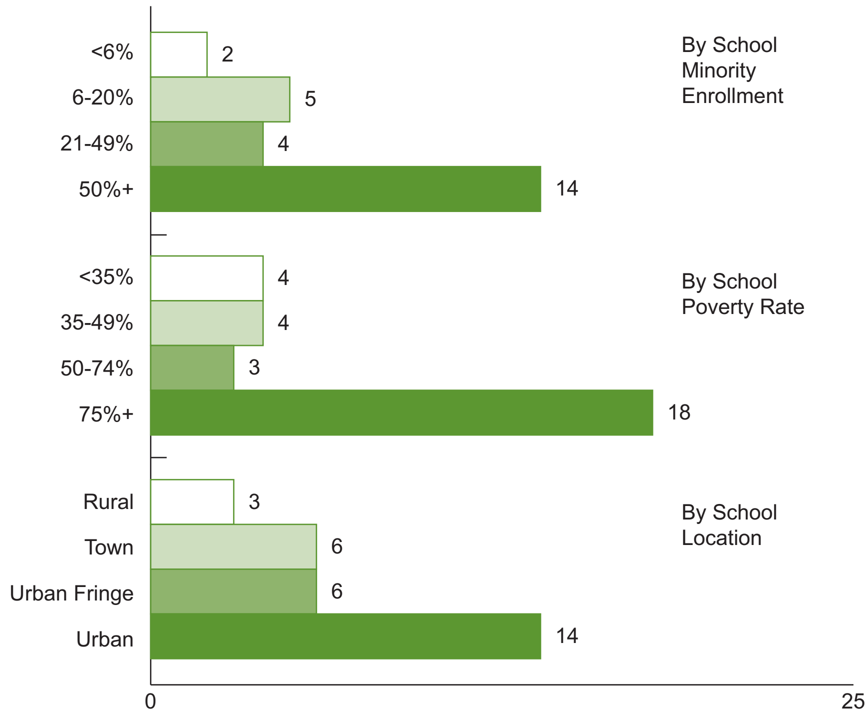

FIGURE 6-4 Percent of schools that do not provide recess to first graders.
NOTE: Poverty rate is based on proportion of students eligible for free or reduced-price lunch.
SOURCE: Parsad and Lewis, 2006. Reprinted with permission.

The National Association of State Boards of Education's (NASBE) (2013) State School Healthy Policy Database supports the above survey findings. It shows that most public elementary schools (83-88 percent) offer daily recess across elementary grades, while 4-7 percent offer it 1 to 4 days per week:

- Large schools generally are less likely than small- and medium-sized schools to have daily recess for first through third grades.
- City schools are less likely than schools in other locales to offer daily recess for first graders. City schools also are less likely than schools in urban fringes and rural areas to schedule daily recess for second through fifth grades.
- Schools with the highest poverty concentrations are less likely than those with lower poverty concentrations to offer daily recess for elementary grades.
- Differences also exist by minority enrollment, with schools with the highest minority enrollment being less likely than those with lower minority enrollment to provide daily recess.

The percentage of public elementary schools offering more than 30 minutes per day of recess ranges from 19 to 27 percent across elementary grades. The average number of minutes per day of scheduled recess for elementary grades differs by school characteristics. Large schools on average offer fewer average minutes per day of recess than small and medium-sized schools; the same is true for schools with the highest and lowest poverty concentrations, respectively. For further detail, a state-by-state list of policies from the NASBE State School Health Policy Database can be found in Appendix C.

Since physical activity, such as recess, has been shown to improve academic achievement, this recess gap may contribute to, not decrease, disparities in academic achievement.

Support for Recess

Both international and U.S. organizations support the importance of recess.

International organizations Aside from the historical literature on the need for children to play (dating back to the 1600's), the most prominent and widespread support for recess is rooted in the International Play Association and its work through the United Nations (UN). The International Play Association, founded in 1961 in Denmark, is a global nongovernmental organization that protects, preserves, and promotes children's fundamental human right to play. The UN's Declaration of the Rights of the Child (1959), Article 7, paragraph 3, states:

> The child shall have full opportunity for play and recreation which should be directed to the same purposes as education; society and the public authorities shall endeavor to promote the enjoyment of this right.

The declaration asserts that spontaneous play fulfills a basic childhood developmental need. It further defines play as, "A combination of thought and action that is instinctive and historical and that teaches children how to live" (IPA, 2013). At the 1989 UN General Assembly, the International Play Association played a key role in the inclusion of "play" in Article 31 of the UN Convention on the Rights of the Child. It reads:

> That every child has the right to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts. That member governments shall respect and promote the right of the child to participate fully in cultural and artistic life and shall encourage the provision of appropriate and equal opportunities for cultural, artistic, recreational and leisure activity. (IPA, 2013)

The U.S. affiliate of the International Play Association has as its primary goal to protect, preserve, and promote play as a fundamental right for all children.

U.S. organizations In a 2013 policy statement, the AAP asserts that recess is a crucial and necessary component of a child's development, and as such, should not be withheld for punitive or academic reasons. It stresses that minimizing or eliminating recess may be counterproductive to academic achievement as mounting evidence suggests that recess promotes physical health, social development, and cognitive performance (AAP, 2013).

Through three sponsored research studies, the Robert Wood Johnson Foundation (RWJF) further supports the need for recess in schools. Published in 2007, *Recess Rules: Why the Undervalued Playtime May Be Americas Best Investment for Healthy Kids in Healthy Schools* (RWJF, 2007) states that recess represents an unparalleled chance to increase physical activity among a large number of children in the United States, as well as an underutilized opportunity to improve the overall learning environment in the nation's schools. For a second study conducted by RWJF (2010), *The State of Play*, 1,951 elementary school principals participated in a Gallup survey devoted to the subject of recess. The survey sample was provided by the National Association of Elementary School Principals, and it reflects a balance of urban, suburban, and rural schools and schools of different income levels, as defined by the percentage of students receiving free or reduced-price lunches. The results show that principals overwhelmingly believe that recess has a positive impact not only on the development of students' social skills but also on achievement and learning in the classroom. When asked what would improve recess at their schools, they highlighted an increase in the number of staff to monitor recess, better equipment, and playground management training, in that order.

A third RWJF study, *School Policies on Physical Education and Physical Activity*, (RWJF, 2011), reports that

1. Whole-school programs that provide opportunities for physical activity across the school day—through recess, in-class breaks, and after-school events—increase children's physical activity levels.
2. 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.
3. Activity breaks during classes not only increase physical activity but also help children focus better on academic tasks and enhance academic achievement.

Other national organizations and studies further support the need for recess in elementary schools:

- The National Association of Early Childhood Specialists in State Departments of Education takes the position that "recess is an essential component of education and that preschool and elementary school children must have the opportunity to participate in regular periods of active play with peers" (National Association of Early Childhood Specialists in State Departments of Education, 2001, p. 1).
- The National Association for the Education of Young Children (1997) believe that unstructured play is a developmentally appropriate outlet for reducing stress in children, improves children's attentiveness, and decreases restlessness (National Association of Early Childhood Specialists in State Departments of Education, 2001, p. 1).
- Through a position statement, *Recess in Elementary Schools*, the National Association for Sport and Physical Education, Council on Physical Education for Children, asserts that "recess also provides the opportunity for students to develop and improve social skills. During recess, students learn to resolve conflicts, solve problems, negotiate, and work with others without adult intervention. Cognitive abilities may also be enhanced by recess. Studies have found that students who do not participate in recess may have difficulty concentrating on specific tasks in the classroom, are restless and may be easily distracted. In addition, recess serves as a developmentally appropriate strategy for reducing stress. Contemporary society introduces significant pressure and stress for many students because of academic demands, family issues, and peer pressures" (NASPE, 2001).

- The National Parent Teacher Association (PTA) and the Cartoon Network launched "Rescuing Recess" in 2006 to help sustain and revitalize the importance of recess in schools across the country. The goal of the campaign is to recognize unstructured break time as an essential element of the school day and to connect educators, parents, and children as advocates for bringing back or retaining recess. A 2006 nationwide survey of PTA leaders found that parents and teachers also think taking a break is a vital part of a child's school day (National Parent Teacher's Association, 2006).

Barriers to Recess

The evidence supporting the cognitive, health, and social benefits of recess could become a thesis on its own merits. Despite these benefits, however, few states have specific policies requiring recess, and those that do have such policies often defer to local school districts to allow individual schools to determine whether students will have a recess period.

Policies requiring increased activity at school each day have the potential to affect large numbers of children and are an effective strategy for promoting regular physical activity. However, external and internal barriers to policy implementation need to be considered (Amis et al., 2012). Competing time demands, shorter school days, lack of teacher participation, and lack of adequate facilities have all been cited as barriers to providing recess (Evenson et al., 2009). Further, weak policies suggesting or recommending changes have shown little or no effect on changing behavior (Ward, 2011; Slater et al., 2012). Additional barriers to enacting effective policies include lack of earmarked resources devoted to policy implementation, principals' lack of knowledge of the policy, and no accountability mechanisms to ensure policy implementation (Belansky et al., 2009).

In addition, the National Association of Early Childhood Specialists in State Departments of Education identifies issues of student safety, lack of adult supervision, potential lawsuits for injured students, and potential for children to come into contact with strangers entering school grounds as barriers to recess (National Association of Early Childhood Specialists in State Departments of Education, 2002). Elementary school principals responding to the above-referenced RWJF (2009) Gallup survey also cited liability and safety issues, as well as access to space and weather.

Strategies for Reviving Recess

Several strategies can be used to promote recess in schools, along with engagement in physical activity among youth participating in these programs. First, it is necessary to provide a safe environment with ample recreational equipment to encourage physical activity. Additionally, regulations should be in place to ensure that schools offer at least 20 minutes of recess per day. It is imperative as well that training be provided to recess supervisors and staff, with a focus on both safety issues and ways to interact with students to better promote physical activity. Recess is not a common occurrence for secondary students; however, they could participate in a civic- or service-oriented program whereby they would oversee and engage in recess for local elementary schools.

Intra- and Extramural Sports

Sports programs have long been an integral part of the school setting. Sport is one of the four human activities, along with play, games, and work. According to Woods (2011, p. 5-6), play is a "free activity that involves exploration, self-expression, dreaming, and pretending. Play has no firm rules and can take place anywhere." Children's play often involves physical movement. Games are forms of play "that have greater structure and are competitive. Games have clear participation goals … [and] are governed by informal or formal rules" (p. 5). Games can be sedentary or physical; involve competition, planning, and strategizing; and result in "prestige or status." Sport is a specialized or higher order of play or games with special characteristics. It must involve physical movement and skill. It must be "competitive with outcomes that are important to those involved" and "winning and losing are a critical part of competition." Thus, an important aspect of sport is institutionalized competition under formal rules. Lastly, work is "purposeful activity that may include physical and mental effort to perform a task, overcome an obstacle, or achieve a desired outcome." Sport can be work.

It is important to note that children in schools can participate in sports as either players or spectators. Kretchmar (2004) suggests that playing sports at a young age tracks to becoming a loyal spectator in later years; however, being a spectator at a young age may not necessarily lead to active participation as a player. Chen and Zhu (2005) analyzed intuitive interest in physical activity among 5-year-olds using the nationally representative sample from the U.S. Department of Education's Early Childhood Longitudinal Study. The results of a logistic regression analysis showed that early exposure to watching a sport may have a negative effect on developing interest in actually playing the sport.

The discussion here focuses on institutionalized in-school sports and on children's participation as players. In-school sports programs typically fall into two categories: *intramural*, or within a school, and *interscholastic*, or competition between schools (AAHPERD, 2011). The type and scope of each of these categories of sports vary by school size (Landis et al., 2007; Lee et al., 2008) and location (Edwards et al., 2012) and the socioeconomic status of students (Edwards, 2009).

In the past 40 years, participation in sports has flourished both within and outside of schools. Although young children are not eligible for formal interscholastic competition until they reach secondary schools, children (or their parents) with athletic aspirations start preparation for competition at a very young age. Results of the National Survey of Children's Health (2007) showed that approximately 58.3 percent of 6- to 17-year olds participated in sports teams or lessons over a 12-month period. The Centers for Disease Control and Prevention (CDC) (2012) reports that in 2011, 58 percent of high school students played on at least one sports team. Intramural sports clubs in middle and high schools also involve large numbers of students.

Participation in sports in and outside of school has increased in the past 20 years. According to the latest report of the National Federation of State High School Associations (NFSHSA) (2012) participation in high school sports nearly doubled in 2011-2012 relative to 1971-1972. While boys' participation increased by about 22 percent during these years, girls' participation increased about 10-fold. Table 6-2 below documents the change by decade.

TABLE 6-2 Change in Participation in High School Sports in the Past Five Decades

	Boys		Girls	
School Year	**Participants**	**Enrollment**	**Participants**	**Enrollment**
1971-1972	3,667,000	7,819,000	294,000	7,364,000
1981-1982	3,409,000	7,541,000	1,811,000	7,101,000
1991-1992	3,430,000	6,754,000	1,941,000	6,392,000
2001-2002	3,961,000	8,224,000	2,807,000	7,836,000
2011-2012	4,485,000	8,553,000	3,208,000	8,060,000

NOTE: Rounded to the nearest 1,000. Participants total is the sum of participants in school sports; if a student participated in more than one sport he or she would be counted for each of those sports.
SOURCE: Adapted from NFSHSA, 2012.

Figure 6-5 shows the ratio of growth in boys' and girls' participation in sports relative to the total enrollment in U.S. high schools during the five decades. The data show that while the ratio for boys has remained steady at about 40-50 percent that for girls has increased from 4 percent in 1971-1972 to 40 percent in 2011-2012.

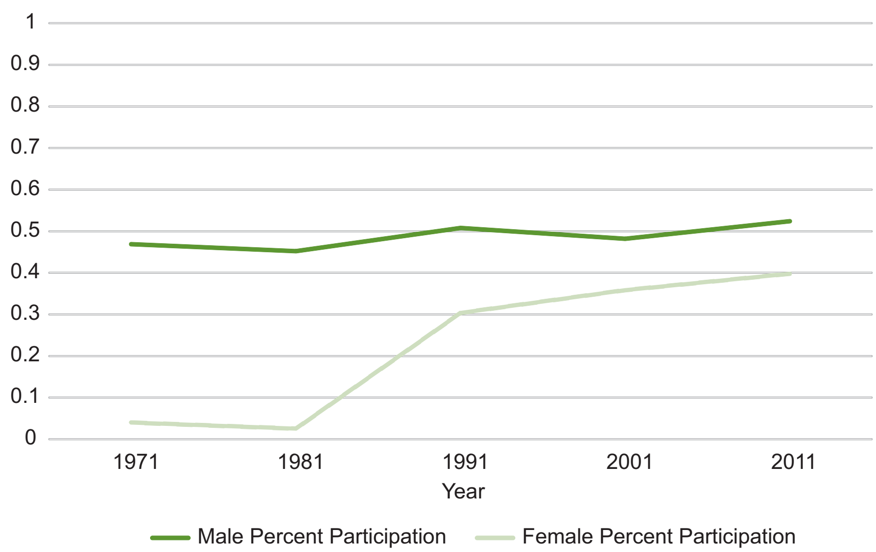

FIGURE 6-5 Change in the ratio of boys' and girls' participation in sports relative to enrollment, 1970-2012.
NOTE: Ratio is number of participants divided by estimated number of boys or girls enrolled in high school in October of the enrollment year. Enrollment data were adapted from the U.S. Census Bureau's October Current Population Survey. For 1971 and 1981, only the total number of students was available, and the proportion of male students was assumed to be 0.515.
SOURCE: U.S. Census Bureau, 1971-2011.

Nationwide, 77 percent of middle schools and 91 percent of high schools offer at least one interscholastic sport, and 48 percent of middle and high schools offer intramural sports or physical activity clubs (Lee et al., 2007; NASPE and AHA, 2010). Based on data from a nationally representative sample of middle schools, Young and colleagues (2007) found that 83 percent of schools offered interscholastic sports, and 69 percent offered intramural sports and clubs. No reports indicate that interscholastic or intramural sports were offered in elementary schools.

Many students who do not play on school teams may participate in sports programs outside of school. CDC (2012) data indicate that 58 percent of high school–age youth played on at least one sports team in 2011, which suggests that an estimated 31 million of the 55 million youth in this age group participated in sports outside of school. The committee was unable to find a national estimate of the number of students who participated in school intramural sports or physical activity clubs. However, one study of four middle schools with similar demographic populations based on race/ethnicity, income, and geographic location suggests that the intramural sports environment may be more conducive to increased physical activity levels than the environment of varsity sports at least for middle school boys (Bocarro et al., 2012). This may be due in part to the fact that all children can participate in intramural activities without having the high skill levels required for interscholastic sports.

Students have many choices of interscholastic sport. Lee and colleagues (2007) cite 23 popular sports, grouped in Table 6-3 team or individual sports. Lee and colleagues (2007) believed that most individual sports may be more likely than team sports to become lifelong activities for individual students.

TABLE 6-3 Interscholastic Sports Choices and Percentage of Middle and High Schools Offering Them

Sport	Middle Schools (percent)	High Schools (percent)
Team Sports		
Baseball	35.7	79.6
Basketball	76.4	90.9
Cheerleading	50.9	77.3
Softball	45.2	77.9
Field hockey	7.1	10.2
Football	53.0	71.0
Ice hockey	2.4	14.3
Lacrosse	2.1	3.8
Soccer	32.3	60.3
Volleyball	57.3	71.4
Water polo	0.5	2.6
Individual Sports		
Badminton	4.2	7.2
Bowling	3.0	17.2
Cross-country running	38.9	68.4
Cross-country skiing	3.2	5.9
Golf	22.1	68.4
Gymnastics	5.2	10.1
Riflery	2.1	3.8
Swimming	6.9	37.8
Tennis	12.6	53.0
Track and field	52.1	73.2
Weight lifting	9.9	23.8
Wrestling	28.7	49.6

SOURCE: Adapted from Lee et al., 2007.

Policies that Affect Participation in Sports

As with physical education and recess policies, data from both the *Shape of the Nation Report* (NASPE, 2010), and the NASBE State School Health Policy Database show variations in amounts, accountability, and regulations for high school sports (NASPE, 2010). Twenty-one states (41 percent) had state requirements regarding sports, most relating to gender equity, concussion management, and local requirements. Although the National Federation of State High School Associations remains the governing body for individual state athletic associations, the governance of district sports opportunities is determined largely by local athletic associations in accordance with individual state association requirements. However, decisions on what sports to offer, the frequency of sport competitions, and other factors are made at the local level. In its report on the Comprehensive School Physical Activity Program (CSPAP), the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) (2011) notes that

65 percent of high schools implemented various forms of team-cut policies for participation in interscholastic sports. The practice requires students to meet minimum performance qualifications before joining a school-sponsored sports team. Such policies include as maintaining a designated grade point average, meeting daily attendance requirements, and adhering to individual school district code-of-conduct policies. One might speculate that such policies may prohibit interscholastic sports from becoming a viable means of promoting maximum student participation in sports and other physical activity.

In summary, trends in participation in sports are encouraging. Compared with physical education, however, it is difficult to expect every child to participate in sports. Although the available data indicate a nearly 60 percent participation rate, the data do not provide specific information about the participants. In addition, studies and national surveys have not provided useful information about those children who do not participate in sports, who may be in the greatest need of physical activity. Although the opportunity for physical activity through participation in interscholastic and/or intramural sports does exist in most secondary schools, the extent to which in sports contributes to children's health and positive behavior change for active living is unclear.

Barriers to Participation in Sports

Although the literature documents the benefits of participating in high school sports, such as academic achievement, increased attendance, and self-esteem, opportunities for participation in sports have not escaped the effects of the budget cuts that have plagued education over the past several years (Colabianchi et al., 2012).

Interscholastic sports have been dominated by a competitive sports model (Lee et al., 2007), which may neglect to engage and support all students. Policies encouraging and funding intramural sports, which are usually more inclusive and less competitive, can increase student participation in sports. The CDC recommends inclusive policies and programs as a strategy for students to meet the 2008 Physical Activity Guidelines (HHS, 2008).

According to the Government Accountability Office (GAO) (2012) report *K-12 Physical Education: School-Based Physical Education and Sports Programs*, school district officials assert that budget cuts have impacted predominately transportation and facilities, both critical to after-school sports programs (GAO, 2012). According to data from the School Health Policies and Practices Study (SHPPS) (2006) (Lee et al., 2007), an estimated 29 percent of schools that offered interscholastic sports in 2006 also provided transportation home for participating students, up from 21 percent in 2000. Transportation costs, a large part of overall school athletic budgets are impacted not only by the need to transport students to practice facilities and competition venues and then home, but also by increases in fuel prices and maintenance costs.

Facilities and equipment are another recognized barrier to participation. Budget cuts have hindered school districts from building new facilities or upgrading existing ones. Where facility and land limitations prevail, schools districts have resorted to developing partnerships and contractual agreements with local community recreation centers or universities to use their facilities for various sports program. A lack of funding for sports equipment has further reduced the number of participating students, as the number of uniforms available per sport has caused the selection process to become more stringent. Colabianchi and colleagues (2012) also conclude that the percentage of students participating in interscholastic sports is contingent on the type and number of facilities (see Figure 6-6).

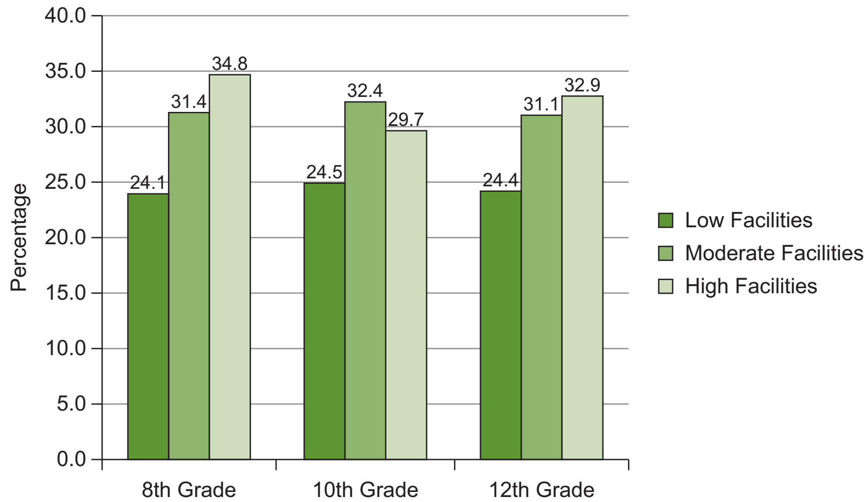

FIGURE 6-6 Participation in interscholastic sports among boys and girls by availability of sports facilities, for 2009-2011.
SOURCE: Colabianchi et al., 2012.

Another challenge to implementing quality sports programs is the availability of quality coaches. Fewer school personnel are coaching in the face of a decline in coaching supplements and increased time commitments. Funding for staffing or staff training is an important aspect of successful sports or after-school physical activity programs. According to 2006 SHPPS data, over half of schools surveyed paid staff for intramural sports programs (Lee et al., 2007). Policies to support supervisory staff can facilitate increased opportunities for physical activity to students.

Budgets have also reduced the number of sports offerings, with the primary sports being retained and the tier-two sports, such as golf and tennis, either being eliminated or requiring that students pay 100 percent of the cost of participation. Indeed, many school districts across the United States have implemented a pay-to-play policy According to the 2006 SHPPS data, 33 percent of schools require students to pay to participate in interscholastic sports. A study released by the University of Michigan, C.S. Mott Children's Hospital (2012), reports that pay-to-play fees are preventing lower-income children from participating in both middle and high school sports. The study found that the average fee was $93 per sport, while some respondents to the survey reported paying $150 or more. When combined with the cost of equipment, uniforms, and additional team fees, the average total cost for a child's participation in sports was $381. Nineteen percent of families making under $60,000 reported that costs led to at least one of their children being unable to participate in sports. Figure 6-7 shows the study regarding participation in school sports among youth aged 12-17 by household income. The study found further that

- More than 60 percent of children who played school sports were subject to a pay-to-play fee; only 6 percent received waivers for the fee.
- Only one-third of lower-income parents reported that their child participated in school sports, compared with more than half of higher-income parents.
- In lower-income households, nearly one in five parents reported a decrease in their child's participation in school sports because of cost.

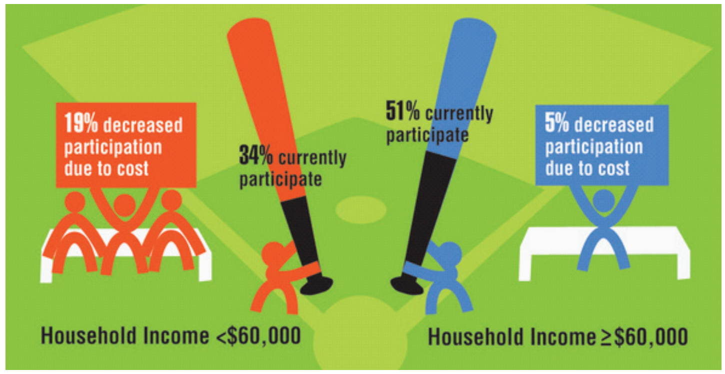

FIGURE 6-7 Participation in school sports for youth aged 12-17 years by household income.
SOURCE: Mott Children's Hospital, 2012.

Colabianchi and colleagues (2012) further determined that the percentage of students participating in sports varied with the students' socioeconomic status. Participation was higher at schools of mid-socioeconomic status than at those of low socioeconomic status, and even higher at schools of high socioeconomic status compared with those of mid-socioeconomic status (see Figure 6-8).

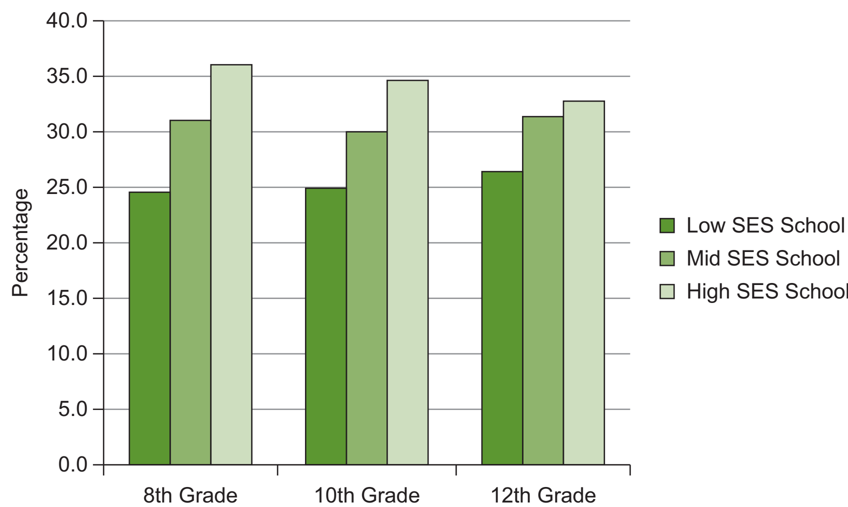

FIGURE 6-8 Participation in interscholastic sports by school socioeconomic status among boys and girls for 2009-2011.
NOTE: SES = socioeconomic status.
SOURCE: Colabianchi et al., 2012.

Interscholastic sports have been criticized for perpetuating racial and gender segregation (Lee, 2007). Further study by Kelly and colleagues (2010), and Bocarro and colleagues (2012) confirmed the relationship between socioeconomic status and sports participation, finding that fewer children and adolescents in schools of low socioeconomic status or of racial and ethnic minority groups participated in sports programs.

To provide the physical activity and psychosocial benefits of engaging in sports at school, education systems need to reevaluate their budgets to ensure that equitable sports opportunities are available for youth in all types of school settings and at all levels of socioeconomic status and at all levels of socioeconomic status. The same holds true with respect to ensuring that school-based intramurals sports opportunities are available before or after-school hours to increase participation in physical activity among all students.

Programs for Students with Disabilities

The 2010 GAO report *Students with Disabilities: More Information and Guidance Could Improve Opportunities in Physical Education and Athletics* notes that students with and without disabilities were provided similar opportunities to participate in physical education in schools, but identifies several challenges to serving students with disabilities. Likewise, for sports, opportunities were provided for students to participate, but students with disabilities participated at lower rates than those without disabilities. Yet, sports programs for students without disabilities have shown similar benefits for students with disabilities, including not only obesity reduction, but also higher self-esteem, better body image, and greater academic success; more confidence and a greater likelihood of graduating from high school and matriculating in college; and greater career success and more options (GAO, 2010; Active Policy Solutions, 2013; U.S. Department of Education, 2013).

To ensure that students with disabilities have opportunities to participate in extracurricular athletics equal to those of other students, the GAO report recommends that the U.S. Department of Education clarify and communicate schools' responsibilities under Section 504 of the Rehabilitation Act of 1973 regarding the provision of extracurricular athletics. Most important, the report recommends improving physical education and athletic opportunities for students with disabilities and recommends that (1) the Secretary of Education facilitate information sharing among agencies, including schools, on ways to provide opportunities; and (2) clarify schools' responsibilities under federal law, namely Section 504 of the Rehabilitation Act of 1973, through the Office for Civil Rights, which is responsible for enforcing Section 504. In January 2013, in a landmark response to the release of the 2010 GAO report, the U.S. Department of Education, Office of Civil Rights, clarified a school's role in providing extracurricular athletic opportunities for students with disabilities.

Active Transport

Active transport or active commuting refers to the use of walking, biking, or other human-powered methods (e.g., skate boarding). It includes using public transportation or walking school buses, or being driven to a point closer to but not at school from which students walk the remainder of the way. Active transport equates to moderate-intensity physical activity, which, as discussed in earlier chapters, provides crucial health benefits. In light of these benefits, CDC has launched programs to encourage parents to walk their children to school.

Active commuting has been proposed as an ideal low-cost strategy to increase physical activity within the general population and can account for one-quarter of an individual's recommended total daily steps (Whitt et al., 2004). Studies have found that active transportation provides children with physical activity (Tudor-Locke et al., 2002) and increased energy expenditure (Tudor-Locke et al., 2003). Bassett and colleagues (2013) suggest that active transport to and from school contributes to 16 minutes of vigorous or moderate-intensity physical activity in youth. These benefits, together with concern about increased traffic congestion and vehicle pollution, have contributed to growing interest in youth using active transport to and from school (Kahlmeier et al., 2010). In addition, it has been suggested that active transport enhances social interaction among children and promotes independent mobility (Collins and Kearns, 2001; Kearns et al., 2003).

Five decades ago, children actively commuting to school were a common sight. Nearly 90 percent of children who lived within a 1-mile radius of school either walked or biked to school (USDOT, 1972). Since 1969, the prevalence of youth walking or biking to school has steadily declined (McDonald, 2007), paralleling a decline in active commuting among in American adults (Pucher et al., 2011). Data from the U.S. Department of Transportation show the decline in active transportation to and from school between 1969 and 2001 (Figure 6-9).

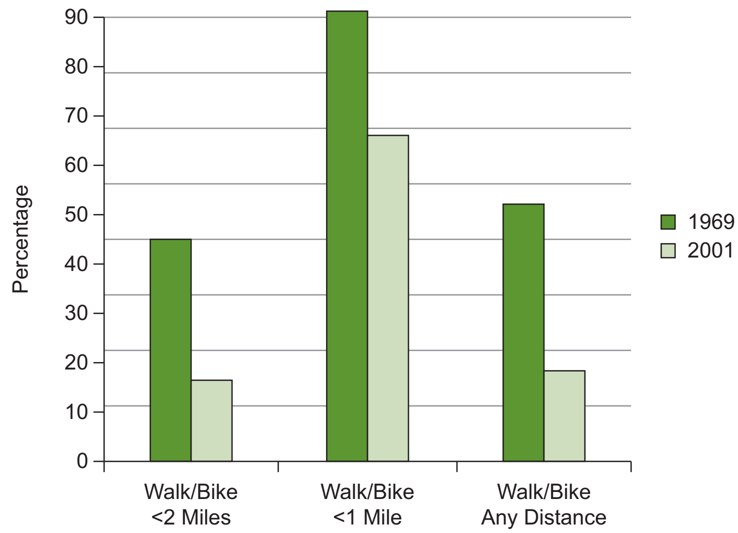

FIGURE 6-9 Decline in active transportation to and from school among youth from 1969 to 2001 in the United States.
SOURCE: CDC, 2008; 1969 Nationwide Personal Transportation Survey (USDOT, 1972) and 2001 National Household Travel Survey.

From an international perspective, active transport among children and adolescents is more prevalent in European countries such as the Netherlands and Germany, which have a culture of active transport, than in other regions. These countries tend to have a lower risk of obesity, diabetes, and hypertension in youth compared with the United States. Indeed, the data support an inverse relationship between the percentage of active transport and obesity rates among residents of the United States, Canada, Australia, and 14 European counties (Bassett et al., 2008). In this study, the United States ranked the lowest on active transport and the highest on obesity prevalence.

Policies That Affect Active Transport

Various environmental and policy factors support and hinder active transport to and from school. For example, school-siting policies that encourage the construction of schools on large campuses far from residential areas and not integrated with housing development are a hindrance (Council of Educational Facility Planners International, 1991). Accordingly, efforts are being made to stop "school sprawl," including eliminating minimum acreage guidelines so schools can be located closer to where school-age children live (Salvesen and Harvey, 2003).

At the national level, the U.S. Secretary of Transportation called for a "sea change" in transportation planning in the United States. He expressed the need to put cyclists and walkers on even ground with motorists and issued a policy statement on accommodations for active transportation (USDOT, 2010). His statement called for the redesign of existing neighborhoods with bicycle lanes, sidewalks, and shared paths. Additionally, the reauthorization of federal transportation legislation charged the Federal Highway Administration with providing funds for states to create and implement Safe Routes to School programs (National Safe Routes to School Taskforce, 2008). Provision of this funding may increase the percentage of children who walk or bike to school through a variety of initiatives including, engineering (e.g., building sidewalks), enforcement (e.g., ticketing drivers who speed in school zones), education (e.g., teaching pedestrian skills in the classroom), and encouragement (e.g., having students participate in walk-to-school days) (CDC, 2005).

Eyler and colleagues (2008) examined policies related to active transport in schools. In 2005, six states (California, Colorado, Massachusetts, North Carolina, South Carolina, and Washington) had statewide safe routes to school or active transport programs. California, Colorado, and South Carolina had regulations regarding the required distance students must live from a school to be eligible for bus transportation (more than 1.5 miles in South Carolina). A review of the NASBE (2012) State School Health Policy Database revealed that only 11 states (21 percent) had legislation requiring walk/bike programs, most in partnership with the state departments of transportation.

Barriers to Active Transport

Several factors contribute to the lack of active transport of youth to and from school. The first is accessibility (Frank et al., 2003), which refers to the proximity (i.e., within a 1-mile radius) of the children's home to the school (Bassett, 2012). Nearly half of the decline in youth walking to and from school from 1969 to 2001 is attributable to the increased distance between home and school (McDonald, 2007). Proximity to school is influenced by families moving farther away from school; schools are being built farther away from home compared with the small neighborhood schools of the past (see Figures 6-10 and 6-11). Proximity also is influenced by the decrease in the number of schools since 1960 even as the number of students enrolled in schools has increased (Wirt et al., 2003).

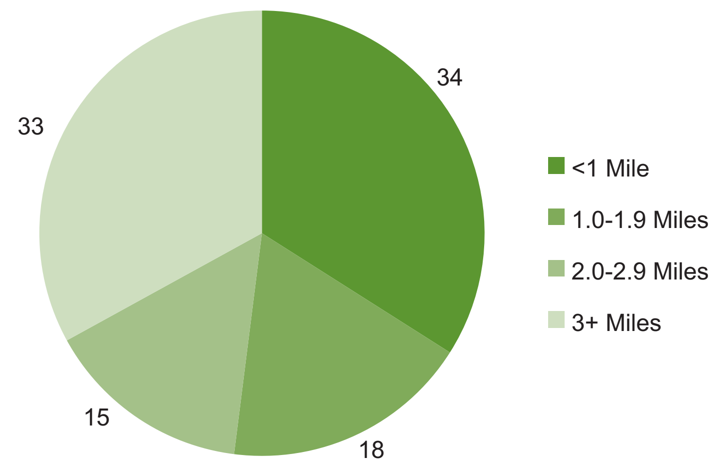

FIGURE 6-10 Distance to school for youth aged 5 to 18 years, 1969.
SOURCE: CDC, 2008.

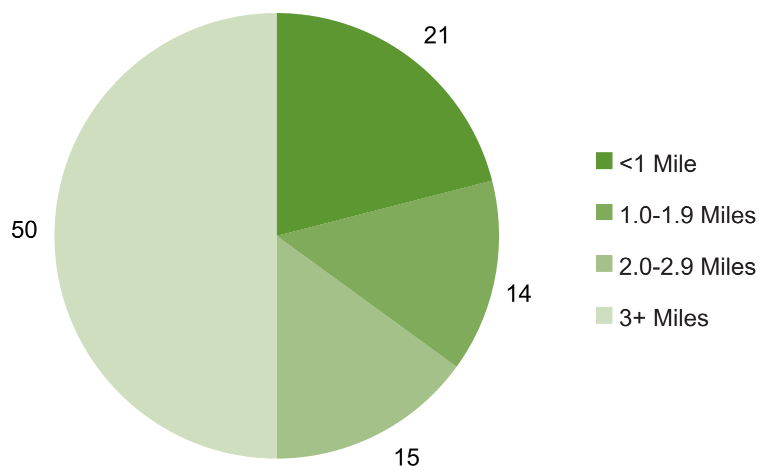

FIGURE 6-11 Distance to school for youth aged5 to 18 years, 2001.
SOURCE: CDC, 2008.

Proximity to school is not the only factor accounting for the decline in active transport, among youth as a significant decline also has been seen among youth living within a 1- to 2-mile radius of school. A second key determinant is infrastructure (Frank et al., 2003). The built environment is key to facilitating active transport. For active transport to be effective, not only must schools be in close proximity to the neighborhoods of students, but sidewalks, pedestrian crossings, and traffic lights must be adequate (Boarnet et al., 2005; Fulton et al., 2005). Boarnet and colleagues (2005) found that children's walking and cycling to and from school greatly increased in urban areas with improvements in sidewalks, traffic lights, pedestrian crossings, and bike paths. In a national study of 4th to 12th graders, the presence of sidewalks was the main modifiable characteristic associated with active transport to and from school (Fulton et al., 2005).

Other parental concerns include street connectivity, busy streets on routes, and mixed land uses (Ewing and Greene, 2003; Fulton et al., 2005; Schlossberg et al., 2006; Timperio et al., 2006).

All nine schools interviewed for one study by active transport programs reported that the environmental factors that most affected these programs were sidewalks, crossing guards/crosswalks, funding, personal safety concerns (see below), and advocacy group involvement. All schools also reported that a school speed zone was the greatest concern (Eyler et al., 2008). Other environmental factors include weather (heat, humidity, precipitation) and geographic location (Buehler and Pucher, 2011), with the South having a built environment less conducive to active transport compared with the Northeast, Midwest, and West (Bassett, 2012).

Related to infrastructure issues are parental concerns about safety (Loprinzi and Trost, 2010). These concerns include traffic dangers (Dellinger and Staunton, 2002; Martin, 2005). For example, 50 percent of children hit by cars near schools are hit by cars driven by parents of students (Wallis, 2003), and drivers often exceed the posted speed limit and/or violate traffic signage in school zones (Wallis, 2003). Safe routes to school initiatives that have linked engineers and educators to make school trips safer have seen a 64 percent increase in the percentage of students walking to school (Boarnet et al., 2005). In urban areas, infrastructure is conducive to active commuting to and from school, but these areas may be characterized by high crime rates (Dellinger and Staunton (2002) propose that safety is of particular concern for primary school children, which may account for their finding that parents rated their child's age as the most important factor in their decision to allow the child to walk to school. Other studies confirm that many 5- to 6-year-olds lack the skills to cope with traffic issues (Whitebread and Neilson, 2000), although other studies have found that neighborhood safety is unrelated to commuting practices in children (Humpel et al., 2004; Wilson et al., 2004). The "walking school bus" (i.e., when an adult escorts a group of children to school) has been shown to be an effective for safely transporting children to and from school (Collins and Kearns, 2005). It may be noted that pedestrian and bicycling injury/death rates among youth have declined by 51 percent and 60 percent, respectively. However, the decrease in walking or biking among youth may have contributed to this downward trend (Wallis et al., 2003).

Finally, parents identify the perceived fitness level of their children as a determinant of their participation in active transport. Specifically, parents who perceive their children as being unfit prefer passive transportation (Yeung, 2008).

Walking School Bus Programs

School-endorsed walking school buses may address several of the barriers identified above—in particular, traffic and crime dangers (White House Task Force on Childhood Obesity, 2010). Walking school buses are popular means for walking young children to school securely in Europe and Australia, but are just starting to emerge in the United States. A walking school bus often entails one or two adult volunteers escorting a group of children from pickup points (walking school bus stops) or their homes to school along a fixed route, starting with the pickup point or home that is farthest from the school and stopping at other pickup points or homes along the way. For increased security for the youngest children, a rope that surrounds the group can be used. On the way back from school, the same system is used in the opposite direction.

The White House Task Force on Childhood Obesity's Report to the President (White House Task Force on Childhood Obesity, 2010) identifies walking school buses as a low-cost initiative communities can undertake to increase physical activity among elementary school children. The prevalence of walking school buses remains low in the United States but is growing; in 2008-

2009, about 4.2 percent of a representative sample of public elementary schools organized walking school buses, with an increase to 6.2 percent in 2009-2010 (Turner et al., 2012). Examples of walking school bus programs are described in Box 6-2.

BOX 6-2
Examples of Walking School Bus Programs

The Safe Passage program in Chicago, a comprehensive initiative designed to help keep children safe on their way to and from school, includes a walking school bus program (see http://www.cps.edu/Programs/Wellness_and_transportation/SafetyandSecurity/SafePassage/Documents/SafePassageGuide.pdf). To further improve the children's safety, veterans have been enlisted to escort the children, on the assumption that their military training enables early detection of any crime-related problems along the way to school (http://www.npr.org/2013/02/15/172130142/checking-in-on-chicago-schools-safe-passage-program). Walking school bus programs also have been undertaken in Columbia, Missouri (http://activelivingbydesign.org/communities/featured-community/albd-sustainability-columbias-walking-school-bus) and in Cleveland, Ohio (http://activelivingbydesign.org/communities/featured-community/clevelands-schools-are-taking-walking-school-bus).

Many resources are available to schools and communities that are interested in starting a walking school bus program. See the following websites:

- CDC KidsWalk-to-School: The CDC's Nutrition and Physical Activity Program has developed KidsWalk-to-School, a community-based program that encourages children to walk and bicycle to school. It provides resources and training models for creating walk-to-school programs. The program increases awareness of the importance of physical activity for children and mobilizes communities to advocate for the creation of safe routes to school. http://www.cdc.gov/nccdphp/dnpa/kidswalk/

- The Santa Clarita, California 2010 Walking School Bus Training Guidebook provides suggestions on how to create walking school bus programs, identify route leaders, plan routes, manage logistics, and fundraise: http://www.altaprojects.net/files/1712/6662/3993/SC%20WSB%20Training%20Guidebook%20WEB.pdf

- Walking School Bus: The Walking School Bus model encourages children to walk or bicycle together in groups, supervised by one or two adults. http://www.walkingschoolbus.org.

- Fire Up Your Feet: This program provides additional perspectives on community methods for creating walking school buses. http://fireupyourfeet.org/resources/walking-school-bus.

Parents' engagement in school-based health promotion activities is another significant benefit of walking school buses. In some communities, walking school buses have provided opportunities for parents and other volunteers to remain engaged in the life of the community while increasing their own physical activity.

Differences in Opportunities for Active Transport

The literature demonstrates that active transporting varies among socioeconomic and ethnic groups and with type of area (suburban, urban, or rural) (Davis and Jones, 1996; Dovey, 1999). Data from Bridging the Gap (Turner et al., 2010)) demonstrate that one in four middle school students and one in eight high school students commutes actively to and from school. Students of low socioeconomic status and those who attend schools where the majority of students are nonwhite (i.e., black and Latino) are more likely to walk or bike to and from school than those of high socioeconomic status and those who attend schools with a predominantly white student body.

Facilitating Active Transport to School Programs

Four common themes have been identified among schools with successful active transport to school programs (Eyler et al., 2008):

1. Collaboration among many organizations and individuals, including school personnel, public safety officials, city officials, parents, and school district representatives
2. Funding for personnel, program materials, and improvements to the built environment.
3. Addressing concerns about safety from both traffic and crime.
4. Making the built environment more conducive to active transport by students.

The same study identified a number of important and specific factors and policies to be considered (Eyler et al., 2008) (Table 6-4).

TABLE 6-4 Factors and Policies That Influence Promotion of Walking or Biking to School

Factors	Policies
Sidewalk presence and quality	School speed zone
Crosswalks and crossing guards	Drop-off policy
Funding	No-transport zones
Personal safety concerns	School siting
Advocacy group involvement	School start/dismissal time
Walk to school days	School choice
Natural environment	

SOURCE: Eyler et al., 2008.

A useful five-component framework for planning programs to enhance active transport to school has been suggested (Fesperman et al., 2008). The framework begins with the development of a plan and the enlistment of key individuals and organizations for input and support. The planning phase is crucial and may take a full year. The implementation of programmatic activities (e.g., training in pedestrian and bicycle safety, walk to school days), policy changes (e.g., school speed zones, modification of school start and dismissal times), and physical changes (e.g., sidewalk improvement, installment of traffic calming devices) follow in a sequence appropriate for the specific school and plan. For all activities, promotional materials to ensure understanding and continued support should be disseminated.

Summary

In summary, active transport to school can be a safe and effective way to increase students' daily physical activity, especially at schools where a large proportion of students live close to the school. Increasing the proportion of children who walk or bike to school commonly requires collaboration among school personnel, public safety officials, city officials, parents, and school district representatives, and requires the obtainment of funding necessary to address the factors and policies listed in Table 6-4.

After-School Programs

After-school programs are emerging as another potential means of promoting physical activity in the context of the school environment. After-school programs are organized school or community-based extracurricular activities that take place outside of the school day, typically between 3:00 and 6:00 PM (Granger et al., 2007), and are characterized by opportunities to build competencies in a wide range of areas (Mahoney et al., 2005). They are conducted on most afternoons during the school week for school-age children. Common areas of focus are nutrition and health education, physical activity and recreation, arts, and music. After-school programs also provide academic assistance (i.e., tutoring and assistance with homework) and opportunities to develop leadership. Personal and social skills are a common theme.

The past two decades, have seen a rapid increase in after-school programs in the United States, and they have become an integral part of the community for many families. In 1988, just 22 percent of K-8 school principals reported offering an after-school program, whereas two-thirds reported offering such a program in 2001 (National Association of Elementary School Principals, 2001). This increase in after-school programs is associated with a growing number of parents working beyond the regular school hours and a rise in maternal employment, which have created a need to provide children with a safe and adult-supervised environment (U.S. Department of Labor, 2005; After School Alliance, 2013). Emerging data indicate that more than 8.4 million youth attend after-school programs for an average of 8.1 hours/per week (After School Alliance, 2013). The After-School Programs and Activities Survey, a nationally representative survey of the 2005 National Household Education Surveys Program (Carver and Iruka, 2006) revealed that 40 percent of students in kindergarten through eighth grade were in at least one weekly nonparental after-school care program, 20 percent of which were school- or center-based programs. Overall, after-school programs have the opportunity to reach large numbers of school-age children. A wealth of research and emerging findings demonstrate the benefits of after-school programs with respect to academic performance; social and emotional development; and health and wellness, including prevention of risky behaviors.

Public opinion supports the need for after-school program. In 1999, the Mott Foundation reported that 94 percent of people believed "there should be some type of organized activity or place for children and teens to go after school every day" (After School Alliance, 1999, p. 1). The federal government also supports afterschool programs, especially in low-income communities. Funding for the 21st Century Community Learning Centers, an after-school program established by the Clinton Administration, has increased dramatically over the years, from $40 million in fiscal year 1998 to $1 billion in fiscal 2002. This grant program supports after-school programs in about 7,500 rural and inner-city public schools in more than 1,400 communities (U.S. Department of Education, 2003).

Policies That Affect After-School Programs

Despite their popularity, there is an absence of nationally recognized standards or policies for promoting physical activity in after-school programs. Moreover, while some states have taken the initiative to create benchmarks, standards and policies are rare, existing in only 70 percent of U.S. states (Beets et al., 2010). Table 6-5 provides an overview of state-level policies, standards, recommendations, and guidelines for physical activity in after-school programs. The table shows wide variation. For example, policies in North Carolina state that 20 percent of the time in an after-school program must be spent in vigorous or moderate-intensity physical activity, while in California, all children must be engaged in a minimum of 30 minutes of vigorous or moderate-intensity physical activity (Beets et al., 2010). Some standards suggest 30-60 minutes of vigorous or moderate-intensity physical activity, while others other suggest ''frequent opportunities'' for physical activity or 30 minutes out of a 3-hour block. By comparison, one recommendation is to allocate at least 50 percent of the program time to physical activity (Beighle et al., in press).

TABLE 6-5 State Policies, Standards, Recommendations, and Guidelines for Physical Activity in After-School Programs

State[a]	Standard, Policy, Recommendation, Guidelines
California	Create afterschool physical activity culture that fosters positive youth development Develop and implement afterschool policies a. Staff/student ratio: 1/20 Plan and evaluate afterschool physical activity Build and maintain strong infrastructure for afterschool physical activity Ensure all directors and staff members support and promote afterschool physical activity programs Develop and maintain high-quality afterschool physical activity Ensure students achieve appropriate amounts of physical activity afterschool a. Provide a minimum of 30 to 60 minutes of moderate-to-vigorous PA during afterschool program b. Limit sitting for no more than 60 minutes at one time c. Limit screen time to 60 minutes per afterschool session Ensure all students are included in the afterschool physical activity Connect afterschool physical activity with the regular school day Build partnerships with the community to support afterschool physical activity
Colorado (Denver)	Outdoor environment: outdoor activities on a daily basis, space for large muscle activity, frequent opportunities for active physical play
Connecticut	Indoor/outdoor environment: allows for regular physical activity Regular opportunities for activities such as active play Staff play with children Alternative plan in place for programs that do not have access to outdoor space on their premises that allows for regular physical activity
Florida	Program provides planned daily recreation, sports, or fitness activities
Illinois	Opportunities for recreation and instruction on nutrition, fitness, and other healthy behaviors
Indiana	Indoor environment a. Space is arranged well for a range of activities – physical games and sports Programs and activities a. Regular opportunities for active, physical play Outdoor environment a. Each child has the chance to play outdoors for at least 30 minutes out of every 3-hour block of time at the program b. Children can use a variety of outdoor equipment and games for both active and quiet play Safety, health, and nutrition a. Equipment for active play is safe
Kansas/Missouri	Promoting physical development – core competencies for professional skill development Level 1 a. Interacts appropriately with and supervises youth during physical activities b. Models healthy behavior c. Facilitates a variety of physical activities that meet the interests, development, and skill levels of youth Level 2 a. Uses a variety of indoor and outdoor physical activities, including structured, unstructured, staff directed, and youth directed b. Supports youth with special needs as they participate in physical activities c. Uses a variety of equipment, activities, and opportunities to promote physical health and fitness Level 3 a. Adapts physical health and fitness activities for youth with special needs

b. Incorporates physical activities into all curricular areas (e.g. recreation and fitness, academic support, life skills, personal growth and development)
c. Provides an environment that is conducive to the exploration and development of physical skills

Level 4

a. Evaluates the appropriateness and effectiveness of physical development activities for groups and individuals
b. Articulates the importance and demonstrates the methods of integrating health and fitness activities into all curricular areas
c. Understands the impact of health and fitness activities on youth
d. Facilitates youth involvement in curriculum design, implementation, and evaluation

Level 5

a. Articulates, analyzes, evaluates, and/or applies current theories and research related to promoting physical development
b. Advocates for policies and practices that promote the physical development of youth

SOURCE: Beets et al., 2010.

After-school programs can be used to combat physical inactivity and obesity while promoting physical activity on school grounds but outside of the normal school-day hours (Lee et al., 2007; Levi et al., 2009). However, national organizations and state entities need to develop appropriate policies and standards for the implementation of after-school programs whose goal is to promote health and physical activity in school-age children. Doing so would help promote physical activity among school-age children in these settings, aiding them in achieving the recommended levels of daily physical activity. However, it is important not only to have such policies in place, but also to ensure that the policies are being implemented (i.e., accountability).

Facilitators of and Barriers to After-School Programs

Various factors serve as barriers and facilitators for after-school programs. The school environment is a facilitator for after-school programs because the setting provides a wide range of activities (Grossman et al., 2001). Schools are equipped with gymnasiums, libraries, auditoriums, and computer labs that provide unique equipment and space. Second, schools have immediate access to participants, and their after-school programs offer legitimacy for parents who may be hesitant to allow their children to participate in a program elsewhere.

Using schools as a venue for after-school programs is not as easy as it may seem however. First, their facilities may not always be available for use. Safety, lack of staffing, insufficient funding, risk of vandalism, and insurance liability concerns often cited as a barrier to opening school grounds outside of school hours (Filardo et al., 2010; Cox et al., 2011; Spengler et al., 2011; Evenson et al., 2012). For instance, teachers use classrooms to prepare for the next day's lesson or to provide extra academic assistance to students; students use the library and computer lab to complete classroom assignments; and sports teams need the gymnasium for practices. Thus, after-school programs often compete for space, particularly in the gymnasium. The availability of school space is critical to the effectiveness and quality of after-school programs, most of which require open, multipurpose space to accommodate a range of activities.

In addition to competing for space, after-school programs entail costs to schools, after-school community partners, and families. In addition to personnel to run the program, there are costs for upkeep and maintenance of school facilities. After-school programs also entail custodial costs for room cleaning. For parents, the average cost for afterschool programs is $67.00 per week, representing a $20.00 increase over the past 5 years (After School Alliance, 2009). Thus, public funds are needed to defray some of these costs to schools and families.

In addition, the inability for an after-school program to provide transportation home is a major barrier to participation for a large number of students. Programs have an advantage in recruiting participants when operating in schools where a majority of the students live within safe walking distance (in particular, urban city schools) (Grossman et al., 2001). For children not living within walking distance of school, busing is an alternative, but the limited supply of buses and drivers, as well as their cost, is a major barrier. There are substantial negative consequences of inadequate transportation. Youth who live beyond walking distance from the school and who are unable to be picked up by a parent or adult at the designated time are unable to participate in the programs. For schools that can provide busing for after-school programs, the number of seats available on those buses limits the number of children that can participate. Even when the children live within walking distance of the school, many parents feel uncomfortable about their child walking home alone in the dark at 5:00 or 6:00 PM. School districts have struggled with easing this transportation problem. Money was unavailable in schools' budgets, or there were restrictions on how transit money could be spent. For example, school districts give transportation funding only to academic programs, and after-school programs are considered nonacademic.

Staff training is another concern for after-school programs. If training does occur, it is often in house. Existing training programs tend to focus on games and to use pre-packaged materials, and fail to address training with respect to promotion physical activity (Ajja et al., 2012; Weaver et al., 2012).

Differences in Opportunities in After-School Programs

In addition to providing children with enrichment opportunities, a key factor behind the policy interest in after-school programs is the increasing need for child care. Almost all adults agree that elementary school children need adult supervision. Young people aged 10-14 are often seen as old enough to stay on their own for short periods of time, but they are also old enough to get into serious trouble. Unfortunately, these older children are much less likely to participate in supervised after-school programs, whether they take place at youth-serving organizations or at school. It is easier to recruit elementary school children to these programs than middle and high school students, who tend to have busier schedules, increased responsibilities and greater freedom (Grossman et al., 2001). Grossman and colleagues (2001) found that 30 percent of enrollees in after-school programs were in 3rd grade or lower, 45 percent were in 4th through 6th grades, 23 percent were in 7th and 8th grades, and only 2 percent were in 9th grade or higher. Additionally, elementary-age children who enrolled attended more frequently than older youth.

SUMMARY

In addition to physical education, schools can offer students non-instructional opportunities to engage in beneficial physical activity before, during, or after the school day. These opportunities take various forms, such as interscholastic sports teams, intramural sports clubs, recess, and in-class physical activity breaks. Interscholastic sports provide opportunities for students with athletic talent. But budgetary constraints, team-cut policies, transportation, a lack of facilities, and pay-to-play policies and practices in many high schools may limit participation. Intramural sport clubs in middle and high schools are a viable way for the majority of children to engage in in-school or after-school physical activities. Research data consistently show, however, that although these programs can serve a large number of children, not every child will opt to participate or be able to find transportation home after the activity. Recess and classroom physical activity breaks have become valuable opportunities for elementary school students to be active during the school day. Their value in middle and high schools is questionable when they are combined with lunch, and at the secondary level, classroom activity breaks are lost to valuable and limited academic time. Evidence supporting the integration of physical activity into academic lessons does exist, but only for elementary schools. Given the nature of institutionalized education and its emphasis on academic achievement, it is unclear that the approach will be embraced by school officials and most classroom teachers.

One consensus from the literature is that to take advantage of and enhance the many opportunities for physical activity outside of physical education, policy makers and practitioners must acknowledge the anchor function of physical education (National Physical Activity Plan, 2010). Curriculum time is insufficient for all of the recommended 60 minutes or more of vigorous or moderate-intensity physical activity to take place during physical education, so the activity children engage in throughout the school day is important. Therefore, a holistic, comprehensive approach is increasingly being advocated to promote physical activity in schools. School environments encourage more physical activity, both before and after school, if they include well-designed playgrounds; open spaces; and facilities and equipment that are available, accessible, and inviting to children AAHPERD's CSPAP program can serve as an example. It provides opportunities anchored in the knowledge and skills learned in physical education and uses a flexible programming method that allows local decision makers and teachers to integrate physical activity opportunities in relevant school activities before, during, and after the school day. It must be emphasized that while school-based physical activity should be used to support physical activity in the school environment, it should not be used as a replacement for physical education, whose importance is explained in Chapter 5.

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7
The Effectiveness of Physical Activity and Physical Education Policies and Programs: Summary of the Evidence

Key Messages

- Regular and quality physical education can help children and adolescents achieve the recommended amount of daily vigorous or moderate-intensity physical activity and improve fitness and potentially body mass index (BMI). Quality monitoring systems are crucially needed to enable monitoring and evaluation of these important outcomes.
- Recommended levels of vigorous or moderate-intensity physical activity for youth are more likely to be achieved and sustained in the school setting if students, administration, teachers, and supportive policies and environments are integrated.
- Recommended levels of vigorous or moderate-intensity physical activity for children and adolescents are more likely to be achieved in schools where the physical environment, the school's programs, and the school's staff all facilitate greater amounts of physical activity throughout the day, including during physical education, recess, instructional classroom time, and before- and after-school opportunities.
- In addition to physical education, recess can provide an opportunity for students to engage in vigorous or moderate-intensity physical activity and has been shown to improve classroom behavior.
- Physical activity during classroom time or activity breaks during lessons may contribute to reduced sedentary time during the school day and increase the amount of light- and moderate-intensity activity among students.
- Together, regular and quality physical education, recess, and physical activity in the classroom setting enable students to be more physically active during school hours, and significantly contribute to recommended levels of vigorous or moderate-intensity physical activity.
- Opportunities exist for increasing physical activity outside of normal school hours, including active transport to school and active after-school and sports programs. These programmatic efforts can further contribute to the daily recommended levels of vigorous or moderate-intensity physical activity among students for whom such programs are available and accessible in the school setting.
- Schools can be rich resources for joint-use agreements that facilitate time physical activity programming for students in a community out of school time.
- Research is limited on the effectiveness of physical education, recess, classroom physical activity, and before- and after-school programs, and across subgroups based on race/ethnicity, and immigrant and socioeconomic status. Additional research is needed to document any differential effects of these approaches among those subgroups.
- Even though sufficient evidence exists to support augmenting student physical activity during school hours and at school-related after-school activities, important questions remain about tailoring interventions to fit the wide social and physical variations among schools.

An effective or promising approach for increasing physical activity in youth is one that both has theoretical underpinnings and has been investigated through methodologically sound qualitative or quantitative research. The type of research and evidence relating to strategies for increasing physical activity in schools varies tremendously by program or policy components. As suggested by the L.E.A.D. (Locate Evidence, Evaluate It, Assemble It, and Inform Decisions) framework, developed to guide decision making on obesity prevention, evidence should be evaluated against criteria for assessing quality that are appropriate and established for this type of evidence (IOM, 2010). All research findings should be considered in light of their strengths and limitations, including internal and external validity, where appropriate and relevant.

This chapter presents a summary of available evidence on and provides examples of effective and promising approaches for increasing physical activity in schools. It is important to note that a lack of favorable research findings concerning the influence of a program or policy must be interpreted with caution, but not altogether discounted. Definitive evidence on effectiveness may be limited by the novelty of the approach, gaps in surveillance, or the lack of feasibility of using "gold standard" study designs to examine certain issues. For example, use of a randomized controlled design to study the effects of a new physical education policy at the state level may not be feasible. At the same time, however, the field of evidence-based policy making, which involves drawing on existing research and surveillance systems, is growing, and is especially relevant to the study of the impact and outcome of the approaches presented in this chapter.

SYSTEMS APPROACHES: MULTICOMPONENT PROGRAMS AND INTERVENTIONS

Strategies for promoting behavior change need to take account of the complex interactions between individuals and the settings in which they spend their time. While ecological models for health promotion encompass the individual, social, and policy levels, a systems approach (discussed in detail in Chapter 1) focuses on the dynamic interactions among various factors at those levels. A systems approach to increasing physical activity in children and adolescents can help address the complexity of this behavior within the school setting. Integrating students and key players such as school and administrative personnel with the school and classroom environments and all levels of policy may be the best way to influence sustainable changes in population-level physical activity behaviors.

According to a recently released report (HHS, in press), multicomponent school-based approaches, which usually included enhanced physical education in conjunction with other forms of school-related physical activity, are effective in increasing physical activity among students (see Box 7-1). Although systematic reviews of the literature identify evidence for the promise of such approaches, however, the context for and generalizability of this evidence vary greatly (Salmon et al., 2007; Naylor and McKay, 2009; Craggs et al., 2011). Perhaps one of the most notable examples of a multicomponent intervention is the Child and Adolescent Trial for cardiovascular Health (CATCH). This 3-year rigorously designed randomized controlled intervention included improvements in physical education class, a health promotion curriculum, food service changes, as well as a family component. Results indicated more intense physical activity during the physical education class and more daily vigorous physical activity in intervention groups compared with controls (Luepker et al., 1996). (See Box 7-2 for a more detailed description of this intervention.)

BOX 7-1 The ENERGY Project

The aim of the ENERGY project (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) is to develop a theory-based, evidence-based multi-component intervention promoting the adoption or continuation of healthy behaviors that can lead to a healthy energy balance (available online at http://www.theenergyproject.com/ [accessed March 1, 2013]). This program also includes a component called UP4FUN, a 6-week school-based project to reduce and break up sitting time in school and at home. The preliminary findings of the ENERGY-project suggest that increased breaks in sedentary behavior can be achieved through a school and home-based intervention. An intervention has to take certain circumstances into considerations: national and cultural traditions and social disparities need to be recognized, along with variations in family structure, ethnicity and education levels. All these may influence the opportunity for intervention and the form and content of the intervention. For this reason it is valuable to involve the participants—especially the teachers, the parents and the children themselves—in the development stages of an initiative. The most successful interventions tend to be those which combine dietary behavior change with physical activity and reduced sedentary behavior, rather than focus on only one of these behaviors. Failed interventions did not combine educational with environmental change strategies, did not involve the family and home environment, and did not conduct careful pre-testing before larger scale implementation. Among a number of school interventions examined for their cost effectiveness, multifaceted school-based programs with an active physical education component have been shown to be most cost effective.

SOURCE: Simon et al., 2004. Reprinted with permission.

BOX 7-2
CATCH: An Example of a Multi-Component Coordinated School Health Promotion Program

The Child and Adolescent Trial for Cardiovascular Health, or CATCH, was a "controlled clinical trial that entailed a multicomponent, multiyear coordinated school health promotion program designed to decrease fat, saturated fat and sodium in children's diets; increase physical activity; and prevent tobacco use" (Perry et al., 1990).

CATCH included school environmental modifications related to food consumption, physical activity, and tobacco use. For physical activity, a whole-of school approach was used (see the discussion of this approach in Chapter 1). Physical education teachers were instructed to increase the involvement of children and to provide for vigorous or moderate-intensity physical activity for at least 50 percent of class time. The CATCH classroom curriculum outside of physical education used social cognitive theory to target third- to fifth-grade students and focused on multiple health behaviors, including eating habits, physical activity, and cigarette smoking. CATCH also incorporated family- and home-based programs to complement in-school activities (Perry et al., 1990).

The trial was carried out in 1991-1994 in 96 schools (56 intervention sites, 40 control sites) in four states (California, Louisiana, Minnesota, and Texas) and included more than 5,100 students with diverse cultural and ethnic backgrounds. By the time it was completed, CATCH had demonstrated sustainable changes in dietary and physical activity behaviors. With respect to physical activity outcomes, students who participated in the intervention were more physically active during physical education classes and participated in more physical activity outside of school compared with students in the control schools (Luepker et al., 1996).

Further sustainability was demonstrated after the main CATCH trial had ended. The CATCH students were studied 3 years following the intervention. With no continued CATCH intervention, the students who had participated in the trial maintained lower fat intakes and higher levels of physical activity compared with those who had not participated (Nader et al., 1999).

Such multicomponent, whole-of-school approaches for increasing physical activity can be successfully sustained with key elements in place. Osganian and colleagues (2003) studied the schools in the original trial and concluded that sustainability was enhanced by staff training; a program champion; and adequate administrative support and resources, such as sufficient funding for materials and equipment (Osganian et al., 2003).

In a recent review, van Sluijs and colleagues found strong evidence for the effectiveness of multicomponent school-based interventions including family or community components (Craggs et al., 2011). With increasing recognition of the importance of these integrated approaches, programs such as Playful City USA (Kaboom, 2013) and Playworks (http://www.playworks.org/) are being launched as national campaigns to promote physical activity. Playful City USA is a national recognition program honoring cities and towns that make play a priority and use innovative programs to get children active, playing, and healthy. Playful City USA is a national recognition program honoring cities and towns that make play a priority and use innovative programs to get children active, playing, and healthy. Playful City USA designees map local play spaces; complete a needs assessment; and develop an action plan that identifies a minimum of three policies, programs, or initiatives aimed at increasing access to play at school, in neighborhoods, and through community engagement. In 2012, 213 cities and towns in 41 different states earned Playful City USA recognition. Playworks is another program promoting physical activity through integrative means. The Playworks mission is to improve the health and well-being of children by increasing opportunities for physical activity and safe, meaningful play at recess and throughout the school day. Trained adult program coordinators go to low-income schools, where they enhance recess and play to make them a positive experience that helps students and teachers get the most out of every learning opportunity throughout the school day. This program has the potential to enhance not only physical activity but also classroom learning and social culture (also see Chapter 4).

The interest in and prevalence of these multicomponent programs for increasing child and adolescent physical activity are growing. As has been brought to light by reviews of these interventions, well-developed evaluation methodology is needed to strengthen the evidence base for their effectiveness.

Cost-effectiveness is another important outcome of these interventions. Growing evidence indicates that population-level environmental interventions are a more cost-effective preventive health measure than interventions targeting individuals, yet more research is needed in this area (Choski and Farley, 2012). Schools, where children spend the majority of their waking hours, are important locations for obesity prevention activities such as those designed to increase physical activity (Story et al., 2009). The World Health Organization, the American Heart Association, and the Centers for Disease Control and Prevention (CDC) have called on schools to assume a leadership role in promoting physical activity among children and adolescents.

Recent research by Aryana and colleagues (2012) shows the need to target obesity prevention strategies at an early age. This study tracked changes in California students' physical fitness, including body mass index (BMI), during 5th, 7th and 9th grade. While the researchers found that school-based physical activity can have some effect on reducing obesity rates, they continued to find increased obesity rates in incoming 5th-grade study participants. Several studies also point to the importance of physical activity in obesity interventions. Findings of Skinner and colleagues (2012) and a new Australian study led by Professor Richard Telford (http://topnews.us/content/251841-physical-activities-vital-controlling-childhood-obesity), both show that obese youth consume the same amount of calories as their normal-weight counterparts, suggesting that increased physical activity in youth may be crucial in reducing obesity prevalence. These findings highlight the need to target physical activity interventions and policies at all youth. Stallman-Jorgensen and colleagues (2007) indicate that a lack of vigorous physical activity, rather than excess calorie intake, is related to body fat in youth.

Even though multicomponent approaches to increasing physical activity in youth often adhere to systems thinking and can be effective and sustained over time, they are complex, and barriers to their implementation and sustainability are numerous. Indeed, physical activity interventions and initiatives in school are more often defined by a single focus, such as a policy or a curriculum. These singular programmatic and policy approaches within schools are increasing in prevalence, as indicated in Chapters 5 and 6. The next section describes effective and promising approaches for individual components. As demonstrated by variations in the space devoted to each approach, many strategies have not been evaluated or disseminated to the fullest extent.

PROGRAMMATIC/POLICY APPROACHES AND THEIR OUTCOMES

This section reviews programmatic and policy approaches for increasing physical activity and their outcomes in the areas of physical education, recess, classroom physical activity, intraand extramural sports and after-school programs, active transport, the environment and reduction in sedentary activity, and partnerships/joint- or shared-use agreements.

Physical Education

Status and Trends

No national data are available concerning population-level trends over time in enrollment and daily attendance in physical education overall physical activity in physical education class, or the amount of time spent in vigorous or moderate-intensity physical activity during physical education lessons among students in elementary and middle schools. However, research pertaining to children in elementary and middle schools documents insufficient physical education opportunities. One study of elementary schools across 10 U.S. localities—found that the schools offered an average of two physical education lessons per week lasting 33 minutes each; children in this study received 25 minutes per week of vigorous or moderate-intensity physical activity—far short of national recommendations—in school physical education (Belsky et al., 2003). And among middle and high school adolescents who participated in wave I of the Adolescent Health Study in 1993, only 21.3 percent reported participating in physical education in their schools on one or more days per week of (Gordon-Larsen et al., 2000).

CDC has collected national data on physical education among high school students over the past two decades through the Youth Risk Behavior Surveillance System (YRBSS). These data reveal disconcerting patterns as well. Among high school students during the period 1991-2007, enrollment and daily attendance in physical education classes and being physically active during these classes fell short of the objectives of Healthy People 2010 (Lowry et al., 2001, 2005, 2009).

Specifically, in 1991, 48 percent of high school students were enrolled in physical education, with no significant changes between 1991 and 2003 (Lowry et al., 2001; Lowry et al., 2005). Moreover, daily attendance at physical education classes declined significantly from 41.6 percent in 1991 to 25.4 percent in 1995, with no significant changes between 1995 and 2007 (Lowry, 2005; Lowry et al., 2009).

In addition to enrollment and attendance, the quantity of physical activity during physical education classes is crucial. In 1991, only 36.8 percent of high school students were physically active in physical education classes; although the percentage was slightly higher in 2003 (39.2 percent) there were no significant changes between 1991 and 2003. Further, no significant changes were observed from 1999 to 2007 (Lowry et al., 2009).

Although physical education may be offered, moreover, high schools do not always require students to take it; these variations appear to follow grade lines. From 2004 to 2007, 88 percent of 8th graders, 48 percent of 10th graders, and only 20 percent of 12th graders attended schools that required physical education in their grade (O'Malley et al., 2009). The average weekly minutes spent by high school students in physical education classes also varies across grade levels—according to a national study, declining from 172 minutes in 8th grade to 164 minutes in 10th, down to 89 minutes by 12th grade, with the overall decrease being statistically significant (Johnston et al., 2007). The available national data indicate that between 1991 and 2007 no significant progress was made toward increasing participation in physical education classes among high school students (Lowry et al., 2009).

Disparities

All youth should engage in physical education, and meet the recommended 60 or more minutes per week of vigorous or moderate-intensity physical activity regardless of geographic region, school attended, grade level, or individual-level characteristics. In addition to the overall troubling physical education participation patterns described above, a number of studies have documented disparities across race/ethnicity, socioeconomic status, and gender.

Race/ethnicity and socioeconomic status Using national data from the Monitoring the Future and Youth Education and Society study, researchers observed that among 8th graders, Hispanic youth attended schools in which smaller proportions of students were required to take physical education relative to schools attended by white youth (Johnston et al., 2007). Compared with schools attended by white students, those attended by Hispanic students had a significantly smaller percentage actually taking physical education in 8th and 12th grades (Johnston et al., 2007). Further, students of lower socioeconomic status were less likely to attend schools that required physical education (Johnston et al., 2007). Racial/ethnic and socioeconomic disparities in physical activity and physical education may be driven by multiple factors, including differences in student-level socioeconomic status and differences in school-level resources such as funding equipment and facilities. Poor facility provision in schools such as availability of gyms was a potential barrier for school physical activity programs and was worse in urban, high minority, and high enrollment schools (Fernandes and Sturm, 2010). Gymnasium availability in schools was associated with an additional 8.3 minutes overall and at least an additional 25 minutes of physical activity per week for schools in humid climate zones (Fernandes and Sturm, 2010).

Gender Participation in physical education and time spent being physically active in physical education differ by gender. Consistent with national data, participation in physical education was found to be higher in boys (66 percent) than girls (59 percent) among California adolescents (Diamant et al., 2011). Moreover, based on national data from the YRBSS, high school girls spent more minutes per week in active physical education (37 minutes) than boys (26.9 minutes). The investigators concluded that physical education increased girls' overall physical activity levels (Cawley et al., 2007).

In direct observations of physical education classes in elementary schools across various U.S. localities, investigators noted that boys spent more time in physical education engaged in vigorous or moderate-intensity physical activity than girls, although there were no gender differences in lesson length and number of minutes of physical education (Belsky et al., 2003). Nevertheless, girls have reported that physical education was their largest source of physical activity (14.3 percent), followed by lunchtime (11.7 percent) and recess (8.3 percent); among boys, lunchtime represented the largest single source of physical activity at school (13.4 percent), followed by physical education (12.7 percent) and recess (9.5 percent) (Brusseau et al., 2011).

Impact on Physical Activity

Physical education programs and policies can shape the quantity and quality of physical activity among students across schools (Slater et al., 2012). Studies using direct observations of physical activity have found large variations in the amount of vigorous or moderate-intensity physical activity performed by students during their school physical education classes: a range of 9-48 percent (Pate et al., 2011).

A number of school-based intervention studies have targeted physical education classes as a focus for increasing vigorous or moderate-intensity physical activity in young children; many of these studies have included other intervention components, such as environmental changes. In the CATCH intervention study, involving children in elementary schools, an increase in the intensity of physical activity in physical education classes during the intervention was observed in the intervention schools compared with control schools. Compared with control students, moreover, those in the intervention schools reported significantly more minutes of daily vigorous activity (Luepker et al., 1996). In the Sports, Play, and Active Recreation for Kids (SPARK) intervention, also comprising elementary schools, vigorous or moderate-intensity physical activity increased during physical education among 4th graders (Sallis et al., 1997). The SPARK intervention also showed that students who received physical education from specialists had the highest percentage of class time (40 percent) in vigorous or moderate-intensity physical activity, compared with those who received physical education from trained teachers (33 percent) and controls (18 percent) (Sallis et al., 1997).

In a follow-up of the CATCH study while participants were in 8th grade, investigators observed that the intervention students maintained a significantly higher amount of self-reported daily vigorous activity compared with control students; however, the intervention-control differences declined over time (13.6 minutes in grade 5, 11.2 minutes in grade 6, 10.8 minutes in grade 7, and 8.8 minutes in grade 8) (Nader et al., 1999), highlighting the need for longer-term school-based interventions. Further, in an intervention for girls aged 11-12 designed to increase vigorous or moderate-intensity physical activity during physical education lessons, the experimental group engaged in more of such activity than the control group and had most opportunities for skill practice (Fairclough and Stratton, 2005).

Cross-sectional studies also have documented that participation in daily school physical education programs is associated with an increased likelihood of engaging in vigorous or moderate-intensity physical activity among middle and high school adolescents nationwide (Gordon-Larsen et al., 2000). Moreover, participating in physical education was associated with engaging in an additional 18 minutes per week of overall physical activity, even after adjusting for age, gender, race, and income, among adolescents in California (Diamant et al., 2011). One study using cross-sectional data from the National Survey of Children's Health found that although there was no significant association between schools requiring physical education and levels of physical activity in the sample overall, such an association did exist for girls (Kim, 2012), suggesting that physical education may be particularly important for increasing physical activity in this group.

Consistent with results from the above studies, several reviews (Dobbins et al., 2009; Kriemler et al., 2011; Pate, 2011; Heath et al., 2012) have concluded that school-based interventions increased vigorous or moderate-intensity physical activity during physical education (Pate et al., 2011); duration of physical activity (Dobbins et al., 2009) (not necessarily only in physical education); physical activity overall (Heath et al., 2012); and physical activity in school, out of school, and overall (Kriemler et al., 2011).

Effects of school-based interventions on the quantity and quality of physical activity are favorable, as are the positive associations documented in observational studies. However, studies involving direct observations of physical activity during physical education classes provide strong evidence that the classes do not provide sufficient activity to enable children or adolescents to attain the recommended levels of daily vigorous or moderate-intensity physical activity; the classes also do not reach the goal of 50 percent of class time spent in vigorous or moderate-intensity physical activity (Pate et al., 2011). Further, there is a dearth of research concerning intervention effects and observational associations of school-based programs and the quantity and quality of physical activity across subgroups based on race/ethnicity, gender, immigration status, and socioeconomic status.

Students are more likely to meet physical education learning standards if taught by certified physical education teachers (Castelli and Rink, 2003).

Similarly, other cross sectional studies have documented significant associations between policies designed to increase physical activity and/or regulate physical education in schools and greater frequency of physical education classes (from 2.0 days in 2004-2005 to 3.7 in 2006-2008), more time in structured physical activity and self-reported physical activity among students in middle schools (Barroso et al., 2009), and overall physical activity in high school female students nationwide (Cawley et al., 2007).

A systematic review of 13 studies concerning physical activity policies and legislation in schools (including physical education policies) found that the majority of the studies focused on policy implementation (Robertson-Wilson et al., 2012). To date, only a handful of studies have evaluated impacts of mandates requiring 150 minutes of physical education per week (Slater et al., 2012) on student activity levels (Cawley et al., 2007; Barroso et al., 2009) or elementary school-level provision.

Are Policies the Answer? Although state and local physical education mandates exist, they vary in content and scope and almost always lack adequate implementation and evaluation. A "top-down" federal level mandate may help guide a collective effort in addressing the prevalence of childhood inactivity.

Impact on Other Outcomes

Fitness Physical fitness (such as aerobic capacity or maximal oxygen consumption [VO_2 max]) is a marker of successful interventions addressing physical activity (Dobbins et al., 2009). In a physical education intervention study in middle schools, Dorgo and colleagues (2009) observed that the experimental groups improved significantly on the six fitness measures used and showed greater improvements than the control group in most fitness measures at 9 and 18.

In the SPARK study, which aimed to increase physical activity in physical education classes, Sallis and colleagues (1997) found that compared with girls in the control condition, girls in the specialist led condition were superior on abdominal strength, endurance, and cardiorespiratory endurance after the 2-year intervention period. Consistent with the findings presented above, a review of interventions focused primarily in school settings found good evidence that school based physical activity interventions had positive effects on physical fitness (measured by VO_2max) among adolescents aged 6-18 (Dobbins et al., 2009). Similarly, in an earlier systematic review, Kahn and colleagues (2002) concluded that strong evidence supports the effectiveness of school-based physical education in increasing physical fitness levels, as measured by aerobic capacity. Compliance with physical education policies appears to be important as well. In a cross sectional observational study of elementary public schools in California, investigators found that school-district compliance with state physical education policies was related to a greater likelihood of children being classified as meeting or exceeding fitness standards, relative to students in districts that failed to comply with the physical education policy (Sanchez-Vaznaugh et al., 2012). The study also found that the favorable association between compliance with physical education policy and children's fitness levels did not differ significantly by race/ethnicity, with all groups being more likely to be classified as meeting or exceeding fitness standards if they attended school in districts that complied with the state's physical education policy; however the level of the association was significant only among white and Hispanic children.

Evidence is limited concerning the effects of school-based physical activity and physical education interventions, including policies on physical activity and fitness levels, across subgroups of children based on gender, race/ethnicity, immigrant generation, or socioeconomic status.

Body mass index (BMI)/weight status The relationship between physical activity and children's body weight has been studied in several reviews of school-based interventions designed to increase physical activity overall and during physical education in particular. Reviewing 25 school-based intervention studies that addressed diet or activity behaviors and used anthropometric outcomes, investigators found that 65 percent of the interventions were effective, reporting a statistically significant reduction in BMI and skin-fold measures for at least one subgroup. The authors concluded that the majority of the reviewed obesity prevention interventions were effective and that physical education in schools is an example of a successful intervention (Doak et al., 2006). In a review of 17 studies concerning physical education in schools, however, investigators found no effects on BMI, although they identified some effects on skinfolds and percent body fat (Kahn et al., 2002). Effects of school-based physical activity interventions on BMI also were not observed in a review that included 14 studies, 10 of which found no effect (Dobbins et al., 2009). And, in a meta-analysis pertaining to prospective, randomized, and nonrandomized clinical trials of school-based physical activity interventions that lasted at least 6 months, no effects on BMI were found (Harris et al., 2009).

Taken together, the evidence concerning the effects of school-based physical activity interventions and their observational associations with BMI, overweight, and obesity is inconsistent. While some studies document no effects on body weight, others report significant associations with measures of skinfolds and percent body fat, and some have documented significant relationships with BMI. There are several possible explanations for these inconsistent findings. First, body weight can increase among participants in physical activity interventions, as observed in a 4-year physical education intervention among students in elementary schools. In that study, students in the intervention experienced greater annual increases in fat mass compared with the controls (Lofgren et al., 2012). Additionally, physical activity/ physical education interventions may not increase the frequency and intensity of physical activity sufficiently to have the desirable impacts on children's body weight (Dobbins et al., 2009). Moreover, interventions may not last long enough to have a measurable impact on children's BMI, overweight or obesity. The inconsistency in the evidence concerning the effects of physical education and physical activity on body weight among children and adolescents merits further investigation. Future studies should be of longer duration and include programs that entail higher frequency and greater intensity of physical activity.

Cardiovascular disease outcomes A systematic review of 26 school-based physical activity interventions documents good evidence that they exerted positive effects on blood cholesterol (as measured in 7 studies), but there was no evidence of effects on systolic (measured in 10 studies) and diastolic (measured in 9 studies) blood pressure (Dobbins et al., 2009). In the CATCH intervention, investigators observed no significant differences in blood pressure or cholesterol measures between control and treatment groups (Luepker et al., 1996).

Policies

Physical education policies, if adequately worded and incorporating mechanisms for monitoring compliance, have the potential to increase physical activity levels among school-age children across the nation. As discussed in Chapter 5, however, only a few state policies require a specific number of minutes of physical activity in physical education (or during school), the language in many of these policies is not strong enough, and monitoring for policy compliance is lacking (Carlson et al., 2013).

Examining the impact of various physical activity opportunities during the school day on daily physical activity among youth, Bassett and colleagues (2013, p. 110) conclude that "policies mandating daily physical education may have the greatest impact on physical activity of U.S. youth." Further, a study based on a nationally representative sample of elementary schools found that schools located in states with a policy requiring 150 minutes per week of physical education were 180 percent more likely to report having provided that many minutes per week of physical education relative to schools in states with no policy on physical education time (Slater et al., 2012). This study also documented a significant association between school district-level policies related to physical education time and a higher likelihood of schools providing 150 minutes of physical education per week (Slater et al., 2012).

A commonly cited barrier to implementing physical education to the recommended extent is lack of time during the school day. There is some evidence for the effectiveness of unique scheduling options that can overcome this barrier (see Chapter 5).

Conclusion

The body of evidence that has accumulated over the past two decades documents significant effects of school-based physical activity interventions on and associations of physical education policies with frequency and duration of physical activity, total activity, and levels of vigorous or moderate-intensity physical activity among children and adolescents (Luepker et al., 1996; Nader et al., 1999; Gordon-Larsen et al., 2000; Khan et al., 2002; Cawley et al., 2007; Barroso et al., 2009; Dobbins et al., 2009). Evidence concerning the associations between school-based physical activity interventions and BMI, overweight, and obesity is less clear, and these associations merit further investigation. Evidence is generally consistent that school-based physical activity interventions exert positive influences on fitness levels (Khan et al., 2002; Dobbins et al., 2009) among students overall. However, there has been a paucity of research on the influence of compliance with physical education policy on students' physical fitness levels (Sanchez-Vaznaugh et al., 2012) or whether this influence varies across race/ethnicity, gender, and socioeconomic status and across locations. The lack of research in this area is due in part due to the absence of data with which to study these questions. Data on the quality and quantity of physical activity during physical education in schools are needed, especially for elementary and middle schools. Research also is needed to examine the effects of school-based physical activity interventions and physical education policies on physical activity and fitness levels across subgroups based on race/ethnicity, immigrant status, gender, and socioeconomic status.

Recess

Recess, as discussed in detail in Chapter 6, is a regularly scheduled break in the school day for unstructured play. The physical activity objectives for *Healthy People 2020* (HHS, 2012) include increasing the number of states and school districts that require regularly scheduled recess in elementary schools and the proportion of school districts that require or recommend an appropriate length of time (20 minutes) for recess in elementary schools. The importance of providing recess during the school day also is highlighted in a recent policy statement issued by the American Academy of Pediatrics, titled "The Crucial Role of Recess in School" (AAP, 2013).

A review by Salmon and colleagues (2007) found that school-based interventions focused on activity breaks such as recess were the most effective way to increase physical activity levels among youth. Thus, requiring and implementing daily recess is one of the most promising policies for increasing physical activity during the school day.

Status and Trends

Only 6 percent (3) of states have a strong law on recess—one that requires 20 minutes of recess daily. An additional 11 percent (5) of states have a weak law—one that suggests 20-minutes or requires fewer minutes of daily recess than the nationally recommended 20-minutes (Slater et al., 2012). At the local level, national data show that many students do not attend schools that meet the national recommendations for recess. As noted in Chapter 6, since the No Child Left Behind Act was passed in 2001, nearly 40 percent of U.S. school districts have reduced or eliminated recess to free up time for core academic subjects (Zygmunt-Fillwalk and Bilello, 2005; Center for Public Education, 2008; McKenzie and Kahan, 2008; RWJF, 2010; Anderson et al., 2011; Basch, 2011). In 2004, however, the Child Nutrition and Women, Infants, and Children (WIC) Reauthorization Act required all school districts to develop local school wellness policies by the 2006-2007 school year. These policies were to "include goals for nutrition education, physical activity and other school-based activities that are designed to promote student wellness in a manner that the local educational agency determines is appropriate."

The act outlined some specific nutrition-related goals, but includes no required physical activity-related components, such as Physical Education or Recess. Although its language allows school districts the flexibility to develop individualized physical activity programs that accord with their existing schedules, it provides no direction or guidance for this wellness policy component.

The Healthy, Hunger-Free Kids Act of 2010 expanded the scope of local wellness policies. Physical education teachers now can participate in the policies' development, but specific physical activity requirements are still lacking. Despite this lack of specificity regarding physical activity requirements, however, a recent survey of a nationally representative sample of elementary school administrators revealed that 70 percent of respondents' schools provided at least 20 minutes of recess daily (Slater et al., 2012), although those schools with predominantly minority or low-income students were significantly less likely to do so (Slater et al., 2012). In addition, many local wellness policies address using or withholding physical activity, such as recess, as a punishment: during the 2008-2009 school year, 21 percent of school districts prohibited this practice (Chriqui et al., 2010).

Impact on Physical Activity

Policies requiring daily recess breaks during the school day could both increase physical activity levels and reduce sedentary behavior. As noted in Chapter 2, no existing surveillance system tracks physical activity levels during recess over time. Nonetheless, numerous studies have shown a positive association between participating in recess and physical activity (Ridgers et al., 2005; Beighle et al., 2006; Tudor-Locke et al., 2006; Erwin et al., 2012). More specifically, Ridgers and colleagues (2005) found that children may accumulate up to 25 minutes of vigorous or moderate-intensity physical activity during recess, and recess also can account for 14 to 44 percent of total school-day steps during school hours (Beighle et al., 2006; Tudor-Locke et al., 2006; Erwin et al., 2012). Howe and colleagues (2012) found a nearly 54 percent relative increase in vigorous or moderate-intensity physical activity post-intervention among youth participating in a 30-minute structured recess. In a recent review, Bassett and colleagues (2013) found that youth accumulate an average of 7 minutes of vigorous or moderate-intensity physical activity during a 15-minute recess period and that infrastructure improvements, such as providing playground equipment, blacktop games, or loose equipment, could increase that time to an average of 12 minutes.

Other studies also have found that environmental changes at the school level can facilitate greater physical activity during recess. Access to play equipment, such as balls and jump ropes (Zask et al., 2001; Verstraete et al., 2006; Parrish et al., 2009; Willenberg et al., 2010), and low-cost environmental changes to blacktop (e.g., painted markings) (Stratton and Mullan, 2005; Ridgers et al., 2007; Loucaides et al., 2009) have been shown to improve physical activity levels during recess. The presence of sports fields and adequate playground equipment also is associated with greater accumulation of vigorous or moderate-intensity physical activity during recess (McKenzie et al., 2010; Ramstetter et al., 2010; Colabianchi et al., 2011; Saint-Maurice et al., 2011; Beighle, 2012; Martin et al., 2012).

Variations in physical activity during recess exist across individual-level factors, such as age, gender, and culture (Holmes, 2012), as well as across environmental factors. For example, numerous studies have shown that boys achieve higher rates of physical activity during recess than girls (Barfield et al., 2004; Beighle et al., 2006; Haug et al., 2010; Brusseau et al., 2011; Ridgers et al., 2012). Evidence regarding the association between physical activity levels during recess and socioeconomic status is mixed (Ridgers et al., 2005), but as previously stated, evidence shows that less socioeconomically advantaged youth are less likely to receive daily recess (Slater et al., 2012). Finally, limited evidence shows no significant differences in children's vigorous or moderate-intensity physical activity levels across days or seasons; thus recess should provide a regular opportunity for physical activity year round (Ridgers et al., 2006). Box 7-3 summarizes evidence-based policy, programmatic, and environmental approaches for increasing physical activity during recess.

BOX 7-3
Evidenced-Based Policy, Programmatic, and Environmental Approaches for Increasing Physical Activity during Recess

Evidence shows that the following approaches can be used to increase levels of physical activity during recess:

- Provide organized sports activities that include adult supervision[1] (Howe et al., 2012), such as the structured recess activities developed by Playworks. Playworks activities have been shown to significantly increase physical activity levels during recess while reducing the prevalence of playground injuries, bullying, and exclusionary behavior of children (RWJF, 2010). Unorganized but well-supervised play time also can be effective (Murray et al., 2013).
- Provide multiple recess breaks during the day to break up long stretches of sedentary behavior. Having more than one regularly scheduled recess break daily is associated with improved classroom behavior (Barroso et al., 2009).
- Schedule recess before lunch. Research has shown that if youth play before they eat, they will consume more fruits and vegetables, drink more milk, and waste less food. Research also has shown that if recess is offered before lunch, youth display better behavior, and playground injuries are reduced (Bergman et al., 2004; Getlinger et al., 1996).
- Implement policies that prohibit withholding recess as a punishment for poor behavior or allowing students to complete schoolwork during recess. Students cannot be physically active during recess if they are not present.
- Implement policies requiring both the recommended number of physical education minutes and physical activity opportunities outside of physical education for every grade level. Currently, elementary schools that provide the nationally recommended 150 minutes of physical education weekly are less likely than other schools to provide 20 minutes of daily recess (Slater et al., 2012).

[1]Evidence on the issue of adult supervision is mixed. Evaluation of Playworks shows a positive association between adult supervision and increased physical activity during recess, but Ridgers and colleague's review (2012) shows the evidence on this association is inconclusive. More research is needed to determine whether the association is with trained adult supervisors or adult participation in leading or encouraging organized games.

Impact on Other Outcomes

Weight and body mass index It is currently unknown whether policies requiring daily recess have a significant impact on weight, as research on this association is sparse. Nonetheless, limited evidence shows a significant relationship between increased weekly minutes of recess and lower BMI in children in grades 1-5 (Fernandes and Sturm, 2011; Miller, 2011).

Cognitive outcomes As discussed more thoroughly in Chapter 6, recent reviews of the literature suggest that daily recess policies can have a positive influence on academic performance (e.g., cognitive skills and attitudes, on-task behavior, organization, attendance, impulse control) (Siedentop, 2009; Trost, 2009; Beighle, 2012; CDC, 2010). Most of these studies showed enhanced learning due to greater classroom attentiveness and on-task behavior among students participating in recess. See the detailed discussion of the association between physical activity and academic performance in Chapter 4.

Other health outcomes Very little research has been conducted on the direct health benefits of providing recess breaks to students. Panksepp (2008) suggests a connection between lack of play and increased symptoms of attention deficit hyperactivity disorder (ADHD). Recess breaks also provide students with the opportunity to develop social skills through peer inter action, as well as free time in which to role play (AAP, 2013). Thus, recess provides opportunities for social and emotional development of youth in addition to its potential to increase physical activity levels.

Policies

Evidence discussed in detail in Chapter 6 and summarized here indicates that implementing recess policies can have a positive impact on increasing both overall physical activity in youth and the amount of recess offered during the school day. As discussed in Chapter 2, strong physical activity-related state laws and local policies are associated with higher levels of implementation of physical activity opportunities at the school level. Existing evidence specific to state-level recess laws and local policies is mixed. Slater and colleagues (2012) found that weak state laws were associated with schools offering at least 20 minutes of daily recess; no association was found for strong state laws or strong or weak school district-level policies. However, the authors note that only three states have an existing strong state-level recess law, and as discussed above, school districts are not required to address recess in their wellness policies.

Evenson and colleagues (2009) examined the impact of a state law on school-based physical activity. They evaluated the impact of North Carolina's Healthy Active Children Policy, which requires all children in kindergarten through 8th grade to receive at least 30 minutes of moderate to vigorous physical activity each school day. The policy allows school districts flexibility in meeting this requirement through physical education, recess, or other approaches. The authors found that elementary schools (69 percent) were most likely to meet the 30-minute daily requirement by offering daily recess.

In a study conducted among a nationally representative sample of Norwegian students, Haug and colleagues (2010) found that schools with a written policy addressing physical activity and those offering organized noncurricular physical activity during the school day were most likely to report student participation in daily recess, although it is unclear whether these written policies contained strong or weak language. In contrast, in a random sample of low-income, rural Colorado elementary schools, Belansky and colleagues (2009) found the number of minutes of recess provided to students decreased after the implementation of the federally mandated local wellness policy. The authors attribute this decline in recess minutes to the weak language of the policies. Finally, Turner and colleagues (in press) found an association between strong state and school district policies and the practice of withholding recess for behavior management or academic reasons. More research is needed on how policies impact school practices, but existing evidence provides some support that strong state laws and local policies are more effective than weak ones.

Conclusions

The implementation of strong state laws and local policies and environmental interventions can be effective increasing both the number of minutes of recess provided and physical activity during recess. Evidence shows that recess can provide another school-based opportunity in addition to physical education to increase physical activity in youth. Recess also is associated with improved classroom behavior. It is important to note that the primary focus of recess is to help youth develop social and emotional skills through unstructured, free play; using recess as a substitute for physical education is inappropriate.

Classroom Physical Activity

Classroom physical activity includes all activity, regardless of intensity, performed in the classroom during academic instruction, as well as during breaks from instruction, designed specifically for higher-intensity physical activity (see Chapter 6 for a detailed discussion). It includes time spent learning special topics (e.g., art, music) even if not taught by the usual classroom teacher and excludes physical education and recess even if conducted in the classroom by the usual classroom teacher.

A number of programs designed to increase classroom physical activity have been described, including ABC (Activity Bursts in the Classroom) (Katz et al., 2010), The Class Moves (De Meij et al., 2010), Energizers (Mahar et al., 2006), Happy 10 (Liu et al., 2008), Instant Recess® (Whitt-Glover et al., 2011), Kinder-Sportstudie KISS (Kriemler et al., 2010), Physical Activity Across the Curriculum (PAAC) (Donnelly et al., 2009), PLAY (Promoting Lifestyle Activity for Life) (Pangrazi et al., 2003), TAKE 10!® (Kibbe et al., 2011), and Texas I-CAN! (Bartholomew and Jowers, 2011) (three of these programs are described in Box 7-4). The framework suggested for augmenting active school transport (Fesperman et al., 2008) also could be used for selecting and implementing a classroom physical activity program (see section titled "Facilitating Active Transport to School Programs" in Chapter 6). It is important to note that sufficient time to prepare and build support for the program is necessary.

BOX 7-4
Examples of Promising Programs for Increasing Classroom Physical Activity

TAKE 10!® "is an evidence-based program that integrates physical activity, nutrition, and health concepts with academic lessons in elementary school classrooms, positively impacting both teachers and students. This program is effective in increasing physical activity levels in K-5th grade children" (Kibbe et al., 2011 [http://www.take10.net/]).

Energizers are "classroom based physical activities that help teachers integrate physical activity with academic concepts"(http://www.eatsmartmovemorenc.com/Energizers/Elementary.html). In a 12-week study of 62 3rd and 4th graders at Grifton Elementary School, a team of East Carolina University researchers found that children were more attentive and on task after participating in physical activity (Mahar et al., 2006).

Physical Activity Across the Curriculum (PAAC) incorporated vigorous and moderate-intensity physical activity into academic lessons delivered by elementary classroom teachers. After 3 years, students in classrooms averaging ≥75 minutes per week of PAAC activity had more favorable BMI scores.

SOURCE: Donnelly et al., 2009.

Status and Trends

The committee found no information on trends in the volume of classroom physical activity and only one study providing an estimate of the proportion of the daily total step count accumulated during classroom time. A study of 6th-grade students near Phoenix, Arizona, using pedometers to measure physical activity, found that about 20 percent of the daily step count during school hours occurred during instructional classroom time for both boys and girls (Tudor-Locke et al., 2006). Baseline levels of classroom physical activity are likely to vary by grade, race/ethnicity, sex, students' socioeconomic status, subject, geographic location, and other factors.

Impact on Physical Activity

Although vigorous or moderate-intensity physical activity is possible during normal classroom time, classroom physical activity is more likely to involve shifts from sedentary to light-intensity activities. Within the past decade, research has demonstrated that shifting the amount of time spent in sedentary activities (metabolic equivalent [MET] values ≤1.5) to light-intensity activities (MET values >1.5–<3.0) results in improved health outcomes for adults (e.g., Grøntved and Hu, 2011; Wijndaele et al., 2010; Wijndaele et al., 2011; Matthews et al., 2012). Likewise, a qualitative review of 232 studies of children aged 5-17 found a dose-response relationship between more sedentary behavior and negative health outcomes, including unfavorable body composition and decreased fitness, lower scores for self-esteem and pro-social behavior, and decreased academic achievement (Tremblay et al., 2011). On the other hand, cohort studies that have controlled for vigorous or moderate-intensity physical activity have yet to demonstrate a relationship between reductions in sedentary activity (which is the same as increases in light-intensity activity) and health or risk factor outcomes (Carson and Janssen, 2011; Ekelund et al., 2012). The implications of these findings are still being discussed and have not yet been explicated in current physical activity recommendations. Nonetheless, it appears prudent to assume that, while vigorous or moderate-intensity physical activity may have more or unique physical (including brain) health and cognitive benefits for children, light-intensity physical activity is preferable to sedentary activity from both health and academic perspectives. Therefore, modifications that increase light-intensity activity in the classroom should be viewed as beneficial even though no change in the volume of vigorous or moderate-intensity physical activity occurs.

Isolating the impact of classroom physical activity interventions on the overall physical activity of children and adolescents is a frustrating venture. Many efforts to increase classroom physical activity are imbedded within programs also designed to increase activity during physical education, recess, and before- and after-school activities (Sallis et al., 2003; Simon et al., 2004; Verstraete et al., 2007; Naylor et al., 2008; Evenson et al., 2009; Kriemler et al., 2010). Evidence reviewed earlier on the effectiveness of multicomponent programs in increasing physical activity in youth (e.g., van Sluijs et al., 2007) suggests that increasing classroom physical activity may be a useful adjunct to broader programs, but says nothing about whether classroom physical activity can actually be increased. Even programs in which classroom physical activity is the apparent center piece are commonly accompanied by efforts to provide children and their parents with information and encouragement to increase physical activity more widely. In addition, assessments of increased activity commonly focus on changes in vigorous or moderate-intensity physical activity while discounting or ignoring increased light-intensity activity. Still, the existing scientific literature does suggest that increases in classroom physical activity can be achieved and are accompanied by increased overall physical activity.

Physical activity has been increased during classroom time by inserting scheduled breaks for physical activity (e.g., stretching, jumping jacks) (Ernst and Pangrazi, 1999; Pangrazi et al., 2003; Liu et al., 2008; Katz et al., 2010; Erwin et al., 2011; Whitt-Glover et al., 2011; Wadsworth et al., 2012) and by incorporating physical activity into academic sessions (e.g., physically active math or spelling games) (Mahar et al., 2006; Trost et al., 2008; Donnelly et al., 2009; Greico et al., 2009; Donnelly and Lambourne, 2011; Kibbe et al., 2011). Estimates of the increase in daily physical activity due to such interventions are modest, ranging from 700 to 1,000 steps/day (Mahar et al., 2006; Erwin et al., 2011). According to one report, physical activity breaks increased light-intensity physical activity by 50 percent and moderate-intensity physical activity by 16 percent (Whitt-Glover et al., 2011).

Just as environmental changes can increase physical activity during recess, changes to the physical classroom environment can facilitate physical activity (Sallis et al., 2003; Evenson et al., 2009). Examples of such changes include standing desks, physioball chairs, balancing boards or balls, podiums with Bosu balls, juggling balls, medicine balls, exercycles on which students can read while riding, and desks on wheels so they can be easily rearranged (Disney, 2012). Examples of classroom space organized to provide room for students to be more physically active are provided in Chapter 5.

Impact on Other Outcomes

Benefits of increased classroom physical activity have frequently been noted, including improved academic achievement and cognitive performance, increased time on task, reduced BMI (Mahar et al., 2006; Liu et al., 2008; Donnelly et al., 2009; Barr-Anderson et al., 2011; Kibbe et al., 2011; Whitt-Glover et al., 2011), and reduced use of medications for asthma and ADHD (Katz et al., 2010).

Risks of increased classroom physical activity include injuries. However, the literature includes no mention of injuries associated with classroom physical activity programs, and it is likely that any injuries that might occur would be minor.

Conclusion

Incorporating physical activity into daily classroom time either as part of academic lessons or as activity breaks is an emerging opportunity to enable students of all ages to be more physically active. The strategy may be especially useful in achieving a shift from sedentary to light-intensity physical activity.

Intramural/Extramural Sports and After-School Programs

Opportunities exist beyond the school day for increasing physical activity in youth. Sports and active after-school programs have the potential to make a significant impact on daily physical activity levels.

For more than a decade, the American Academy of Pediatrics has recommended youth sports as a means of obtaining physical activity, as well as social benefits (Washington et al., 2001). Sports programs typically fall into two categories: intramural, or within schools, and interscholastic, or competition between schools (AAHPERD, 2013). The type and scope of each vary by school size (Landis et al., 2007; Lee et al., 2008) and location (Kanters et al., 2012), as well as the socioeconomic status of students (Edwards et al., 2012). Evidence shows the benefits of participation in school sports for many aspects of health and well-being (see Chapter 6).

After-school programs are formal programs for school-age youth that operate outside of normal school hours for at least part of the year, are supervised or monitored by adults, and are intended to promote growth and development (Durlak et al., 2009). Roughly 6.5 million students attend after-school programs in the United States. Even after a steady increase over the last two decades, the number of such programs is predicted to grow as a result of shifting family demographics, such as higher numbers of single and employed mothers (Vandell et al., 2005). Although after-school programs vary greatly in availability, attendance, and implementation, they can provide both structured and unstructured opportunities for physical activity and can teach students the behavior and movement skills associated with lifelong participation in physical activity (Trost et al., 2008).

Status and Trends

Sports programs are widespread in U.S. schools (see Chapter 6). Nearly 77 percent of middle and 91 percent of high schools offer at least one sport. Participation rates vary, but it is estimated that 33-55 percent of students participate in school sports programs (McDonald, 2007). Edwards et al., 2012).

Forty-eight percent of schools offer at least one intramural sport or physical activity club, with rates of participation and opportunities varying among elementary, middle, and high schools (Lee et al., 2007). More intramural sports are offered in middle than in high schools, but both offerings and participation in middle school intramural programs have been declining (Lee et al., 2007). Interscholastic sports are more common in high schools, and participation rates tend to decline from 9th to 12th grade (Landis et al., 2007). Overall, fewer girls than boys participate in school sports (Lee et al., 2007; CDC, 2012) and girls are less likely than boys to engage in vigorous intensity physical activity during sports (McDonald, 2007).

Participation in sports also varies by socioeconomic status and race/ethnicity (Johnston et al., 2007; CDC, 2012). Studies indicate fewer sports opportunities and lower participation in schools with a higher percentage of black and Hispanic students compared with schools with a majority of white students (Edwards et al., 2011) was shown to be a correlate of physical activity in black, Hispanic, and white Middle School girls (Kelly et al., 2010).

According to the American Heart Association, "in recent years, there has been substantial interest in offering additional after-school activities to serve the needs of more students. For example, researchers at Stanford University are testing after-school ethnic and popular dance classes for girls in grades 2 to 5 and an after-school team sports program designed exclusively for overweight children in grades 4 and 5, a population that would not normally participate in sports teams" (Pate et al., 2006).

Nationwide, 8.4 million children in grades K-12 children currently attend after-school programs averaging 8.1 hours per week, and 18.5 million others would attend if suitable programs were available (Smith, 2007; Afterschool Alliance, 2009; Kang and Weber, 2010) (see Chapter 6 additional discussion). The Afterschool Alliance's 2009 America After 3PM study revealed that an average of 67 percent of students participating in after-school programs qualify for free/reduced price lunch, 14 percent are limited English proficient and 11 percent have special needs/disabilities. Few studies have examined correlates of participation in physical activity within after-school programs.

Programs with more structure and supervision have been found to generate more physical activity among participants (Beets et al., 2012). As with sports, Trost and colleagues (2008) found that elementary-age boys were more likely than girls to engage in physical activity during after-school programs.

Impact on Physical Activity

The adoption of policies to provide sports programs in schools has great potential to increase physical activity among students (Kanters et al., 2012). This holds true for disparate populations, including rural, inner-city, and economically disadvantaged youth (Vandell et al., 2007; Edwards et al., 2012).

Although studies vary in methodology and population, evidence shows that involvement in sports enhances cardiovascular fitness (Beets and Pitetti, 2005; Beets et al., 2012) and increases the amount of time spent in vigorous or moderate-intensity physical activity (Nelson et al., 2005; Nelson et al., 2006; Coleman et al., 2008; Dodge and Lambert, 2009; Graham et al., 2011). In one study of sports involving boys aged 6-12, Wickel and Eisenmann (2007) found that participants averaged 110 minutes of vigorous or moderate-intensity physical activity during a day in which they participated in a youth sport, compared with only 30 minutes on a non-sport day. Another study, by Leek and colleagues (2011), found that youth involved in soccer, baseball or softball teams engaged in a mean of 45.1 minutes of vigorous or moderate-intensity physical activity, with variation by sport. Participation in these programs thus appears to contribute to the overall recommendation of 60 minutes per day of vigorous or moderate-intensity physical activity for youth. The authors note, however, that "enhanced policies could ensure sufficient physical activity during practices by emphasizing participation over competition, sponsoring teams for all skill levels across all ages, ensuring access by lower income youth with sliding scales for fees, increasing practice frequency, extending short seasons, using pedometers or accelerometers to monitor physical activity periodically during practices, providing coaches strategies to increase physical activity, and supporting youth and parents in obtaining adequate physical activity on non-practice days" (Leek et al., 2011, p. 298).

Although after-school physical activity programs are increasing in number, their effectiveness in increasing physical activity among participants is unclear (Beets et al., 2009). Data are limited on physical activity levels in the after-school period (Trost et al., 2008), which vary by program and the context in which the activity takes place (e.g., indoor versus outdoor, structured versus unstructured) (Trost et al., 2008; Beets et al., 2009), as well as implementation and program content (Beets et al., 2009). However, a meta-analysis by Beets and colleagues (2009) found that after-school settings hold considerable promise for increasing physical activity in youth, and that strategies designed to increase physical activity in these settings should include policies targeting staff training and ongoing technical support (Beets et al., 2012).

Impact on Other Outcomes

Weight and body mass index Policies promoting sports in schools may help curb the childhood obesity epidemic. Students who participate in sports are less likely to be overweight or obese than those who do not participate (Salbe et al., 2002; Levin et al., 2003; Menschik et al., 2008; Drake, 2012). Involvement in sports also has been shown to improve dietary behaviors (French et al., 1994; Harrison and Narayan, 2003; Coleman et al., 2008). While it is intuitive that increasing physical activity through after-school programs would have a positive impact on weight status, there is no conclusive evidence of a temporal effect. Research does show, however, that the weight status of youth is an important moderator of physical activity in after-school settings. Trost and colleagues (2001, 2008) found than overweight students enrolled in an after-school program were substantially less active that their non-overweight counterparts during organized outdoor activities. More research is needed to understand the activity preferences of overweight children attending after-school programs.

Psychosocial outcomes Policies favoring school sports programs can influence factors in students that play a role in their success as adults, including competence (Anderson et al., 2009; Greenleaf et al., 2009), self-concept and self-esteem (Harrison and Narayan, 2003; Dishman et al., 2006), and body image (Greenleaf et al., 2009) (see Chapter 3). Involvement in sports also confers unique psychosocial benefits that protect adolescents against suicide (Taliaferro et al., 2011) and depressive symptoms (Dishman et al., 2006; Johnson, 2011). In addition, participation in sports may enhance school connectedness, social support, and bonding among friends and teammates (Weintraub et al., 2008). There are developmental benefits as well; involvement in school sports may enhance initiative, goal setting, and emotional control (Gould and Carson, 2008), along with general well-being (Greenleaf et al., 2009).

Other health outcomes Sports programs may help reduce the risk of alcohol, tobacco, and illicit drug use in students (Forman et al., 1995; Pate, 1995; Harrison et al., 2003; Kulig et al., 2003; Lisha and Sussman, 2010; Nkansah-Amaka et al., 2011). Studies also point to a reduced risk for violence (Garry and Morrissey, 2000) and sexual behavior (Taliaferro et al., 2011) among student athletes.

Policies

In addition to the policies discussed in Chapter 6, the development, use, and maintenance of school facilities have a major impact on opportunities for both school sports and after-school programs. A study by Kanters and colleagues (2012) found that the majority of school sports fields are underutilized, suggesting opportunities for increased programming. Shared use or joint use with community facilities holds promise as well (see the discussion of joint- or shared-use agreements later in this chapter).

Do Policies Matter? Policies for after-school programs that outline the percentage of time to be dedicated to physical activity are being implemented. Because of variation in the scope and content of these policies and the lack of surveillance of their implementation, the outcomes, beneficial effects, and feasibility of such policies are largely unknown.

Conclusion

School sports and active after-school programs offer the potential to increase physical activity among youth. More research is needed to define specific factors that increase the effectiveness of such programs and ways in which they can be tailored and implemented in varied school settings across the United States. Consideration of equity in sports and after-school programs is especially important as the quality and scope of these opportunities vary tremendously by district.

Active Transport

Active transport or active commuting to school includes walking, cycling, and the use of other human-powered modes of transportation (e.g., skate boarding); it also includes using public transportation or being driven to a point closer to school and walking the remainder of the way. The major focus of this discussion is on walking and cycling the full distance between home and school. (See the detailed discussion of active transport to school in Chapter 6.)

Programs to increase walking and cycling to school include changes in site selection regulations for new/remodeled schools, infrastructure improvements (e.g., sidewalk improvements, overpasses, traffic calming), safety initiatives (e.g., crossing guards, school speed zones), educational campaigns, "walking school buses," and others (see Chapter 6 for more detailed discussion). The committee could find no empirical evaluations of changes in active transport to school due to relocation of schools from the edge of communities to the center. Evaluations of state and federal programs to increase the proportion of students walking or cycling to school provide some evidence of success[1] (Staunton et al., 2003; Boarnet et al., 2005; Buliung et al., 2011; Hinckson and Badland, 2011; Mendoza et al., 2011).

As discussed in Chapter 6, safety is a major concern among parents who do not want their children to walk or bike to school. Funding for infrastructure (e.g., building sidewalks, installing traffic calming structures) or hiring of staff (e.g., crossing guards) can make areas near schools safe for children to walk or bike to school. From 2005 through 2012, the federal Department of Transportation provided state departments of transportation with about $1 billion for Safe Routes to School projects. These funds benefited about 13,000 schools—13 percent of eligible schools in the country (Department of Transportation, 2012). The new transportation bill, Moving Ahead for Progress in the 21st Century (MAP-21), allows states to spend the money they receive to enable students to walk and bike to school more safely, but dedicates no funds specifically for that purpose.

[1]A Department of Transportation Fact Sheet provides two more examples but includes no information about how the information was obtained (Department of Transportation, 2012).

Place Matters Residents of neighborhoods with close proximity to schools and greater connectivity of pathways walk and cycle to school more than residents of neighborhoods with low proximity and connectivity (Saelens et al., 2003; Duncan and Mummery, 2005).

Support from a variety of community organizations also is possible. Pedestrian advocacy groups (e.g., WalkBoston, Pedestrians Educating Drivers about Safety [Atlanta], PedNet [Missouri]) are likely to be supportive, as are some health groups concerned about conditions such as diabetes, obesity, and heart disease. Two groups likely to be willing to help promote active school transport and prevent associated traffic mishaps are local emergency department physicians and the local chapter of the American Academy of Pediatrics. In Miami, a program led by providers of hospital emergency room care has offered educational programs on pedestrian and bicycle safety as well as infrastructure changes to enhance safety (Gillian et al., 2004).

Status and Trends

The prevalence of walking or bicycling to school among American school-aged children declined from 42 percent in 1969 to 13 percent in 2001 (McDonald, 2007) (see Figure 2-11 in Chapter 2). Among children who live within one mile of their school, the prevalence has fallen from 86 percent to 50 percent. There is a strong and inverse relationship between distance to school and the prevalence of active transport (Table 7-1) (McDonald, 2009). During the past 40 years, but especially in the 1970s and 1980s, new schools were likely to be built away from residential neighborhoods. As a result, fewer students now live close enough to walk to school (McDonald and Aalborg, 2007). Today only about one-third of students live within a mile of their school (Martin et al., 2007). In some areas, the proportion is much lower; in Georgia for example, only an estimated 10-15 percent of students live close enough to walk (Falb et al., 2007). The proportion varies widely among schools, however, so that active transport programs for some schools could have a major impact. The shift from placing new schools in residential areas to placing them in sparsely populated areas at the edge of communities is responsible for about half of the decline in active transport since 1969; changes in demographics and social norms and an increase in the proportion of special-focus schools (e.g., science, arts) account for the other half of the decline.

TABLE 7-1 Percentage of Students Who Usually Walk or Bike to School, 2009

	Elementary Schools (%)		**Middle Schools (%)**	
Miles from School	Walk	Bike	Walk	Bike
0 - < 0.25	53	1	66	1
0.25 - < 0.5	26	2	50	3
0.5 - < 1	14	3	19	4
1 - < 2	3	1	7	2
≥ 2	1	0	2	<1

SOURCE: McDonald, 2011.

Impact on Physical Activity

Recent systematic reviews have found that students who walk or bike to school are more physically active than students who do not (Davison et al., 2008; Lee et al., 2008; Faulkner et al., 2009). A few studies have estimated the difference in minutes of daily vigorous or moderate-intensity physical activity between children and adolescents who walk to school and those who are driven. Basset and colleagues (2013) estimate that w walking or biking to school adds an average of 16 minutes per day of vigorous or moderate-intensity physical activity. According to other estimates, the figure ranges from 2 to 24 minutes per school day (Sirard et al., 2005; van Sluijs et al., 2009; Owen et al., 2012; Saksvig et al., 2012). Not surprisingly, the excess minutes are greater among students who walk longer distances than among those who walk shorter distances (van Sluijs et al., 2009).

A few studies have assessed the impact of a walking school bus intervention. Two studies found that the proportion of children actively commuting to school increased and that accelerometer-measured physical activity was higher among students at intervention schools than those at comparison schools (Heelan et al., 2009; Mendoza et al., 2011). A third study found no differences between intervention and comparison schools (Slayers et al., 2012).

Impact on Outcomes

Evidence that students using active transport have lower BMIs is suggestive but inconsistent (Davison et al., 2008; Lee et al., 2008; Faulkner et al., 2009; Lubans et al., 2011). Active transport also is thought to enhance neighborhood social capital and social interactions among children and promote independent mobility (Collins and Kearns, 2001; Kearns et al., 2003).

Benefits of walking or cycling to school also include reduced use of automobiles and school buses and the associated reductions in air pollution, fuel consumption, and traffic congestion. A simulation study estimated that, compared with locations where few to no students could walk or cycle to a neighborhood school, locations where active transport was feasible would see a 15 percent reduction in noxious emissions (EPA, 2003). Enabling more students to walk or cycle to school could substantially reduce the cost of busing. One school reportedly is saving $49,000 per year in busing costs after improving the safety of active transport with new sidewalks, crosswalks, and signage (Department of Transportation, 2012). Infrastructure improvements such as new or repaired sidewalks benefit not just students but all pedestrians.

Policies

Some evidence suggests that favorable school districts and/or state policies increase the likelihood of implementation of a walking school bus (Turner et al., 2012).

Conclusions

For students who live close enough to school, active transport is an important source of vigorous or moderate-intensity physical activity. Substantial evidence shows that students who walk or bike to school are more physically active than those who do not. Enabling students to walk or bike to school provides a number of environmental and economic benefits as well. Evidence that environmental, safety, and educational interventions increase the proportion of students who walk or bike to school is suggestive but limited in volume and quality.

The Environment and Physical Activity

The discussion to this point has focused primarily on how different segments of the school day, such as physical education class or recess, and the policies that affect them can influence physical activity behaviors. Also important is the physical environment in which the various segments of the day take place and the policies that shape it.

As in communities generally, the built environment of a school plays a role in access to opportunities for physical activity. In particular, policies supporting adequate space for leisure-time or after-school active programming may decrease overall sedentary time. McKenzie and colleagues (2000) used an objective measure of the outdoor environment during leisure time in a middle school setting. They found that few students took advantage of opportunities to be physically active during leisure time at school, and recommend policies and environmental manipulations (e.g., supervision, equipment, structured programs) to attract more adolescents, especially girls, to existing activity areas.

Equally important is the location of schools. School siting policies at the state or local level can dictate the size of schools, the distance between homes and schools, and general school locations. Not only do these factors impact the ability to commute actively to and from school (McDonald, 2009), but a school's location in relation to facilities for physical activity may encourage such activity. In a study by Trilk and colleagues (2011), 12th-grade girls who attended schools with at least five facilities for physical activity within the designated parameter reported more physical activity per day than girls in schools with fewer than five such facilities. In addition, girls who attended rural schools surrounded by at least five such facilities reported about 12 percent more physical activity per day than girls who attended rural schools with fewer than five such facilities nearby. The authors conclude that the number of facilities for physical activity surrounding the area should be considered when school siting decisions are made.

On school grounds, age-appropriate equipment and outdoor space that is safe and attractive enable and encourage children and adolescents to participate in active play (need refs). Walkways can encourage walking during breaks and before- and after-school.

The indoor environment is important as well. The presence of gymnasiums and other open spaces enables active play. As discussed above, mobile desks, standing chairs, physioballs, and other equipment can encourage higher levels of energy expenditure in the classroom. Building guidelines that specify stairwell placement, classroom design, and building flow also have the potential to increase the volume of physical activity during the school day (Zimring et al., 2005; Nicoll and Zimring, 2009; Cohen, 2008; McGann, 2013).

Just as the work environment is a factor in employee health, a school's physical environment plays an important role in student health—including sedentary behavior. Tremblay and colleagues (2011) find that "there is a large body of evidence from all study designs which suggests that decreasing any type of sedentary time is associated with lower health risk in youth aged 5-17 years." Similarly, Kwon (2012) notes that "breaks in sedentary time notably decrease during childhood and adolescence. During school hours, boys and girls have fewer breaks in sedentary time than during any other period of weekday or weekend day" (Kwon, 2012, p1075).

School policies encouraging an environment that promotes physical activity and decreases sedentary time are promising obesity prevention strategies (McKenzie et al., 2000; Leung et al., 2012). In some children, changes in sedentary behaviors may be important to modify energy balance and prevent obesity (Epstein et al., 2004, 2006). A recent review indicates that, even considering the varied and limited methodologies of intervention studies, evidence suggests the effectiveness of strategies designed to reduce overall sedentary behavior among children and adolescents (Leung et al., 2012). However, much of the existing research consists of studies within the home, neighborhood, or community environment (Robinson, 1999; Epstein et al., 2006; Robinson and Borzekowski, 2006; Leung et al., 2012; Tandon et al., 2012). Few studies examine interventions that entailed modifying school physical environments and policies to support regular physical activity and improved dietary practices (Simon et al., 2004; Newton et al., 2010; Leung et al., 2012). New research is being conducted on the association between the school environment and healthy eating (Huang, 2013), with plans to expand the focus to encompass physical activity and reduction of sedentary behavior. Healthy Eating Design Guidelines are being developed for elementary schools to promote indoor environments that are spatially organized to be conducive to learning and health.

Joint- or Shared-Use Agreements

Joint- or shared-use agreements entail "two or more entities—usually a school and a city or private organization—sharing indoor and outdoor spaces like gymnasiums, athletic fields and playgrounds. The concept is simple: share resources to keep costs down and communities healthy" (Joint Use, 2009, p. 1).

Such agreements are one policy strategy communities and schools can use to provide schools with additional or alternative opportunities for physical activity. They may be a particularly important strategy for providing structured physical activity programs during summer months and other out-of-school time. The agreements can be either formal or informal, and are designed to encourage shared use of facilities for both physical activity-related other kinds of programs.

Joint-use agreements have been promoted by a number of national organizations (McCambridge et al., 2006; Solomon et al., 2009; Leadership for Healthy Communities, 2010; National Physical Activity Plan, 2010; White House Task Force on Childhood Obesity, 2010; HHS, 2012) as a way to provide access to existing neighborhood physical activity facilities for communities, such as rural or low-income areas, that may have few or no such facilities available to them. Shared use of existing facilities is also more cost-effective than building new structures in resource-poor areas. Despite the promise of this strategy, however, and the significant attention and promotion it has received at the national level, little is known about its effectiveness in increasing physical activity.

Status and Trends

In a survey conducted with a nationally representative sample of public and nonpublic elementary, middle, and high school administrators in 2000 and again in 2006, researchers found that two-thirds of schools allowed youth sports teams to use school facilities outside of school hours. A significantly lower percentage, however, allowed community-sponsored youth programs, open gyms, and adult sports programs (Table 7-2). Results were similar across the survey years (2000 and 2006), with no appreciable changes noted in facility availability across groups.

TABLE 7-2 Weighted Percent of Community Access to Indoor or Outdoor School Facilities for Physical Activity Use in 2000 and 2006 Among Schools with Any Indoor or Outdoor Physical Activity Facilities.

	2000 (n = 911)		2006 (n = 981)		
	Weighted percent	Standard error	Weighted percent	Standard error	*p*-value[a]
Outside of school hours or when school is not in session, do children or adolescents use any of this school's physical activity facilities for:					
. . . community-sponsored sports teams?	66.9	2.3	68.9	2.0	0.52
. . . community-sponsored classes/lessons?	31.4	2.1	33.5	2.1	0.49
. . . community-sponsored supervised "open gym" or "free-play"?	37.6	2.2	40.5	2.2	0.36
Outside of school hours or when school is not in session, do adults who are not school employees adults use any of this school's physical activity facilities for:					
. . . community-sponsored sports teams?	52.6	2.4	47.6	2.0	0.11
. . . community-sponsored classes/lessons?	26.3	2.0	23.3	1.7	0.24
. . . community-sponsored supervised "open gym" or "free-play"?	27.9	2.1	30.9	2.3	0.33
Can children or adults in the community use any of this school's outdoor physical activity and athletic facilities without being in a supervised program?					
. . . Yes	66.6	2.2	66.7	2.1	0.98
. . . . . . If yes, can they use it:					
. . . . before school?	70.4	2.5	71.4	2.9	0.78
. . . . after school?	93.7	1.1	94.4	1.2	0.67
. . . . in the evening?	96.6	0.8	95.3	1.2	0.34
. . . . on the weekend?	97.3	0.8	96.0	1.1	0.35
. . . . during school vacation?	96.6	0.9	95.2	1.2	0.36

[a] *p*-value is obtained from Wald chi-square test to examine changes between 2000 and 2006.

SOURCE: Evenson et al., 2010. Reprinted with permission.

More recent research conducted in 2009, which surveyed a national sample of school principals in underserved communities, also found that nearly 70 percent of principals reported that their school recreational facilities were open to the public outside of school hours for either unsupervised or supervised use (Spengler et al., 2011). Finally, in a study conducted in 2010, researchers examined and coded joint use agreement policies collected in a national sample of 157 school districts during the 2009-2010 school year (Chriqui et al., 2012). They found that 93 percent of the sampled school districts had an existing joint use agreement with 81 percent of the agreements specifically allowing for recreational use of school grounds. However, results also showed that agreements lacked specificity in identifying which specific types of facilities could be used or what community groups had access to the school grounds (Chriqui et al., 2012).

Impact on Physical Activity and Other Health Outcomes

Little research has been conducted examining the impact joint use policies may have on youth physical activity behavior. We were only able to identify one study that evaluated the impact of a newly enacted joint use agreement. Results of the study showed that as a result of the joint use agreement over 1,000 community members were served the provision of 900 class sessions (Maddock et al., 2008). However, this study did not examine physical activity levels in class participants pre- or post-joint use agreement implementation. In another study conducted by Van Acker et al. (2012) that examined barriers and facilitators for providing physical activity after school programs, and found that communities with agreements to use school facilities was positively associated with the presence of an after school program. There is some limited evidence that opening school playgrounds outside of school hours is associated with increased physical activity and reduced screen time/sedentary behavior (Durant et al., 2009).

Because so little research has been conducted on the impact of joint use agreements on physical activity behavior or the provision of increased access to additional physical activity programs through joint use agreements, It is still unclear what specific components should be included in a model joint/shared use policies to help facilitate increased physical activity, such as: 1) informal (open gym) vs. formal (organized sports) programs; 2) the timing on when facilities should be available for public use (weekdays vs. weekends vs. holidays); 3) what hours are important (after school or evening); and, 4) the availability of which facilities (indoor vs. outdoor).

Built Environment

There is some promising and emerging evidence that shows an association between the accessibility and availability of renovated school playgrounds during non-school hours and increased utilization and activity levels (Farley et al., 2007; Brink et al., 2010; Colabianchi et al., 2011).

Conclusions

Implementing joint-use policies as a means to increase access to available community-based school physical activity settings is an emerging and promising strategy to improve physical activity behavior. However, further research is needed on the utilization of opening up school grounds outside of school hours to determine the utility and impact of such agreements on physical activity. Finally, additional research is needed on whether just opening the school grounds is effective at increasing physical activity levels in youth, or whether more structured/formal programs or supervision needed to really see increased physical activity benefits in youth from joint use agreements.

SUMMARY

Many examples exist of effective and promising strategies to increase vigorous or moderate-intensity physical activity in schools (Table 7-3). The most thorough, yet often most difficult to implement are multicomponent interventions that address increasing physical activity by a systems approach through both school and community strategies. For singular-focused strategies, there is the most evidence for interventions involving physical education. Physical education can increase overall physical activity, increase the intensity of physical activity, and potentially influence BMI/weight status in youth and adolescents. However, the lack of consistent surveillance (especially in elementary and middle schools) on physical activity levels during physical education classes in schools impedes monitoring and evaluating progress toward increasing physical activity during Physical Education in schools across the nation.

Outside of physical education, opportunities for increasing physical activity are present in both the classroom and for elementary schools, recess. Classroom physical activity and strategies to reduce sedentary time in the school setting hold promise in increasing overall physical activity of children and adolescents; yet isolating the impact of these approaches is complex, and these strategies are often met with resistance from key stakeholders. Also during the school day, recess is a nationally recommended strategy to increase physical activity and there is evidence that participating in recess can increase light, vigorous or moderate-intensity physical activity and improves classroom behavior. However, this approach is not currently being implemented in sufficiently high doses to make a greater impact.

TABLE 7-3 Examples of Effective and Promising Single Component Approaches to Increase Physical Activity in Youth*

Approach	**Examples**
Physical Education	• Physical education requirements – Quality curriculum – Required minutes of vigorous or moderate-intensity physical activity – Monitoring and enforcement – Elimination of exemptions • Teacher certification • Class-size restrictions • Adequate environment, facilities, and equipment • Integrated curriculum • Fitness testing and reporting
Classroom Physical Activity/Reduction of Sedentary Behavior	• Active-learning lessons • Activity breaks during lessons • Environmental modifications (e.g., standing desks) • Modified sitting (e.g., balls)
Recess	• Recess requirements/policy – Time – Supervision – Not taken away for punishment • Environment/equipment
School Sports/After-School Programs	• Access • Policies – Low cost – Transportation provided • Supervision • Program criteria
Active Transport	• Policies • Educational programs • Infrastructure improvements – School (e.g., bike racks) – Community (e.g., sidewalks)
Joint-Use Agreements	• Policies – Allowing access – Reducing liability • Increased awareness

NOTES: *As discussed in the text, multicomponent interventions with a whole-of-school focus that include two or more of these single-component approaches have the potential to be more effective and sustainable in increasing vigorous or moderate-intensity physical activity in youth.

Effective and promising strategies beyond the school day also exist, including after-school programming and sports teams, as well as active transport to and from school. School sports and after-school programming offer important physical activity opportunities in the school setting, but access and implementation vary greatly. Formal policies also are needed to specify physical activity standards for after-school programs. Evidence shows that children who walk or bicycle to school are more physically active than those who do not. Successful active transport interventions address policy and infrastructure barriers.

Also associated with the school environment are agreements between schools and communities to share facilities as places to be physically active. Although this is a relatively new research topic, these joint-use agreements can provide youth with additional opportunities for out-of-school physical activity. Further research is needed on the utilization of facilities resulting from these agreements and their impact on physical activity.

For both single- and multicomponent strategies, evidence on effective programs and policies is limited by the lack of quality surveillance and a disparate focus across racial/ethnic groups. This lack of evidence needs to be remedied if research on increasing physical activity in schools is to move forward.

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8
Recommendations

INTRODUCTION

The committee's recommendations for strengthening and improving programs and policies for physical activity and physical education in the school environment, including before, during, and after school are summarized in this chapter. The committee's recommendations were developed based on a set of guiding principles, which included recognizing the benefits of instilling lifelong physical activity habits in children; the value of using systems thinking in improving physical activity and physical education in the school environment; the recognition of current disparities in opportunities and the need to achieve equity in physical activity and physical education; the importance of considering all types of school environments; the need to take into consideration the diversity of students as recommendations are developed; the importance of practicality of implementation and taking into account the challenges and barriers that stakeholders face; and the need to base recommendations on the best available scientific evidence and promising approaches. The consensus recommendations presented in this chapter are a result of the committee deliberating on existing evidence and the need for additional evidence.

In making its recommendations, the committee also recognized that although schools can play a major role in improving physical activity among the nation's children, the school by itself will not be sufficient to implement the cross-systems changes that will be required to accomplish a healthy and educated future generation. Many more institutional players and supports will be necessary to make and sustain needed changes. The committee employed systems thinking to delineate the elements of the overall system of policies and regulations at multiple levels that can influence physical activity and physical education in the school environment. To frame its deliberations, the committee drew from its conceptual framework (see Chapter 1, Figure 1-4) and closely examined the evidence (see Appendix B for additional details).

RECOMMENDATIONS

Taking a Whole-of-School Approach

Recommendation 1: District and school administrators, teachers, and parents should advocate for and create a whole-of-school approach to physical activity that fosters and provides access in the school environment to at least 60 minutes per day of vigorous or moderate-intensity physical activity more than half (>50 percent) of which should be accomplished during regular school hours.

- **School districts should provide high-quality curricular physical education during which the students should spend at least half (≥50 percent) of the class-time engaged in vigorous or moderate-intensity physical activity. All elementary school students should spend an average of 30 minutes per day and all middle and high school students an average of 45 minutes per day in physical education class. To allow for flexibility in curriculum scheduling, this recommendation is equivalent to 150 minutes per week for elementary school students and 225 minutes per week for middle and high school students.**
- **Students should engage in additional vigorous or moderate-intensity physical activity throughout the school day through recess, dedicated classroom physical activity time, and other opportunities.**
- **Additional opportunities for physical activity before and after school hours, including but not limited to active transport, before- and after-school programming, and intramural and extramural sports, should be made accessible to all students.**

Rationale

Because the vast majority of youth are in school for many hours, because schools have important infrastructure and are critical to the education and health of children and adolescents, and because physical activity promotes health and learning, it follows that physical activity should be a priority for all schools, particularly if there is an opportunity to improve academic achievement. As noted earlier, schools have for years been the center for other key health-related programming, including screening, immunizations, and nutrition and substance abuse programs. Unfortunately, school-related physical activity has been fragmented and varies greatly across the United States, within states, within districts, and even within schools. Physical education typically has been assumed to provide physical activity as well as curricular instruction for youth; as discussed above, however, even the best quality physical education curriculum will not allow children to meet the guideline of at least 60 minutes per day of vigorous or moderate-intensity physical activity. Interscholastic and intramural sports are another traditional opportunity for physical activity, but they are unavailable to a sizable proportion of youth. Schools are being underutilized in the ways in which they provide opportunities for physical activity for children and adolescents. A whole-of-school approach that makes the school a resource to enable each child to attain the recommended 60 minutes or more per day of vigorous or moderate-intensity physical activity can change this situation.

The committee therefore recommends a whole-of-school approach to increase physical activity for children and adolescents. Under such an approach, all of a school's components and resources would operate in a coordinated and dynamic manner to provide access, encouragement, and programs that enable all students to engage in vigorous or moderate-intensity physical activity 60 minutes or more each day. A whole-of-school approach encompasses all segments of the school day, including travel to and from school, school-sponsored before- and after-school activities, recess and lunchtime breaks, physical education, and classroom instructional time. Beyond the resources devoted to quality daily physical education for all students, the whole-of-school approach means that other school resources, such as classroom teachers, staff, administrators, and aspects of the physical environment, are all oriented toward physical activity. Intramural and extramural sports programs are available to all who wish to participate, active transport is used by substantial numbers of children to move from home to school and back again, recess and other types of breaks offer additional opportunities for physical activity, and lesson plans integrate physical activity as an experiential approach to instruction.

A whole-of-school approach encompasses all people involved in the day-to-day functioning of the school, including students, faculty, staff, and parents. It creates an atmosphere in which physical activity is appreciated, encouraged, and rewarded by all. Similarly inactivity is discouraged and minimized. School buildings, outdoor grounds and playgrounds, indoor and outdoor equipment, and streets and pathways leading to the school from the surrounding neighborhood encourage and enable all persons to be more physically active. Moreover, the school is part of a larger system that encompasses community partnerships outside the school to help these goals be realized.

Potential Actions

For state legislatures and state departments of education, potential actions include

- Adopting and/or strengthening physical education and recess policies so they align with existing national recommendations for both total number of weekly minutes of physical education, as well as requiring students to spend at least half (≥50 percent) of the class-time doing vigorous or moderate-intensity physical activity, while maintaining an appropriate emphasis on skills development.
- Adopting and/or strengthening before- and after-school program policies so they align with national recommendations on physical activity standards.
- Adopting school siting policies that encourage schools to be located within residential neighborhoods.
- Working with national and state-level parent–teacher organizations to mobilize and create engagement in this effort.

For school districts and schools, potential actions include

- Continuing to strengthen policies by requiring time for physical education and recess that aligns with the national recommendations.

- Increasing the amount of time youth spend in physical activity through brief classroom breaks or incorporating physical activity directly into academic sessions.
- Offering intramural sports and physical activity clubs before or after school and helping such programs be accessible to all students.
- Adopting joint or shared use agreements allowing school facilities to be used for physical activity programs during nonschool hours.
- Identifying key champions in schools to lead efforts.
- Working with parent groups and parent–teacher associations to create a demand for physical activity and mobilize this effort.

For municipalities, local governments, and urban planners, potential actions include

- Considering renovating schools already located in existing neighborhoods rather than building new schools away from where students live.
- Incorporating traffic calming (e.g., reduced speed limits, speed humps or tables, sidewalks with buffers, medians) and traffic control (marked crosswalks, traffic lights with pedestrian signals) strategies into community planning to ensure safe active travel routes for students.
- Adopting school policies that encourage schools to be located within residential neighborhoods.

Considering Physical Activity in All School-Related Policy Decisions

Recommendation 2: Federal and state governments, school systems at all levels (state, district, and local), city governments and city planners, and parent–teacher organizations should systematically consider access to and provision of physical activity in all policy decisions related to the school environment as a contributing factor to improving academic performance, health, and development for all children.

Rationale

Many examples exist of effective and promising strategies for increasing vigorous and moderate-intensity physical activity in schools. The most thorough, yet often most difficult to implement, are multi-component interventions based on a systems approach that encompasses both school and community strategies. For strategies with a singular focus, the evidence is most robust for interventions involving physical education. Quality physical education curricula increase overall physical activity, increase the intensity of physical activity, and potentially influence body mass index (BMI)/weight status in youth. However, the lack of consistent monitoring of physical activity levels during physical education classes in schools (especially elementary and middle schools) impedes monitoring and evaluation of progress toward increasing physical activity during physical education in schools across the nation (see Recommendation 4 below).

Beyond physical education, opportunities for increasing physical activity are present in both the classroom and for elementary and middle schools, during recess. Classroom physical activity and strategies to reduce sedentary time in the school setting hold promise for increasing overall physical activity among children and adolescents, yet isolating the impact of these strategies is complex, and they are often met with resistance from key stakeholders. With respect to recess, its use to increase physical activity is a nationally recommended strategy, and there is evidence that participating in recess can increase physical activity and improve classroom behavior. However, implementation of recess across school districts and states is not currently at a sufficient level to increase physical activity.

Effective and promising strategies beyond the school day include after-school programming and sports, as well as active transport to and from school. After-school programming and participation in sports are important physical activity opportunities in the school setting, but implementation of and access to these opportunities vary greatly. Moreover, formal policies adopting physical activity standards for after-school programs are needed. Finally, evidence shows that children who walk or bicycle to school are more physically active than those who do not. Successful active-transport interventions address policy and infrastructure barriers.

Also associated with the school environment are agreements between schools and communities to share facilities as places to be physically active. Although this is a relatively new research topic, these joint-use agreements can be a way to give youth additional opportunities for physical activity outside of school. Further research is needed on the utilization of facilities due to these agreements and the impact they have on physical activity.

Potential Actions

For states, school districts, schools, and school wellness committees, potential actions include

- Designating individuals or committees specifically responsible for physical activity–related opportunities and programs. An emphasis on physical activity is important and new enough that these individuals should not also be responsible for worthy but already well-established health-related behaviors such as nutrition or drug abuse.
- Specifying objectives for vigorous and moderate intensity physical activity during all segments of the school day (e.g., physical education, recess, classroom, transportation to and from school, before- and after-school programs).
- Work with leading professional organizations across disciplines to emphasize the importance of physical activity and encourage them to embed this priority into their national recommendations or position statements.

Designating Physical Education as a Core Subject

Recommendation 3: Because physical education is foundational for lifelong health and learning, the U.S. Department of Education should designate physical education as a core subject.

Rationale

Physical education in school is the only sure opportunity for all school-aged children to access health-enhancing physical activity and the only school subject area that provides education to ensure that students develop knowledge, skill, and motivation to engage in health-enhancing physical activity for life. Yet, states vary greatly in their mandates with respect to time allocated for, and access to, physical education. Nearly half (44 percent) of school administrators report having cut significant time from physical education and recess to increase time devoted to reading and mathematics since passage of the No Child Left Behind Act, which made federal funding dependent on schools making adequate progress in the latter subject areas. Moreover, disparities have been documented in access to physical education for students of Hispanic ethnicity and lower socioeconomic status.

Currently, despite growing concern about the negative consequences of physical inactivity, physical education is not considered or treated as a core subject. Several national studies and reports have pointed to the importance of implementing state laws and regulations mandating both time requirements for physical education and monitoring of compliance with those requirements. Although a number of national governmental, nongovernmental, private industry, and public health organizations and agencies have offered specific recommendations for the number of days and minutes per day of physical education, no standardized state policy has emerged. Physical education as a core academic subject would receive much-needed policy attention that would enhance its overall quality in terms of content offerings, instruction, and accountability. The enactment of this recommendation also would likely result in downstream accountability that would assist in policy implementation.

Potential Actions

For the U.S. Department of Education and federal and state public health agencies, potential actions include

- Finding innovative application of physical education as a core subject in sample states or districts to highlight and measure outcomes.

For non-governmental organizations, potential actions include

- Developing advocacy materials and planning dissemination of these materials to key stakeholders.

Monitoring Physical Education and Opportunities for Physical Activity in School

Recommendation 4: Education and public health agencies at all government levels (federal, state, and local) should develop and systematically deploy data systems to monitor policies and behaviors pertaining to physical activity and physical education in the school setting, so as to provide foundation for policy and program planning, development, implementation, and assessment.

Rationale

The intent of this recommendation is to give citizens and officials concerned with the education of children in the United States—including parents and teachers plus education and public health officials at local, state, and federal levels—the information they need to make decisions about future actions. Principals, teachers, and parents who know that regular vigorous and moderate-intensity physical activity is an essential part of the health and potentially the academic performance of students and who have adopted a “whole-of-school” approach to physical activity will want and need this information. This information also is important to support the development of strategies for accountability for strengthening physical activity and physical education in schools.

Aside from a few good one-time surveys of physical activity during physical education classes, remarkably little information is available on the physical activity behaviors of students during school hours or school-related activities. Even the best public health monitoring systems do not obtain this information. This dearth of information is surprising given that school-related physical activity accounts for such a large portion of the overall volume of physical activity among youth and that vigorous and moderate-intensity physical activity is vital to students' healthy growth and development and may also influence academic performance, and classroom behavior.

Evidence is emerging that laws and policies at the state and district levels can have important influence on the physical activity behaviors of large numbers of children and adolescents. Also emerging is evidence of a gap between the intent and actual implementation of school physical activity–related policies, so that their final impact is commonly less, sometimes appreciably so, than expected. The factors that create an effective policy are still being elucidated. Policies that entail required reporting of outcomes, provision of adequate funding, and easing of competing priorities appear to be more likely to be implemented and effective. Further evaluation of physical activity and physical education policies is needed to fully understand their impact in changing health behavior.

Monitoring of state and district laws and policies has improved over the past decade. In general, the number of states and districts with laws and policies pertaining to physical education has increased, although many such policies remain weak. For example, most states and districts have policies regarding physical education, but few require that it be provided daily or for a minimum number of minutes per week. Those that do have such requirements rarely have an accountability system in place. Although some comprehensive national guidelines exist, more are needed to define quality standards for policies on school-based physical activity and create more uniform programs and practices across states, school districts, and ultimately schools.

The few existing monitoring systems for school-related physical activity behaviors need to be augmented. Information is needed not only on the amount of vigorous or moderate-intensity physical activity in which youth are engaged but also on its distribution across segments of the school day (i.e., physical education, recess, classroom, travel to and from school, school-related before- and after-school activities). Existing national surveys are not designed to provide local or even state estimates of these student behaviors. State departments of education, local school districts, and state and local health departments will need to collaborate to provide adequate monitoring. Also needed is augmented monitoring of physical activity-related guidelines, policies, and practices at the federal, state, and local levels.

Potential Actions

For the U.S. Departments of Education and Health and Human Services, potential actions include

- Collaborating to assure the availability and publication of information about school physical activity- and physical education-related policies and students' physical activity behaviors.
- Facilitating collaboration among state and district departments of education and state and local health departments to obtain and publicize such information.

For federal agencies, specifically the Centers for Disease Control and Prevention (CDC), potential actions include

- Continuing to improve the Youth Risk Factor Behavior Surveillance System (YRBSS) and National Health and Nutrition Examination Survey (NHANES) systems to capture more completely student school-related physical activity behaviors.
- Developing tools suitable for use by schools and school districts for monitoring students' physical activity behaviors throughout the school day.
- Provide training for state and local health departments and state and district school systems as they endeavor to improve the monitoring of school-related physical activity behaviors and student achievement.

For local school districts and schools in coordination with local health departments, state departments of education, and state departments of public health, potential actions include

- Regularly assessing student achievement of physical education standards and the physical activity behaviors of students during all segments of the school day.
- Developing systems to collect and publicize the information collected by the local schools.
- Augmenting existing monitoring systems for student's physical fitness to include school-related physical activity behaviors and student achievement.
- Utilizing current systems of collecting educational information within schools and districts to monitor the quality of physical education and the usual dose of physical activity for students during school hours, going to and from school, and at school-related functions. Involving teachers in developing the most efficient ways to collect and provide data needed for monitoring.
- Involving wellness committee members and parents in the monitoring of opportunities for students to be physically active during physical education, recess, classroom activities, traveling to and from school, and at school-related events before and after school.

Providing Preservice Training and Professional Development for Teachers

Recommendation 5: Colleges and universities and continuing education programs should provide preservice training and ongoing professional development opportunities for K-12 classroom and physical education teachers to enable them to embrace and promote physical activity across the curriculum.

Rationale

Teaching physical education effectively and safely requires specific knowledge about physical/mental development, body composition (morphology) and functions (physiology and biomechanics), and motor skill development and acquisition. Teaching physical education also requires substantial knowledge and skill in pedagogy, the science and art of teaching, which is required for any subject. In addition, because health is associated with academic performance, priority should be given to educating both classroom and physical education teachers regarding the importance of physical activity for the present and future physical and mental health of children.

The current wave of effort to curb childhood physical inactivity has begun to influence teacher education programs. Data appear to suggest that training programs for physical education teachers are beginning to evolve from a traditionally sport- and skill-centered model to a more comprehensive physical activity- and health-centered model. However, education programs for physical education teachers are facing a dramatic decrease in the number of kinesiology doctoral programs offering training to future teacher educators, in the number of doctoral students receiving this training, and in the number of professors (including part-time) offering the training. Additional data suggest a shortage of educators in higher education institutions equipped to train future physical education teachers. With unfilled positions, these teacher education programs are subject to assuming a marginal status in higher education and even to elimination.

Professional development—including credit and noncredit courses, classroom and online venues, workshops, seminars, teleconferences, and webinars—improves classroom instruction and student achievement, and data suggest a strong link among professional development, teacher learning and practice, and student achievement. The most impactful statement of government policy on the preparation and professional development of teachers was the 2002 reauthorization of the Elementary and Secondary Education Act. Although, Title I of the act places highly qualified teachers in the classroom, Title II addresses the same goal by funding professional development for teachers. According to the No Child Left Behind Act, professional development should be offered to improve teachers' knowledge of the subject matter they teach, strengthen their classroom management skills, advance their understanding and implementation of effective teaching strategies, and build their capabilities to address disparities in education. This professional development should be extended to include physical education instructors as well.

Potential Actions

For the U.S. Department of Education and local school districts, potential actions include

- Identifying exemplary training programs and highlighting as best-practices.
- Establishing requirements for competencies in physical education and physical activity for preservice and continuing education for all teachers and school administrators.

Ensuring Equity in Access to Physical Activity and Physical Education

Recommendation 6: Federal, state, district, and local education administrators should ensure that programs and policies at all levels address existing disparities in physical activity and that all students at all schools have equal access to appropriate facilities and opportunities for physical activity and quality physical education.

Rationale

All children should engage in physical education and meet the recommendation of at least 60 minutes per day of vigorous or moderate-intensity physical activity regardless of their region, school attended, grade level, or individual characteristics. However, a number of studies have documented social disparities in access to physical education and other opportunities for physical activity by race/ethnicity, socioeconomic status, gender, and immigrant generation. Moreover, because not every child has the means or opportunity to participate in before- and after-school activities and intramural/extramural sports, curriculum-based physical education programs often provide the only opportunity for *all* school-aged children to access health-enhancing physical activity.

Potential Actions

For the U.S. Department of Education, state departments of education, and school boards, potential actions include

- Conducting an inventory of facilities including the type, condition, safety, and availability and opportunities for physical activity across schools and districts to give insight on where improvements can be made to address disparities.

For local school districts, school wellness committees, and other relevant local entities, potential actions include

- Thoroughly reviewing existing physical activity opportunities and reducing barriers to access for all students including, but not limited to creation and maintenance of physical facilities and safety of their use.

FUTURE RESEARCH NEEDS AND AREAS FOR ADDITIONAL INVESTIGATION

Even though much is known in this area, more knowledge is needed. In addition to developing recommendations for action by strengthening and improving programs and policies for physical activity and physical education in the school environment, during its review of the literature, the committee was also asked to identify major gaps in knowledge and recommend key topic areas in need of research. These gaps are acknowledged in the discussion of the evidence in each chapter. They are also highlighted here to emphasize the important need for continuing to refine the research base on which future recommendations can be made relevant to advancing the health and academic achievement of children and youth through physical education and physical activity in schools.

The committee identified a number of broad future research needs and areas for additional investigation:

- What are the effects of various doses and settings in which those doses occur, of physical activity on measures of academic achievement?
- How can the whole-of-school approach be expanded to include opportunities for community-based promotion of physical activity?

- What are the short- and long-term health, development and academic impacts of physical education on children and adolescents?
- What are the acute and long-term health, development and academic effects of daily sedentary behavior in school;
- What specific features of the built environment in schools influence physical activity participation?
- What is the effect of increasing school-based physical activity on physical activity outside of school?
- What are specific behavioral, environmental and policy-related barriers to increasing physical activity in schools?
- What are innovations that can improve the effectiveness of physical education on children and adolescents?

More specifically:

- In the area of brain, cognition, and academic achievement, future research is needed on
  - the effects of physical activity and increases in aerobic fitness on basic measures or brain health, cognition, and learning.
  - the dose-response relationship between physical activity with academic performance.
  - the daily school schedule and how best to integrate physical education classes as well as recess, and classroom physical activity breaks, because little is known about the effects of time of day and the timing of delivery of physical activity bouts in relation to the demands of the cognitive tasks.
  - the effects of different physical activity types such as aerobic, motor skill oriented, or perceptual-motor, on academic performance.
  - the relative effects of different settings within the school in increasing physical activity.
  - the multifaceted nature of the relationship between physical activity with cognitive and brain health,
    - including the degree to which these effects can be attributed to a break from academic time and what portion is a direct result of the physical activity engagement.
- In the area of physical health and development, future research is needed on
  - the limitations of previous research in order to address and facilitate a deeper level of understanding of the relationship between motor competence and physical activity,
    - more specifically, longitudinal data to fully understand the relationship of motor skills and physical activity participation across the lifespan and experimental studies in order to manipulate (positively or negatively) the level of skill ability to determine how participation in physical activity changes.
  - motor skill and participation in physical activity.
  - the effects of intermittent versus sustained physical activity on disease risk factors.

- In the area of monitoring, future research is needed on
  - youth physical activity and physical fitness and its effects on academic performance.
  - effective strategies for the development and employment of systems to track the quality and frequency of physical education and physical activity opportunities across the curriculum.
  - effective implementation of systems to monitor school-related laws, policies, and practices which may enable or impede physical activity and physical education.
  - baseline estimates of physical activity behaviors of children and adolescents at school, across all age groups and grade levels, race/ethnicity, socioeconomic and geographic groups, and for all segments of the school day (including transportation to and from school, physical education, recess, classroom time, and before and after school activities).
  - standardized, national-level data on the offering of participation in physical education, as well as student performance and engagement in vigorous or moderate-intensity physical activity during physical education.
- In the area of policy and programming, future research is needed on
  - systematic examinations of personal, curricular, and policy barriers to successful physical education in schools.
- In the area of equity, future research is needed on
  - a reexamination of school-based intramural and extramural sport and active transport opportunities for physical activity to address disparities based on race/ethnicity, socioeconomic status, school location and resources, and students' disabilities or cultural/religious barriers.
  - the effectiveness of physical education, recess, classroom physical activity, and sedentary time reduction strategies to increasing physical activity across subgroups based on race/ethnicity, and immigrant and socioeconomic status, including the differential effects of these approaches among those subgroups.
  - the benefits of tailoring school-based physical education and physical activity interventions to fit the wide social and physical variations among schools.
  - the disparities in the built environment within schools and whether they contribute to physical activity disparities across subgroups defined based on race/ethnicity and socioeconomic status.

A

Acronyms and Glossary

ACRONYMS

3DPAR	3-Day Physical Activity Recall
AAHPERD	American Alliance for Health, Physical Education, Recreation and Dance
AAP	American Academy of Pediatrics
AARP	American Association of Retired Persons
ACS	American Cancer Society
ACSM	American College of Sports Medicine
ADA	American Diabetes Association
ADHD	Attention Deficit Hyperactivity Disorder
AHA	American Heart Association
ALT	academic learning time
AYP	adequate yearly progress
BMI	body mass index
CAT-3	Cognitive Abilities Test, third edition
CATCH	Coordinated Approach to Child Health (formerly Child and Adolescent Trial for Cardiovascular Health)
CDC	Centers for Disease Control and Prevention
C.L.A.S.S.	Classification of Laws Associated with School Students
CNV	contingent negative variation
CRP	C-reactive protein
CSPAP	Comprehensive School Physical Activity Program
DDR	Dance Dance Revolution
DOE	Department of Education
DOH	Department of Health
DOT	Department of Transportation

ELA	English language arts
ERN	error-related negativity component
ERP	event-related brain potential
ES	elementary school
FFMI	fat free mass index
FMI	fat mass index
fMRI	functional magnetic resonance imaging
GAO	Government Accountability Office
GPA	grade point average
HDL	high-density lipoprotein
HHS	U.S. Department of Health and Human Services
HS	high school
IL	interleukin
IOM	Institute of Medicine
IPA	International Play Association
IQ	intelligence quotient
JROTC	Junior Reserve Officer Training Corps
LEA	local education agency
L.E.A.D.	Locate Evidence, Evaluate Evidence, Assemble Evidence, Inform Decisions (framework)
LDL	low-density lipoprotein
MET	metabolic equivalent of task
MRI	magnetic resonance imaging (fMRI stands for functional MRI)
MS	middle school
MVPA	moderate and vigorous physical activity
NASBE	National Association of State Boards of Education
NASPE	National Association for Sport and Physical Education
NCATE	National Council for Accreditation of Teacher Education
NCEP	National Cholesterol Education Program
NCLB	No Child Left Behind
NFL	National Football League
NFSHSA	National Federation of State High School Associations
NHANES	National Health and Nutrition Examination Survey
NIH	National Institutes of Health
NRC	National Research Council

PA	physical activity
PAAC	physical activity across the curriculum
PAGAC	Physical Activity Guidelines Advisory Committee
PE	physical education
PHYSICAL	Promoting Health for Youth Skills in Classrooms and Life
PTA	Parent Teacher Association
RCT	randomized control trial
RWJF	Robert Wood Johnson Foundation
SES	socioeconomic status
SHPPS	School Health Policies and Practices Study
SOCARP	System for Observing Children's Activity and Relationships during Play
SOFIT	System for Observing Fitness Instruction Time
SOPLAY	System for Observing Play and Leisure Activity in Youth
SOPARC	System for Observing Play and Recreation in Communities
SPARK	Sports, Play, and Active Recreation
SPED	special education and disabilities
SY	school year
TVB	TVBasics
UN	United Nations
WHO	World Health Organization
YRBS	Youth Risk Behavior Survey
YRBSS	Youth Risk Behavior Surveillance System

GLOSSARY

Academic learning time Physical education (ALT PE): A measure used to assess quality physical education instruction. ALT PE is the time during physical education class that children are exposed to motor skill development, understanding of movement principles, attainment of health-enhancing levels of fitness, regular engagement in physical activity, socially responsible behaviors in physical activity settings, and an appreciation of the importance of physical activity engagement.

Adiposity: The state of an excess of body fat.

Active transport: Modes of transportation to and from school that involve physical activity; primarily includes walking and biking.

Aerobic capacity (power): An indicator of endurance capacity or fitness. It is a measure of the body's ability to process oxygen. It involves a combination of lung capacity, the size of the capillaries, the pumping action of the heart, and the transfer of oxygen from red blood cells to target tissues. It is frequently referred to as maximal oxygen uptake or VO_2max.

Balance: A health related component of physical fitness that relates to the maintenance of equilibrium while stationary or moving.

Body mass index: An indirect measure of body fat, calculated as the ratio of a person's body weight in kilograms to the square of a person's height in meters.

BMI (kg/m^2) = weight (kilograms) ÷ height (meters)^2

BMI (lb/in^2) = weight (pounds) ÷ height (inches)^2 x 703

In children and youth, BMI is based on growth charts for age and gender and is referred to as BMI-for-age which is used to assess underweight, overweight, and risk for overweight. According to the Centers for Disease Control and Prevention (CDC), a child with a BMI-for-age-and-sex that is equal to or greater than the 85th percentile and lower than the 95th percentile is considered to be overweight. A child with a BMI-for-age-and-sex that is equal to or above the 95th percentile is considered to be obese. In this report, the definition of obesity is equivalent to the CDC definition of obesity. Earlier CDC criteria defined BMI-for-age-and-sex that is equal to or above the 95th percentile as overweight.

Body composition: A health related component of physical fitness that applies to body weight and the relative amounts of muscle, fat, bone, and other vital tissues of the body. Most often, the components are limited to fat and lean body mass (or fat-free mass)

Bone mineral content: The amount of mineral at a particular skeletal site, such as the femoral neck, lumbar spine, or total body.

Bone mineral density: Determined by dividing the bone mineral content by the area of a scanned region.

Built environment: The manmade elements of the physical environment; buildings, infrastructure, and other physical elements created or modified by people and the functional use, arrangement in space, and aesthetic qualities of these elements.

Cardiorespiratory endurance: A health-related component of physical fitness that relates to the ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity (also called cardiorespiratory fitness aerobic capacity).

Child development: The biological, psychological, and emotional changes that occur in human beings between birth and the end of adolescence.

Children: Persons ages 2 to 11 years. In this summary, refers mainly to persons ages 6 to 11 years.

Classroom physical activity: Opportunities for physical activity integrated into classroom lessons.

Cognitive control: Processes that are mediated by networks that rely upon prefrontal cortex.

Cognitive flexibility: The ability to quickly and flexibly switch perspectives, focus attention, and to adapt behavior for the purposes of goal-directed action.

Community: A social entity that can be spatial based on where people live in local neighborhoods, residential districts, or municipalities, or relational, as with people who have common ethnic or cultural characteristics or share similar interests.

Developmentally appropriate physical activity: Physical activity that meets/includes the following criteria: (1) orderly sequence of motor skill learning; (2) provisions for individual differences; (3) appropriate goal structures; and (4) ample learning time.

Disparities: A term used to describe differences in quality of health and health care across racial, ethnic, and socioeconomic groups.

Duration: The length of time spent doing an activity or exercise, usually expressed in minutes (e.g., 30 minutes per occasion).

Energy balance: A state in which energy intake is equivalent to energy expenditure, resulting in no net weight gain or weight loss. In this report, energy balance is used to indicate equality between energy intake and energy expenditure that supports normal growth without promoting excess weight gain.

Energy expenditure: Calories used to support the body's basal metabolic needs plus those used for thermogenesis, growth, and physical activity.

Epidemic: A condition that is occurring more frequently and extensively among individuals in a community or population than is expected.

Executive control: See *Cognitive control*.

Exercise: Planned, structured and repetitive activity designed to target a particular outcome (e.g., a component of fitness).

Extramural sports: Organized and supervised sports programs sanctioned by the school system that provide opportunities for competition outside the bounds of a particular school.

Fat: The chemical storage form of fatty acids as glycerol esters, also known as triglycerides. Fat is stored primarily in adipose tissue located throughout the body, but mainly under the skin (subcutaneously) and around the internal organs (viscerally). Fat mass is the sum total of the fat in the body, while, correspondingly, the remaining, nonfat components of the body constitute the fat-free mass. Lean tissues such as muscle, bone, skin, blood, and the internal organs are the principal locations of the body's fat-free mass. In common practice, however, the terms "fat" and "adipose tissue" are often used interchangeably. Furthermore, "fat" is commonly used as a subjective or descriptive term that may have a pejorative meaning.

Flexibility: A health-related component of physical fitness that relates to the range of motion available at a joint.

Frequency: The number of times an exercise or activity is performed, usually expressed in episodes per week (e.g., two times per week).

Health: A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.

Health-related fitness: The components of physical fitness referred to as health-related components are cardiorespiratory fitness, muscular strength and endurance, body composition, flexibility, and balance.

Health promotion: The process of enabling people to increase control over and improve their health. To reach a state of complete physical, mental, and social well-being, an individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. Health is a resource for everyday life, not the objective of living, and is a positive concept emphasizing social and personal resources, as well as physical capacities.

Healthy weight: In children and youth, a level of body fat at which comorbidities are not observed. In adults, a BMI of between 18.5 and 24.9 kg/m^2.

Incidence: The frequency of new cases of a condition or disease within a defined time period. Incidence is commonly measured in terms of new cases per 1,000 (or 100,000) population at risk per year.

Inhibitory control (Inhibition): Refers to the ability to override a strong internal or external pull to appropriately act within the demands imposed by the environment.

Intensity: A characteristic of a physical activity that represents how much work is being performed in a given period of time (i.e., the rate of energy expenditure) (absolute intensity) or the magnitude of effort required to perform an activity as perceived by a person (relative intensity). See also *Vigorous-intensity physical activity*, *Moderate-intensity physical activity*, *Light-intensity physical activity*, and *Sedentary-intensity physical activity*.

Intervention: A policy, program, or action intended to bring about identifiable outcomes.

Intramural sports: Organized and supervised sports programs of within-school teams and clubs that provide opportunities for all students to participate.

Light-intensity physical activity: Physical activity with a rate of energy expenditure of >1.5 to <3.0 METs (>1.5 to <3 times the energy required for sitting at rest) such as strolling, making a bed, or cooking.

Metabolic Equivalent of Task: One MET is the rate of energy expenditure while sitting at rest. It represents approximately 3.5 milliliters of oxygen consumption per kilogram of body weight per minute.

Moderate–intensity physical activity: Physical exertion that is equivalent to brisk walking. Such activities are usually done at between 3.5 and 6.0 times resting metabolic rate.

Musculoskeletal fitness: Fitness that includes muscular strength, muscular endurance, muscular power, and muscular flexibility.

Obesity: An excess amount of subcutaneous body fat in proportion to lean body mass. In adults, a BMI of 30 or greater is considered obese. In this report, obesity in children and youth refers to age- and gender-specific BMIs that are equal to or greater than the 95th percentile of the CDC BMI charts. In most children, these values are known to indicate elevated body fat and to reflect the comorbidities associated with excessive body fatness.

Overweight: In children and youth, BMI is used to assess underweight, overweight, and risk for overweight. Children's bodyfatness changes over the years as they grow. Girls and boys differ in their body fatness as they mature; thus, BMI for children, also referred to as BMI-for-age-and-for-sex, is gender and age specific. BMI-for-age is plotted on age- and gender-specific BMI charts for children and teens aged 2 to 20 years. According to CDC, overweight is defined as BMI-for-age-and-for-sex equal to or greater than the 85th percentile.

Pandemic: Prevalent over the whole country or the world.

Physical activity: Bodily movement that increases energy expenditure.

Physical activity breaks: Opportunities for physical activity provided briefly throughout the day, such as during morning announcements.

Physical education: A planned sequential K-12 standards-based program of curricula and instruction designed to develop motor skills, knowledge, and behaviors of healthy active living, physical fitness, sportsmanship, self-efficacy, and emotional intelligence.

Physical fitness: A set of physiologic attributes that are either health-related or skill-related. Physical fitness is an adaptive physiologic state that varies with growth and maturity status and physical activity.

Physical inactivity: A lifestyle comprised exclusively of sedentary intensity and light intensity physical activities (≤3 METs). Also commonly used to refer to individuals who do not perform the recommended volume of vigorous or moderate intensity physical activity.

Policy: A written statement reflecting a plan or course of action of a government, business, community, or institution that is intended to influence and guide decision making. For a government, a policy may consist of a law, regulation, ordinance, executive order, or resolution.

Power: A skill-related component of physical fitness that relates to the rate at which one can perform work.

Prevalence: The number of instances of a condition or disease in a population at a designated period of time, usually expressed as a percentage of the total population.

Program: An integrated set of planned strategies and activities that support clearly stated goals and objectives designed to lead to desirable changes and improvements in the well-being of people, institutions, or environments or all of these.

Recess: Regularly scheduled periods within the school day for supervised physical activity and play.

Resistance training: Training designed primarily to increase muscle strength, power, and endurance.

Sedentary lifestyle: A way of living or lifestyle that requires minimal physical activity and that encourages inactivity through limited choices, disincentives, and/or structural or financial barriers.

Sedentary-intensity physical activity: Physical activity with a rate of energy expenditure of ≤1.5 METs (up to 1.5 times the energy required for sitting at rest) such as sitting or reclining.

Strength: The ability of the muscle to exert force.

Systems approach: A paradigm or perspective involving a focus on the whole picture and not just a single element, awareness of the wider context, an appreciation for interactions among different components, and transdisciplinary thinking.

Systems thinking: An iterative learning process in which one takes a broad, holistic, long-term perspective on the world and examines the linkages and interactions among its elements.

Vigorous-intensity physical activity: Physical exertion that leads to sweating and heavy breathing, such as running, basketball, soccer, and swimming laps; usually done at or above an intensity of 6.0 times resting metabolic rate.

VO_2: The amount of oxygen consumed per minute by an individual while performing an activity.

VO_2max: The maximal capacity for oxygen consumption by the body during maximal exertion.

Well-being: A view of health that takes into account a child's physical, social, and emotional health.

Working memory: The ability to mentally represent information, manipulate stored information, and act upon it; moving information from the short to long term memory.

Youth: Often used to describe younger and older adolescents or teens, ages 12 to 19 years. For convenience in this report, the term youth is often used to refer to all school-aged children and adolescents.

Youth development: The process through which adolescents acquire the cognitive, social, and emotional skills and abilities required to navigate life.

B

Methodology

The committee was convened to develop recommendations regarding approaches for strengthening and improving programs and policies for physical activity and physical education in the school environment. In tackling the committee's charge, a set of over 1,000 articles and reports were identified from peer-reviewed published literature and from organizations relevant to physical education, physical activity, and health. The focus of the literature review was to retrieve review articles and seminal articles on the evidence available on influences of physical activity and physical education on the short- and long-term physical, cognitive and brain, and psychosocial health and development of children and adolescents; and potential physical activity and physical education policies and programs.

Scopus and ERIC (Education Resources Information Center) were primarily used to search the literature, supplemented by Medline. Scopus is a multidisciplinary research tool indexing more than 15,000 peer-reviewed journals from 4,000 publishers. Subject areas covered by Scopus include chemistry, physics, mathematics, engineering, life and health sciences, social sciences, psychology, economics, biological, agricultural and environmental sciences, and general sciences. ERIC is sponsored by the Institute of Education Sciences (IES) and the U.S. Department of Education. ERIC contains over 1.4 million records for education journal articles and other education materials from scholarly organizations, professional associations, research centers, policy organizations, university presses, the U.S. Department of Education and other federal agencies, and state and local agencies. Medline is the U.S. National Library of Medicine's bibliographic database, covering the fields of medicine, nursing, dentistry, veterinary medicine, the healthcare system, and preclinical sciences. PubMed provides access to over 12 million Medline citations. Medline contains bibliographic citations and author abstracts from more than 4,600 biomedical journals published in the United States and 70 other countries.

The literature search strategy generated search terms based on the committee's framework approach to its task (see Figure 1-4). The initial search strategy paired the terms "physical education" and "physical activity" with terms related to themes including academic achievement, brain development, classrooms, disparities, exercise, fitness, intra- and extramural sports, joint-use, mental health, out of school time, policy, psychosocial health, recess, sedentary activity, school financing, somatic growth, transport, and weight. More detailed searches also included terms such as somatic growth and health, muscle, heart, bone, metabolic syndrome, lipids, and blood pressure, for example. Searches were typically limited to U.S. populations and to children and adolescents, with the exception of studies examining the long-term and adult health benefits of childhood activity.

In addition, the committee invited presentations from experts on programmatic approaches to physical activity in the school environment (see Appendix D).

The committee developed recommendations, key messages, and action steps based on the evidence retrieved through the literature searches and expert presentations.

C

State Legislative Policies on Physical Education and Physical Activity

Table C-1 provides a summary of data extracted on physical education and physical activity policies from the National Association of State Boards of Education (NASBE) State School Health Policy Database. The database is a comprehensive set of laws and policies from 50 states on more than 40 school health topics. The database can be found at: http://www.nasbe.org/healthy_schools/hs/. The NASBE State School Health Policy Database, begun in 1998 and continuously updated, is another data source that supplements the School Health Policies and Practices Study (SHPPS) survey by providing supplemental information on the presence of relevant state laws and policies. The database provides a summary description of the actual state-level laws, legal codes, rules, regulations, administrative orders, mandates, standards, and resolutions. The database includes a summary of the most recent state-level laws and regulations, but does not provide historical information on laws that were in place dating back to 1998. The other two state-level policy databases vary from the NASBE database by providing scores related to the strength of policies rather than the actual policy language. They also provide historical data by year, which allows for the examination of change in state laws over time.

TABLE C-1 Summary of State Laws and Policies on Physical Education and Physical Activity

STATE	STATE STATUE	POLICY	WAIVERS	CURRICULUM	ASSESSMENT	CERTIFICATION	GRADUATION REQUIREMENT	RECESS	ATHLETICS	WALK/ BIKE	WELLNESS POLICY
ALABAMA	CODE 16-40-1 ; ADMINISTRATIVE CODE: 290-3-1-02	Requires physical education for students in grades K-8. A minimum daily instructional period of at least 30 minutes is required in grades 1-6. The physical education may include dance class if taught at a magnet school, marching band, JRTOC or other activity as approved by a student's IEP.	K-8 NO EXEMPTIONS, NO SUBSTITUTIONS	The Alabama Course of Study: Physical Education (2009) specifies the required K-12 content standards for physical education and is based on the National Standards for Physical Education. Administrative Code 290-2-3 (1997) requires schools to purchase from the list of Health and Physical Education Textbooks Adopted by the Alabama State Board of Education unless another textbook is recommended by the local textbook committee, recommended by the local superintendent, and adopted by the local board of education.	Physical Fitness Assessment: The Department of Education (DOE) Requires yearly student assessment for all students K-12 in physical education. Schools use the President's Challenge Physical Fitness Test and are required to report the results to the DOE only on odd numbered years.	The minimum requirement for prospective physical education teachers in elementary, middle, and high school grades prior to licensure is a bachelor's degree and completion of a state approved teacher education program in physical education.	One credit of physical education	NO STATE POLICY	NO STATE POLICY	NONE	Each School Conduct Survey
ALASKA	04 AAC 06.075 (2005)	Physical education is not a required course for students.	NONE	Curriculum Content: Physical Education Content Standards (2010) provide outline objectives for grades K-12.	NONE	NONE STATED	1 credit of either health or physical education in order to graduate from high school.	No State Policy	Equal Opportunity	No Policy	Provides Guidance

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ARIZONA	Mandate: State Board of Education Administrative Code R7-2-301 (1993)	Mandate: State Board of Education Administrative Code R7-2-301 (1993) establishes the minimum course of study and competency goals. Does not specify grades, levels, or a minimum amount of instruction.	Exemptions: ARS 15-102 (no date available) allows for parents to withdraw a child from an activity class or program if they object to any activity or learning material.	The state adopted the Physical Education Standards (2009), which includes the rationale, standards, and major content areas for physical education.	NONE	The Special Subject Area Endorsement (2008) requires a valid elementary, secondary or special education certificate, 30 hours or courses to include one course in the methods of teaching physical education at the elementary level, one course for the secondary level, and either twenty-four semester hours of courses in physical education content areas, a master's degree in physical education or a comparable certificate from the NBPTS.	NONE	No State Policy	ARS 15-705 (no date available) requires each governing board to adopt policies and procedures including minimum statewide requirements regarding pupil participation in extracurricular activities for pupils in grade 6-12	No Policy	The DO E has a Step-by-Step Guide designed to walk schools through the process of creating a wellness policy.
ARKANSAS	ACT 317; CODE 20-7-135; ACT317	Mandate: Act 317 (2007) requires 60 minutes per calendar week of physical education training and instruction for students in grades K-6 and for grades 5-8 for schools organized to teach these grades. The statute	Code 6-16-132 (2003) waivers only for medical or religious reasons.	Arkansas has not formally adopted state standards for physical education; however, the state does require schools to follow the K-8 Physical Education and Health Curriculum	The Department of Education requires students to participate in a "national recognized health-fitness assessment for	Code 6-16-132 **(2003)** does not require schools or districts to hire personnel certified in physical education. However,	1/2 unit course for graduation.	No State Policy	No State Policy	No State Policy	Act 1220 of 2003 (codified as Codes 6-7-117 through 6-7-119) pre-dates Section 204 and is generally stronger than the federal requirements

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		requires 90 minutes of additional physical activity per week for grades K-6, which may include physical education in addition to the previous requirement, daily recess, or intramural sports. The Rules Governing Nutrition and Physical Activity Standards allow local districts to require physical education or activity in excess of these requirements. Arkansas Public Schools (2009) detail the course requirements for students: in grades K-8 all students must receive instruction in physical education (the amount is not specified).		Framework and Physical Education and Curriculum Framework for Grades 9-12 (2005).	the purpose of setting age-appropriate personal goals" along with improvement in various physical areas.	minimum requirements are a bachelor's degree and passing scores on the appropriate Praxis content knowledge exam. The State Board of Education's Rules Governing Nutrition and Physical Activity Standards (**2007**) require districts to employ at least one licensed and/or qualified full-time physical education teacher for every 500 students in grades K-6. Beginning in **2012**, all personnel teaching physical education in grades K-12 must hold a physical education license appropriate for grade levels being taught.					

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CALIFORNIA	CONCURRENT RESOLUTION 31 EDUCATION CODE 33350 EDUCATION CODE 51210 EDUCATION CODE 51210-1 EDUCATION CODE 51223 EDUCATION CODE 51222 EDUCATION CODE 51225-3	Education Code 51210 (no date available) requires 200 minutes of physical education to be included in the adopted course of study for grades 1-6. Code 51222 requires a minimum of 400 minutes of physical education instruction every 10 school days for students in grades 7-12. Education Code 51225.3 (2000) does not allow a student to receive a high school diploma without the completion of two courses in physical education, unless an exemption was made.	Education Code 51241 (2007) permits a school district to exempt a student if the pupil is Ill or injured and a modified program to meet the needs of the pupil cannot be provided or (2) Enrolled for one-half, or less, of the work normally required of full-time pupils. Exemptions from physical education course may be granted to pupils for two years any time during grades 10 to 12, inclusive, if the pupil has met satisfactorily any five of the six standards of the physical performance test administered in grade 9 pursuant to Section 60800. Education Code 51242 (1976) states that students who participate in school sponsored interscholastic athletic programs may be exempted from courses in physical education**.**	Education Code 60605.2 (2001): The State Board adopted Physical Education Model Content Standards for California Public Schools (2005). However, the Education Code does not require schools to follow the standards.	California Code of Regulations Title 5, Division 1, Chapter 10, Subchapter 1, Article 3.1, 10060 requires each high school student to be evaluated on his or her progress in each of the following content areas: the effect of physical activity upon dynamic health, mechanics of body movement, aquatics, gymnastics and tumbling, individual and dual sports, rhythms and dance, team sports, and combatives.	Education Code 51210.2 (2002) encourages each school district to employ a credentialed physical education teacher within any elementary school and provide each teacher instruction in physical education with yearly theoretical practical training in developmental physical education. Education Code 44257 (1993) requires the commission to issue single subject teaching credentials in physical education.	Two courses in Physical Education Required	Not Required but encourages daily recess.	Education Code 33350 (1976) encourages districts to provide extra-curricular physical activity. The Education Code also establishes the California Department of Education as the authority over interscholastic athletics.	Streets and Highways Code 2333.5 (1999) requires the Department of Transportation, in conjunction with California Highway Patrol, to establish and administer a Safe Routes to School program.	Guidance for the Development of California School Wellness Policies (2005), developed in a collaborative effort between the Department of Education and other organizations, provides districts with suggestions and concrete recommendations for meeting Section 204 requirements. Project LEAN; Healthy Children Ready to Learn

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COLORADO	NO STATE POLICY	NO STATE POLICY - HB 11-1069 (2011) requires each school district board of education to adopt a policy that incorporates a minimum number of minutes of physical activity each month, or each day if the school meets less than 5 days per week, into each elementary school student's schedule. The requirement for students who attend 5 days per week for a full day is 600 minutes per month.	NONE SPECIFIED	The Comprehensive Health and Physical Education Standards (2009) provides standards and a suggested curriculum framework for physical education.	NONE SPECIFIED	Bachelor's degree in the liberal arts, with additional coursework in physical education. High school physical education teachers are required to have a bachelor's degree in physical education, as outlined in State Board of Education Regulation 2260.5-R-8.16 (2004).	NO REQUIREMENT	No State Policy	No State Policy	Statute 43-1-1601 (2004) requires the Department of Transportation to establish and administer a Safe Routes to School program to distribute federal funds to improve pedestrian and bicyclist safety in school areas.	

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CONNECTICUT	Chapter 164 Sec. 10-16bChapter 170 Sec. 10-221o Chapter 170 Sec 10-221a ;	Statute Chapter 164 Sec. 10-16b (1997) requires students in public schools receive physical education instruction. Statute Chapter 170 Sec. 10-221o of the Connecticut General Statutes (2004) requires each local board of education to include in a regular K-5 school day a period of physical exercise with the exception of those students requiring special education and related services. The Action Guide for School Nutrition and Physical Activity Policies (2009) provides guidelines and policy recommendations to local districts for physical education, along with other areas.	Statute Chapter 170 Sec 10-221a allows for medical exemption.	No specific curriculum required	Physical Fitness Assessment: Al l students in grades 4, 6, 8, and 10 participating in physical education are required to complete physical fitness assessment. Fitness assessment data are to be reported to the Connecticut State Department of Education annually for inclusion in each school district Strategic School Profile.	Bachelor's degree with a major in physical education.	One credit of physical education for graduation.	While not specifying "recess," Chapter 170 Section 10-221 (2003) requires each local board to include a period of physical exercise in the regular school day for students in grades K-5.	No State Policy	No State Policy	State provides guidance

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DELAWARE	Administrative Code 14:505 (2004) Administrative Code 14:503 (2005)	Administrative Code 14:503 (2005) requires students in grades 1-8 to be enrolled in a physical education program.	Administrative Code 14:503 allows the physical education requirements to be waived only for students who have an excuse from a qualified physician or objections based on religious beliefs.	The Delaware Recommended Curriculum and Delaware Standards for Physical Education are aligned with and reflect the NASPE approved National Standards for Physical Education for all students grades K – 12.	Code 14:122(b) (2006) requires each school district to assess the physical fitness of each student at least once at the appropriate elementary, middle and high school level, with the results to be provided to the parent, guardian or relative caregiver. Code 14:122(b) (2006) also provides for the fitness assessments to be administered at common grade levels statewide.	The minimum requirements for licensure as a physical educator are a bachelor's degree from an accredited college or university, completion of a teacher preparation program in Physical Education for grades K-12, and completion of a minimum of 27 semester hours in physical education coursework.	1 credit of physical education for graduation	No State Policy	Administrative Code 14:1001 (2002) states, Local school districts shall establish their own academic eligibility criteria for participation in extra-curricular activities for all extra-curricular activities except for interscholastic athletics", which are defined in Administrative Codes 14:1008 and 14:1009 (2004).	Administrative Code 10:17 (2002) authorizes the Department of Transportation to establish and administer a Safe Routes to School program.	Provides Guidance

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FLORIDA	Statute 1003.455	Statute 1003.455 (2007) requires 150 minutes of physical education each week for students in grades K-5. This was expanded in 2008 to include the requirement for students in grade 6 who are enrolled in a school that contains one or more elementary grades. It requires instruction to be at least 30 consecutive minutes on any day physical education instruction is given. Beginning with the 2009-10 school year, students in grades 6-8 are required to complete the equivalent of one class period per day of physical education for one semester of each school year.	Waivers are permitted for certain conditions for high school which include JROTC, Marching Band, and Interscholastics with specified requirements. K-8 can be waived for special requirements	The Next Generation Sunshine State Standards for Physical Education (2008), which are based on the National Standards for Physical Education, describe the state's learning expectations for grades K-12. The state does not provide or recommend particular curriculum materials.	None specified	For certification in K-12 physical education, Rule 6A-4.0283 (2003) requires a bachelor's degree or higher with either a teacher education major in physical education or 30 semester hours in physical education that includes areas specified in the Rule	Statute 1003.428 Requires one credit in physical education to include integration of health beginning with students entering their first year of high school in the 2007-2008 school year.	No State Policy	Statute 1000.05 (2004) prohibits the exclusion; requires equal athletic opportunity for both genders. Statute 1002.20 (2004) mandates that all students first enrolling in a school be eligible; specifies meet academic and conduct requirements.	Statute 335.066 (2002) establishes the Safe Paths to Schools program in the Departmen t of Transporta tion	Statute 18.1003.453 (2006) requires every school district to annually review its school wellness policy.

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GEORGIA	Georgia Code 20-2-142; Code 20-2-776 (2009); Code 20-2-142. State Board of Education Rule 160-4-2-.12 (2011) ; State Board of Education Rule 160-4-2-.47 (2002)	Georgia Code 20-2-142 (no date available) requires the State Board of Education to prescribe a course of study in health and physical education for all grade levels. State Board of Education Rule 160-4-2-.12 (2011) The rule further requires 90 hours of contact instruction in physical education and health for students in grade K-5 and must be made available for students in grades 6-12.	NONE SPECIFIED	The Quality Core Curriculum Standards and Resources	Code 20-2-777 (2009) requires each local school district to conduct an annual fitness assessment program one time each school year for students in grades 1-12, The assessment must be conducted during a physical education course taught by a physical education instructor.	The minimum requirements for prospective health and physical education teachers in elementary, middle and high school grades prior to licensure is a clear renewable certificate according to PSC Rule 505-2-.71 (2004).	State Board of Education Rule 160-4-2-.47 (2002) requires high school students to complete one unit of Health and Physical Education (out of 22 units) in order to graduate.	No State Policy	State Board of Education Rule 160-5-1-.19 (1997) requires each local school board to adopt a policy regulating competitive interscholastic activities for grades 6-12. Student eligibility and physical examination requirements are outlined in the rule.	No State Policy	No Sate Specific Policy
HAWAII	STATE BOARD OF EDUCATION POLICY 4540 (2006)	The state Wellness Guidelines, which schools are required to implement over a four year period through 2010-11, require 45 minutes of physical education classes per week for grades K-3, 55 minutes per week for grades 4-5, 107 minutes per week for elementary grade 6, and 200 minutes per week for secondary grades 6-12.	NONE SPECIFIED	The state has adopted Physical Education Content Standards (2005) for grades K-12 that serves as a guideline, but is not a specific curriculum for schools to follow	NONE SPECIFIED	The minimum requirement for prospective physical education teachers in elementary, middle, and high school grades prior to licensure is a bachelor's degree, with no additional coursework in physical education. The specific details of initial licensure are outlined in Administrative Rule 8-54-9 (1998).	State Board of Education Policy 4540 (2006) requires one credit of physical education for high school graduation.	No State Policy	No State Policy	Statute 291C-A (2012) creates a safe routes to school program within the DOT, DOE, DOH	The State Board of Education amended its Health, Wellness, and Safety Policy in 2006 to require the Department of Education to create a plan for measuring implementation of the wellness policy. Hawaii is unique in that the entire state constitutes a single school district.

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IDAHO	Statute 33-1605	Statute 33-1605 (no date available) requires all school districts to provide instruction in health and physical fitness.	NONE SPECIFIED	The Idaho Content Standards for Physical Education (2010) sets uniform content standards for physical education for elementary, middle, and high school.	NONE SPECIFIED	NONE SPECIFIED	NONE SPECIFIED	No State Policy	No State Policy	No State Policy	No Specific Policy
ILLINOIS	105 ILCS 5/27-5 (1996)	105 ILCS 5/27-5 (1996) mandates all school boards to provide for instruction and training in physical education of students in their schools. 105 ILCS 5/27-6 (1996) also states that students enrolled in public schools must engage in a course of physical education daily during the school day. K-12.	A school board may, however, authorize an exemption for students in grades 11 and 12 for reasons specified in the Statute., for the following reasons: (1) ongoing participation in interscholastic athletic programs, (2) enrollment in academic classes required for admission to an institution of higher learning, and (3) enrollment in academic classes required for graduation from high school, (4) involvement in for-credit marching band program (grades 9-12), and (5) involvement in a school-sponsored ROTC program or to receive special education support and services.	105 ILCS 5/27-7 (1998) calls for the State Board of Education to prepare and make available guidelines that incorporate the purposes stated in the Statute for physical education for all grades and types of schools. In 1997, the state approved the Illinois Learning Standards for Physical Development and Health.	NO STATE POLICY	Candidates must complete a state approved program for physical education that is based on state content and teacher standards.	NONE SPECIFIED, BUT EXEMPTIONS ARE FOR GRADES 11 AND 12.	NO STATE POLICY - However, recess may count toward the daily physical education mandate 105 ILCS 5/27-6 (1996) at the elementary level as long as it is supervised by a certified teacher.	No State Policy	20 ILCS 2705/2705 -317 (2002) requires the State Board of Education, and the DOT to establish and administer a Safe Routes to School Program.	The State Board of Education and the Illinois Nutrition Education and Training Program provides districts with wellness policy resources. The State Board of Education also a dopted a State Goal on Wellness Policy (2007).

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INDIANA		Code 20-30-5-7 (2005) requires school corporations (local school districts) to provide physical fitness as part of the curriculum. Code 20-30-5-7.5 (2006) requires school corporations to provide daily physical activity in elementary school, which may include recess. 511 IAC 6.1-5-2.6 (2010) includes physical education in the required curriculum for elementary school. 511 IAC 6.1-5-3.6 includes physical education in the required curriculum for middle school	NONE STATED	511 IAC 6.1-5-0.6 (2010) requires each school corporation to develop and implement a curriculum for K-12	NONE STATED	Required to have a bachelor's degree with a content area in physical education from an approved program. Prospective high school teachers are required to have a major in physical education from an approved program. The specific details of initial licensure are outlined in 515-8-1-29.1 (2010)	Requires two credits of physical education for graduation.	NO STATE POLICY - IAC 20-30-5-7.5 (2006) requires school corporations to provide daily physical activity for students in elementary school consisting of curriculum and programs and may include the use of recess beginning in the 2006-07 school year.	No State Policy	No State Policy	Code 20-26-9 (2006) requires each school board to establish a coordinated school health advisory council.

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IOWA		Code 256.11 (2005) requires physical education to be taught in grades 1-12. All students in grades 9-12 are required to participate in physical education activities for at least a 1/8 unit each semester Iowa Code 256.11(6) (2009) requires K-5 to engage in 30 minutes of physical activity daily, and grades 6-12 120 minutes per week. Exemptions may be granted on the basis of conflict with religious beliefs, upon a written request from a parent. For students in grades 6-12, the requirement may be met by participation in interscholastic athletics, school-sponsored marching band, show choir, dance, drill, cheer or similar activities, specified non-school sports activities, or similar endeavors that involve movement, manipulation or exertion of the body.	Code 256.11 (2009) Twelfth graders: allows for exemptions for work study, special academic class, or athletics. Students in grades 9-12 may be excused if requested by a parent or guardian but must participate in an athletic program. This is not required if a parent/guardian files a written statement with principal that course or activity conflicts with religious belief.	281 IAC 12.5 outlines the specifics of instruction that students should receive in prekindergarten, kindergarten, and grades 1-12.	NONE REQUIRED	282 IAC13.28 states that the minimum requirement for a physical education K-12 basic teacher license and physical education endorsement is the completion of 24 semester hours in specific courses.	Requires 1 credit of basic physical education for high school graduation.	The Iowa Association of School Board's model Wellness Policy (2010) at least 20 minutes a day of recess recommended and discourages more than two hours of inactivity a day. The policy also recommends withholding recess should not be used as a tool for punishment.	281 IAC 36.14 prescribes rules for participation in extracurricular athletic competition. 281 IAC 36.15 prescribes the eligibility requirements. Code 280.13 organization must be registered with the department of education	No State Policy	The Iowa Association of School Boards provides a model wellness policy and additional support materials.
KANSAS		State Board Regulation 91-31-32 (2005) requires that as a prerequisite for accreditation, each school should provide physical education. The Kansas School Wellness Policy Model Guidelines (2005) provides time recommendations for physical education. House Resolution 6011 (2006) states the legislature's support for	Regulation 91-31-35 (2005) allows the physical education (including health) high school graduation requirement to be waived for medical or religious reasons. Regulation 91-31-34 (2005) states, a school shall neither offer credit for athletic practice nor count athletic practice as a physical education course."	The state does not have a required or suggested curriculum. However, the Department of Education encourages the use of the Kansas Model Curricular Standards for Physical Education (no date available) to plan and implement health education in the schools.	NO STATE POLICY	The minimum requirement for prospective physical education teachers in elementary, middle, and high school grades prior to licensure is a bachelor's degree, with no additional coursework in physical	For graduation from high school, State Board Regulation 91-31-35 (2005) requires one unit of physical education	The Wellness Policy Guidelines recommends elementary schools provide 20 minutes of supervised recess daily.	No State Policy	No State Policy	The state requires LEAs to annually complete the online Wellness Policy Builder assessment tool required by Senate Bill 154.

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		physical education and urges the State Board of Education to require some type of physical education class for all grades K-12.				education.					
KENTUCKY		Kentucky schools must follow the Program of Studies for Kentucky Schools Grades P-12 (2006), which outlines minimum state education requirements and provides curriculum guidelines	NONE STATED	The State Board of Education's Learning Goals and Academic Expectations detail the state's standards	UNDER REVISION	Bachelor's degree, successful completion of the applicable assessment, a recommendation from an approved preparation program.	Must complete a unit of both health and physical education in order to graduate.	NO STATE POLICY	State Board of Education Regulation 702 KAR 7:065 (2004) designates the KY High School Athletic Association as the agent to manage interscholastic athletics at the high school level.	No State Policy	Revised Statute 158.856 (2005) requires each school food service director to annually assess and prepare a written report for local school board members, council members, and parents that addresses compliance with federal food and meals.
LOUISIANA		Bulletin 741 (2008) requires students in grades 1-6 and 7-8 to receive 150 minutes of and physical education per week.	In Bulletin 741, 2717 allows an approved Junior Reserve Officer Training Corp program to be substituted for the 2 credits of health and physical education upon board approval. and exemption for medical reasons only, but the number of credits required for graduation remains at 23.	The Louisiana State Board of Elementary and Secondary Education formally adopted Physical Education Content Standards with Bulletin 102 (2009). The standards document also serves as a suggested curriculum framework, although local schools are not required to adhere to it.	NO STATE POLICY	Bachelor's degree, with four semester hours in health and physical education. Secondary certification requires a completion of 30 hours of health and physical education courses.	In Bulletin 741 (2005), 2319 requires 1.5 units of physical education for public high school graduation	No State Policy	No State Policy	No State Policy	The state DOE in collaboration with the Dairy Council, created a comprehensive Model School Wellness Policy (2006).

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MAINE	STATUTE TITLE 20-A 4711	Statute Title 20-A 4711 (2001) requires all elementary schools to provide the basic coursework, which includes physical education, for all students.	NONE SPECIFIED	PreK-12 Standards, but no curriculum	Title 20-A Chapter 207-A & Chapter 222 provide guidance on the instruction standards and assessment requirements.	Bachelor's degree with at least 36 credit hours in physical education.	Education Rule Chapter 127 (2002) requires one credit of physical education for graduation from high school.	NO STATE POLICY	NO STATE POLICY	No State Policy	The State Board of Education adapted its model local wellness policy (2005) directly from the Michigan State Board of Education's Policy (2005).
MARYLAND		Codes 7-409 (2005) and 2-205 (1996) require each public school to have a physical education program for all students in grades K-12. State Board of Education Regulation 13A.04.13.01 (2001) outlines the requirements for the physical education instructional program in grades K-12.	NONE STATED	Regulation 13A.04.13.01 (2001) provides program goals for physical education in grades K-12.	NONE STATED	Bachelor's degree with a major in the physical education or completion of 36 semester hours of course content work in physical education and completing the professional education course and experience requirements found in State Board of Education Regulation 13A.12.02.06 (2003).	One-half credit of physical education.	NO STATE POLICY	State Board of Education Regulation 13A.06.03.02 (1994) sets the eligibility requirements for student participation in interscholastic athletics at the high school level.	NO STATE POLICY	HB1264 (2009) authorizes local school systems to develop and implement annual wellness policy implementation and monitoring plans.

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MASSACHUSETTS		General Law 71.1 (no date available) requires all schools to provide instruction in physical education, but grade levels or amounts of instruction are not specified. General Law 71.3 (no date available) says that, "Physical education shall be taught as a required subject in all grades for all students in the public schools for the purpose of promoting the physical well-being of such students."	General Law 71.3 waives for medical reasons	General Law 71.1 requires instructions in "fitness and body dynamics" The Common Core of Learning (1994) outlines the state's basic standards for students and the Massachusetts Comprehensive Health Curriculum Framework (1999) provides a more detailed vision of standards for what students should be able to learn and know regarding physical activity and fitness in grades prek-12. The framework serves as a suggested curriculum for local schools.	NO STATE POLICY	Bachelor's degree. 603 CMR 7.05 (2006) provides the general guidelines.	However, high school students are not required to complete specified units of physical education to graduate.	NO STATE POLICY	NO STATE POLICY		HB4459 (2010) requires each School Wellness Advisory Council to review and evaluate the school district Wellness Policy every three years.
MICHIGAN		The Michigan State Board of Education's nonbinding Policy on Quality Physical Education (2003) recommends that instructional periods total 150 minutes per week (elementary) and 225 minutes per week (middle and high school). Their Model Local Wellness Policy (2005) recommends districts adopt policies promoting physical educational opportunities.	MCL 380.1278b allows a student to substitute one physical education and health credit to acquire extra English language arts, mathematics, science or world language credits, if a student has an approved personal curriculum. In addition, students may test out of any state required graduation credit	Schools are encouraged to use the Michigan Department of Education's Physical Education Content Standards and Benchmarks (1998).	NO STATE POLICY	NO STATE POLICY	MCL 380.1278a (2007) Requires 1 credit of health and physical education for graduation. Schools have flexibility in how they meet the requirement.	The Michigan State Board of Education (2000) recommends that public schools offer daily recess or physical activity	NO STATE POLICY		The Michigan State Board of Education Model Local Wellness Policy (2005) provides a comprehensive policy template for districts to meet Section 204 requirements that can be modified to address local governance issues

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MINNESOTA		Statute 120A.22 (2005) requires physical education for students between 7-16 years (duration and frequency not specified) and assigns the responsibility of developing standards to local districts. Although not outlined in code, precedence has determined that physical education must be taught at all grade levels in the elementary and middle/junior high levels, and must be taught at least once in high school.	The State Board of Education (no link available) requires all students to participate in physical education classes unless there is an appropriate written request (from a parent, guardian or medical practitioner) for a student not to participate.	Standards are to be developed locally. The Healthy Kids Bill (2010) requires the Department of Education to adopt the National Association of Physical Education (NASPE) standards as statewide standards.	Local districts are required to develop assessments for physical education. NO STATE POLICY	State Board of Education Rule 8710.4700 (2002) requires a Bachelor's degree	Must be taught at least once in high school. NO HIGH SCHOOL GRADUATION REQUIREMENT	No State Policy	Statute 121A.04 (2003) requires each educational institution to provide equal opportunities for both sexes to participate in its athletic program.		The Healthy Kids Bill (2010) encourages the Department of Education to develop guidelines that local districts can adopt

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MISSISSIPPI	CODE 37-13-134	Code 37-13-134 (2007) requires the following for physical education: 150 minutes weekly of activity based instruction as defined by the State Board of Education instruction for K-8 and half of a Carnegie unit of physical activity or physical education for graduation (grades 9-12). State Board of Education Policy 4012 (2008) defines physical education, physical activity and activity based instruction further stipulates that of the required 150 minutes of activity based instruction, the total number of minutes of physical education may not be under 50 minutes per week for grades K-8.	State Board of Education Policy 4012 (2008) allows extracurricular activities in grades 7-8, that is sanctioned by the Mississippi High School Association and ROTC if approved by the Mississippi Department of Education supervises practices and games. State Board of Education Policy 4012 (2008) also allows for a medical exemption.	Standard 33 of the Mississippi Public School Accountability Standards (2006) states the basic curriculum of each elementary and middle school to include physical education. Standard 32 requires physical education be a part of the high school basic curriculum on an elective basis.	State Board of Education Policy 4012 (2008) requires fitness testing using the Fitnessgram, Activitygram, President's Challenge to Fitness, or other comparable program. The assessment must be conducted in grade 5, and the grade the student will earn the 1/2 Carnegie unit of physical education for graduation.	The minimum requirement for prospective physical education teachers in elementary, middle, and high school grades prior to licensure is a bachelor's degree, a standard MS license, and 21 semester hours in physical education.	Half of a Carnegie unit of physical activity or physical education for graduation (grades 9-12).	No State Policy	NO STATE POLICY		The state Department of Education produced the Local School Wellness Policy Guide for Development (2005),

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MISSOURI	STATE STATUTE 161.102	The Missouri School Improvement Program, which includes school accreditation standards (2001), requires that each elementary student receives instruction in physical education for a minimum of 50 minutes each week (25 minutes for half-day kindergarten classes), and that the classes be taught by teachers certificated in the field. Junior high/middle schools must teach physical education to all students for a minimum of 3,000 minutes each year.	None, except for students in the adult diploma program. The state's Graduation Requirements Handbook (2009) specifies that, Courses devoted to conditioning for interscholastic sports or practicing for interscholastic sports may not be counted toward meeting the minimum requirement."	5 CSR 50-375.100 (1996) lists the Show-Me" standards for health and physical education. The state's voluntary framework is Missouri's Framework for Curriculum Development in Health Education and Physical Education (2009) which calls for students to receive instruction on efficiency of human movement and performance and on physical activity and lifetime wellness.	Each year, schools are required to submit by building the percent of 5th and 9th grade students that meet the minimum criteria for the Missouri Physical Fitness Assessment Program (2000).	The state does not have a policy specifically stating pre-service physical educator requirements; however, Revised Statute 168.081 (2002) prohibits a person from engaging in the practice of teaching in grades K-12 without a valid Missouri certificate.	Students must complete 1 unit credit in physical education, out of 24 specified units, for high school graduation as outlined in the Graduation Requirements Handbook (2009).	SB291 (2009) requires elementary schools to provide students a minimum of one recess period of twenty minutes per day. This may be incorporated into the lunch period.	NO STATE POLICY		A Local Wellness Policy Presentation created by a Department of Education staff member includes resources, guidelines, requirements, etc to aid districts in developing local wellness policies.

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MONTANA		In Montana, elementary, middle/junior high, and high school students are required to take health enhancement courses per standards for school accreditation outlined in State Board of Education Administrative Rule 10.54.2501 (2000). State Board of Education Administrative Rule 10.55.905 (2000) requires 1 unit of health enhancement, with one-half unit each year, for two years in high school and 1/2 unit each year for middle school students. A "unit" is equal to 225 minutes per week. (Note: In the Montana School Accreditation Standards, the traditional disciplines of 'health education' and 'physical education' are combined into one content area called Health Enhancement.	NONE STATED	With State Board of Education Administrative Rule 10.54.7010-7073 (1999), the State Board adopted the Health Enhancement K-12 Content and Performance Standards for grade levels (by end of grade 4, 8 and 12). The state does not require schools to follow a specific curriculum.	NO REQUIREME NT	NONE SPECIFIED	State Board of Education Admini strative Rule 10.55.905 (2000) requires 1 unit of health enhancement, with one-half unit each year, for two years in high school	No State Policy	No State Policy	NO STATE POLICY	The State Board of Public Education adopted a position statement encouraging districts to adopt and implement local wellness policies.

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NEBRASKA		92 NAC 10-004.04B7 (no date available) requires that the high school program include 20 instructional units" (out of a total of 400) or two years of daily classes or the equivalent in personal health and physical fitness. 92 NAC 10-004.03A9 (no date available) and 92 NAC 10-004.03A9 (no date available) mandate physical education for elementary and middle school.	NONE SPECIFIED	92 NAC 10-004.02A6, 92 NAC 10-004.03A9, and 92 NAC 10-004.04B7 outline the required K-12 curriculum for Nebraska schools. The Nebraska Physical Education Essential Learnings (2006) outlines what students are expected to know and be able to do by the end of grades 2, 5, 8 and 12.	NONE	The minimum requirements for a physical education endorsement are a minimum of 27 semester hours in physical education courses for K-6 or 7-12 endorsements. Both endorsements require a minimum of 15 semester hours in scientific foundations and a minimum of 12 semester hours in techniques.	92 NAC 10-004.04B7 (no date available) requires that the high school program include 20 instructional units" (out of a total of 400) or two years of daily classes or the equivalent in personal health and physical fitness	NO STATE POLICY	Statute 79-2,116 (no date available) declares it unfair and discriminatory to deny comparable opportunity for interscholastic and intramural athletic programs for both genders.		NO STATE POLICY

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NEVADA		NRS 389.018 (2003) requires physical education be taught, as practicable, in all public schools. State Board of Education Administrative Code 389.2425, 389.283, 389.2946, 389.386, 389.485, 389.2425 (2000) detail student performance standards in physical education for grades 2, 3, 5, 8, and high school. NO MANDATE for elementary, middle, or high school.	State Board of Education Administrative Code 389.488 (1987) allows a student to be exempt from taking a course in physical education based on a physical or mental condition supported by a written statement from a physician, religious beliefs supported by a written statement from a parent/guardian, enrollment in ROTC, or intentions of enrolling into a course comparable to physical education. A school district may exempt a pupil for not more than 1 credit for participating in interscholastic athletics, on a drill team, in a marching band, in a dance group or on a cheerleading squad if school sponsored and participates for at least 120 hours.	State Board of Education Administrative Code 389.283, 389.2946, 389.386, 389.485 also include student performance standards for physical education for grades 2, 3, 5, 8 and 12. The state department of education's website offers documents that summarize the Physical Education Content Standards (2000). Schools are not required to follow a specific curriculum.	NO STATE POLICY	Bachelor's degree and the completion of 12 semester hours of physical education. For prospective secondary physical education candidates, the minimum requirements are a bachelor's degree and a major (constituting 36 semester hours) or minor in physical education. For a K-12 physical education endorsement, the candidate must also possess a bachelor's degree, 42 semester hours of coursework, and 22 semester hours of professional education outlined in State Board of Education Administrative Code 391.280 (1991).	State Board of Education Rule 389.664 (Board of Education Rule) requires 2 units of physical education to receive a standard high school diploma.	No State Policy	No State Policy	AB231 (2005) requires local and regional governmental entities to conduct a review and evaluation of existing walking paths and sidewalks for pupils in a one mile radius of each public school.	The State Board of Education implemented mandatory guidelines via a Statewide School Wellness Policy (2005) that local wellness policies are required to meet.

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NEW HAMPSHIRE		State Board of Education Rule Ed 306.26 (2005) gives local school boards the authority to adopt instructional time requirements for K-8 physical education.	The state permits local districts to allow students to substitute extended learning," (activities provided outside of the regular school day that align with the local physical education curriculum) to meet the physical education requirements in middle and high school.	The Physical Education Curriculum Guidelines (2005) provides suggestions for curriculum content in physical educational for students in grades K-12.	NO STATE POLICY	The minimum requirement for prospective physical education teachers in grades K-12 prior to licensure is a bachelor's degree and demonstrate competency in the areas described in State Board of Education Rule Ed 507.16 (2003).	State Board of Education Rule Ed 306.27 (2005) requires that high school students complete 1 credit in physical education coursework in order to graduate (out of 20 required), and high schools must offer at least 2 credits of courses in physical education (out of 45 required).	State Board of Education Rule Ed 310.04 (2005) requires the developmentally appropriate daily physical activity policy to encourage physical activity recess periods."	NO STATE POLICY		The state Department of Education has created a Local Wellness Policy Toolkit (2005) that includes school wellness policy and resources assessment form.

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NEW JERSEY		N.J.S.A 18A:35-7&8 (1967) requires that students in grades 1-12 receive 150 minutes (or 2 hours) of health, safety and physical education per week. Local school districts decide how many minutes per week are necessary in each area in order to achieve the core standards	Determined by local school boards. Per State Board of Education Administrative Code N.J.A.C. 6A:14-4.1(f) (no date available) schools are required to provide alternatives in order for students with a disability to meet the physical education core standards.	The mandatory CCCS for Comprehensive Health and Physical Education (2009) include instruction in identifying the short-term and long-term benefits of physical activity and engaging students in vigorous physical activity that develops all components of fitness. Standards 2.5, Motor Skill Development, and 2.6, Fitness, must be met by the end of grades 2, 4, 6, 8, and 12.	NO STATE POLICY	State Board of Education Administrative Code N.J.A.C. 6A:9-9.2 (2004) allows a physical education or health and physical education endorsement which both authorize the holder to teach physical education in public schools. For an endorsement in health and physical education, State Board of Education Administrative Code N.J.A.C. 6A:9-11.8 (2004) requires the candidate to fulfill a 30-credit sequence of courses and a minimum of 15 credits in physical education.	State Board of Education Administrative Code N.J.A.C. 6A:8-5 (no date available) requires 3.75 credits of health and physical education per year (out of a total 110 credits required) for high school graduation.	NO STATE POLICY	NJAC 6A:16 requires a medical examination prior to participation on a school-sponsored interscholastic or intramural team or squad for students enrolled in grades 6-12		N.J.S.A. 18A:33-15 to 18 (2007) requires school districts participating in any of the federally funded Child Nutrition Programs to submit their local policies to the state Department of Agriculture for a compliance check with the state's Model Nutrition Policy (2005),

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NEW MEXICO		22-13-1 NMSA (2005) requires students in grades 1-8 to receive instruction in physical education.	6.30.2.10.J9(n) NMAC (2000) allows the physical education graduation requirement to be waved because of a permanent or chronic medical condition that does not permit physical activity.	6.29.9.8 NMAC (2009) details the NMPED K-12 content standards with benchmarks and performance standards for Physical Education. Local school districts are required to align their K-12 Physical Education Curriculum to these K-12 Physical Education Standards (1997, revised 2006)content standards with benchmarks and performance standards.	NO STATE POLICY	Complete the requirements for an elementary [K-8] license (6.61.2 NMAC) or a middle school [5-9] license (6.61.3 NMAC) or a secondary [7-12] license (6.61.4 NMAC) or a PreK-12 license (6.61.5 NMAC).	NMSA (2009) requires students to have one unit in physical education or other physical activity for graduation	The School Wellness Policy Guidance Document recommends that schools provide daily recess for all elementary students. It also recommends that all districts prohibit withholding physical activity (physical education class, recess, etc) as a means/method of punishment.	State Board of Education Administrative Code 6.13.3.8 NMAC (2000) sets the eligibility requirements for student participation in interscholastic student activities. State Board of Education Administrative Code 6.13.4.8 NMAC (2000) requires local school boards to comparable athletic opportunities for both sexes.	66-7-501 NMSA (2003) creates the Safe Routes to School program to increase and make safer a student's ability to walk or ride a bicycle to school.	Rule 6.12.6 NMAC requires each school district and charter school to develop and implement a policy that addresses student and school employee wellness through a coordinated school health approach". The law goes beyond federal minimum requirements to specifically include nutritional requirements for a la carte items and school sponsored fundraisers before, during, and after school hours, and requires that a planned, sequential K-12 health and physical education curriculum aligned with state benchmarks be included in the wellness policy.

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NEW YORK		Regulation 135.4(c) (2) (a) requires daily participation in physical education for students in grades K-3 and three times each week for grades 4-6. The minimum time devoted to physical education shall be at least 120 minutes each week. For grades 7-12, the regulations require physical education 3 times per week in one semester, and 2 times per week in the second, or a comparable time each semester if the school is organized in other patterns. Education Law 803 requires physical education instruction for all pupils above the age of eight in all elementary and secondary schools.	NO STATE POLICY	Standard 1 of the Learning Standards for Health, Physical Education, and Family and Consumer Sciences (1996) provides a suggested curriculum framework, but does not require schools adhere to it or any other specific curriculum.	NO STATE POLICY	Bachelor's degree with specified course work and grades for all teachers and have passed the Assessment of Teaching Skills, CST in Physical Education, and the LAST. They must also have 40 days of supervised teaching experience in physical education within the applicable grade range, and have fingerprint clearance.	Regulation 100.5 (2005) requires high school students to earn 2 units in physical education (out of 22) in order to graduate.	NO STATE POLICY	NO STATE POLICY	Transportation Law 444 (Section 14, Subdivision 35) (2004) establishes and administers a Safe Route to School Program.	A February 2005 memo to School Food Services Directors/Managers from the state Department of Education provides guidance and suggestions for creating local wellness policies, including links to resources, background information, rationales, and policy process guidance.

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NORTH CAROLINA		State Board of Education Policy GCS-S-000 (2005) requires students enrolled in K-8 to participate in physical activity as part of the district's physical education curriculum. Elementary schools should consider providing 150 minutes per week and middle schools should consider 225 minutes per week including a minimum of physical education every other day for the school year	NO STATE POLICY	The North Carolina Healthful Living Standard Course of Study (2006) outlines the content that districts are expected to follow. The curriculum calls for students in grades K-1 2 to receive instruction in motor skills and movement patterns, skill acquisition and performance, establishing and maintaining regular participation in physical activity, accepting responsibility for personal fitness, demonstrating responsible personal and social behavior in physical activity settings, development of an awareness of the intrinsic value and benefits of participation in physical activity.	The North Carolina Healthful Living Standard Course of Study (2006) requires that students in select grades complete a pre and post health-enhancing fitness assessment, including monitoring of the heart.	An approved teacher education program, which in NC includes a cumulative grade point average of at least 2.5 at the time of admission to and exit from a teacher education program, a satisfactory Praxis I score for admission to the program, a minimum of 10 weeks of student teaching, completion of a technology product of learning and completion of a program of study that meets state-approved standards and indicators for the specialty area.	Complete 1 credit (out of 20) in health and physical education in order to graduate.	Although there is no specific recess requirement, State Board State Board of Education Policy GCS-S-000 (2005) requires schools to provide a minimum of 30 minutes daily of moderate to vigorous physical activity to all K-8 students. Recess is often used to fulfill this requirement. In addition, the policy prohibits taking away structured/unstr uctured recess and other physical activity from students as a form of punishment. In addition, it prohibits using severe and inappropriate exercise as a form of punishment for students.	16 NCAC 06E .0202 (2000) only allows students in grades 7-12 to participate in interscholastic athletic competition. Requirements to qualify for participation are outlined in the code.		State Nutrition Consultants review local wellness policies as part of the School Meal Initiative Review.

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NORTH DAKOTA		In Code 15.1-21-01 (no date available), the superintendent ensures that all students will receive instruction in physical education.	NONE SPECIFIED	NONE SPECIFIED	NO STATE POLICY	The minimum requirements to teach physical education are possession of a license to teach by the education Code 15.1-18-10	Code 15.1-21-02 (2007) requires 1 unit of physical education, of which 1/2 may be health for grades 9-12 (local district requirements range from ½ to 2 credits of PE for graduation).	NO STATE POLICY	NO STATE POLICY		The state Department of Public Instruction provides resources from its Moving Forward with School Wellness: Making Your District Policy Work for Healthy Children workshop. In conjunction with Team Nutrition, the Department has produced a Local Wellness Policy handout (2006) to inform others in the school about federal wellness requirements and to help aid districts in the basic requirements for local wellness policies.

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OHIO		Pursuant to OAC 3301-35-04 (2001) and 3313.60 (2001), physical education is a required part of the curriculum for all levels, although duration and frequency are not specified. ORC 3313.6016 (2010) requires the board of education of each city or local school district to require all students in K-12 to engage in at least 30 minutes of moderate to rigorous physical activity each school day, exclusive of recess	Pursuant to OAC 3313.603 (2007), the board of education of each school district may adopt a policy to excuse from the high school physical education requirement each student who, during high school, has participated in interscholastic athletics, marching band, or cheerleading for at least two full seasons. If the board or authority adopts such a policy, it may not require the student to complete any physical education course as a condition to graduate.	NO STATE POLICY	NO STATE POLICY	Physical educators in Ohio are required to hold the Multi-Age License in physical education valid for teaching physical education in all grades Pre-kindergarten through 12th grade. ORC 3319.076 (2010) requires all physical education teachers hired by districts after July 1, 2013 to provide instruction in grades K-12 to have a valid license for teaching physical education purs uant to ORC 3319.076 (2010).	Complete .5 unit of coursework in physical education in order to graduate	No State Policy	No State Policy		Healthier Schools: A Brighter Tomorrow which not only acts as a guide for the development of wellness policies but also points to examples of best practices in other states.

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OKLAHOMA	STATUTE 70-11-103.9	Statute 70-11-103.9 (2005) requires that all public elementary schools, grades K-5, provide instruction in physical education or exercise program for a minimum of an average of 60 minutes per week. SB 1186 (2008) requires an additional 60 minutes each week of physical activity, which may include, but is not limited to, physical education, exercise programs, fitness breaks, recess, classroom activities and wellness and nutrition education. Each school district board of education shall determine the specific activities and means of compliance with the provisions of the law. Statute 70-11-103.9 (2005) requires school districts to provide all students physical education programs, which may include athletics, for accreditation.	NO STATE POLICY	PASS Integrated Curriculum: Health, Safety and Physical Education (2002) provide a suggested framework to promote the health and well-being of each student in grades K-12 and guide them toward becoming physically active for life.	NO STATE POLICY	The Competencies for Licensure & Certification (2002) provides an outline of the knowledge and skills required for Physical Education/Safety licensure and certification.	NO STATE POLICY	70-11-103.9 (2007) requires the Board of Education to strongly encourage school districts to incorporate physical activity into the school day by providing to students in full-day kindergarten and grades 1-5 at least a twenty-minute daily recess, in addition to the 60 minutes of required physical education. It also encourages districts to allow students brief physical activity breaks throughout the day, physical activity clubs, and special events.	NO STATE POLICY		Statute Title 70, Section 24-100b (2005) requires each school district to report to the state Department of Education on the district's wellness policy, goals, guidelines, and progress in implementing the policy and attaining the goals.

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OREGON		OAR 581-022-1210 (2005) requires school districts to provide a K-12 instructional program that includes physical education. HB 3141 (2007) requires every public school student in grades K-8 to participate in physical education for the entire school year. Students in grades K-5 are required to participate in physical education for at least 150 minutes each week. Students in grades 6-8 are required to participate in physical education for at least 225 minutes each week. School districts are required to devote at least 50 percent of physical education class time to actual physical activity. Full compliance is required by the 2017-2018 school year.	OAR 581-022-1910 (1996) allows a district to excuse a pupil from a state required program or learning activity to accommodate for a student's disability or religious beliefs.	The Physical Education Standards (2005) recommend students in grades K-12 acquire the knowledge and skills to understand the role of physical activity has in promoting health. OAR 581-022-1210 requires each district to have a planned K-12 instructional program with common curriculum goals and content standards in physical education. HB 3141 (2007) requires school districts to offer instruction in physical education that meets the academic content standards for physical education adopted by the State Board of Education under ORS 329.045 (2003).	NO STATE POLICY	OAR 584-036-0015 (2005) states that an elementary subject matter endorsement for grades preK-9 is valid for departmental assignments in physical education. All subject matter endorsements, except elementary, are valid for teaching physical education in grades 5-12. For a basic physical education endorsement, 48 quarter hours are required to demonstrate competence outlined in OAR 548-038-0230 (1989). I	OAR 581-022-1130 (2002) Complete 1 unit of coursework in physical education in order to graduate from high school.	NO STATE POLICY	OAR 581-022-1680 (1996) states that school districts may only allow those organizations to administer interscholastic activities which have been approved by the state board.	ORS 195.119 (2003) requires local governments to work with school district personnel to identify barriers and hazards to children walking or bicycling to and from school. HB 2742 (2005) establishes the Safe Routes to School program and fund within the Department of Transportation	The Department of Education has provided LEAs with several documents for creating and implementing wellness policies, including a school wellness newsletter with tips, resources, and highlights of exemplary districts.

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PENNSYLVANIA		Students at the elementary, middle, and high school levels shall receive planned instruction in physical education aligned to the academic standards according to 022 PA Code 4.27 (1999). Further details of the requirements at the elementary level can be found in 022 PA Code 4.21 (1999), at the middle school in 022 PA Code 4.22 (1999), and at the high school level, in 022 PA Code 4.23 (1999).	Parents/guardians may remove the child from instruction when it conflicts with religious beliefs. A written request must be submitted to the school.	Academic Standards for Health, Safety, and Physical Education (2003) describe what students should know and be able to do by the end of third, sixth, ninth, and twelfth grades. The standards are mandated and binding. Schools are not required to follow a specific curriculum but are required to use the standards as a curricular framework for the development of the local curriculum.	NO STATE POLICY	24 P.S. 12-1202 (no date available) requires that teachers be certified in the field in which they teach.	022 PA Code 57.31 (1988) requires the completion of one health and physical education credit to fulfill the graduation requirement.	NO STATE POLICY	022 PA Code 4.27 (1999) requires students of both sexes to have equal access in interscholastic and intramural programs.		Local Education Agencies (LEAs) are required to complete a. "Local Wellness Policy Checklist" and submit it to the state Department of Education with their Wellness Policy.
RHODE ISLAND	STATUTE 16-22-4	Statute §16-22-4 (2008) requires all children in grades 1-12 attending public schools to receive instruction in health and physical education for an average of at least 20 minutes in each school day	NONE SPECIFIED	Statute 16-22-4 (2008) requires the physical education curriculum to be based on the physical education standards of the Rhode Island Physical Education Framework: Supporting Physically Active Lifestyles through Quality Physical Education (2003) by September 2012.	Statute §16-1-5 (2004) assigns the Commissioner of Elementary and Secondary Education to establish an assessment program in areas of health and fitness.	The minimum certification requirement for prospective physical education teachers is a bachelor's degree that must include 24 semester hours of physical education coursework	Statute §16-22-4 (2008) requires all children in grades 1-12 attending public schools to receive instruction in health and physical education for an average of at least 20 minutes in each school day. No Graduation Requirement	NO STATE POLICY	NO STATE POLICY		Statute §16-2-9(a)(25) (2005), Statute §16-21-28 (2005) and Statute §16-7.1-2(h) (2005) require the school committee of each district to establish a district-wide coordinated school health and wellness subcommittee, chaired by a member of the full school committee, to implement policies and plans to meet Section 204 requirements.

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SOUTH CAROLINA		Code 59-10-10 (2005) mandates that students in grades K-5 must be provided with at least 150 minutes of physical activity per week, 90 minutes of which must be provided in physical education	Code 59-10-10 (2005) allows students in grades K-5 to be exempt from physical education and activity requirements if they meet the standards for exemptions set forth in Code 59-29-80 Exemptions are granted for students involved in a military or naval ROTC . Waiver from the local school board of trustees for medical or religious reasons.	The Board of Education adopted the Physical Education Curriculum Standards (2008). The state does not require schools to follow a specific curriculum, nor does it provide one.	Code 59-10-10 requires student's individual fitness status to be reported to their parent or legal guardian during their fifth grade, eighth grade, and high school physical education courses.	Bachelor's degree, certification at the early childhood, elementary, middle, secondary, or preK-12 level, minimum qualifying score on the content area examination, and 30 semester hours in physical education coursework.	Complete 1 unit (out of 24) of physical education or junior ROTC for a high school diploma State Board of Education R 43-259 (2003).	The Position Statement on School Recess of the Governor's Council on Physical Fitness recommends that schools allot time each day for supervised recess for elementary students. It also states that recess should not be denied as a form of punishment.	State Board of Education Regulation R 43-244 (1980) prohibits schools serving grades 1-6 from providing competitive sports "of a varsity pattern with scheduled league games and championships ." State Board of Education Regulation R 43-244.1 (1988) and Code 59-39-160 (no date available) outline the academic requirements for students in grades 9-12 to participate in interscholastic activities.	Code 59-17-150 (2004) requires municipal and county governing bodies to work with school districts to identify barriers and hazards to children walking or bicycling to and from school.	Code 59-10-330 (2005) requires each school district to establish and maintain a Coordinated School Health Advisory Council (CSHAC). The CSHAC is required to assess, plan, implement, and monitor district and school health policies and programs, including the development of a district wellness policy.

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SOUTH DAKOTA		Physical education is not required at any specific grade level.	NO STATE POLICY	The State Board of Education approved voluntary South Dakota Physical Education Content Standards (2000) which are organized in grade level clusters K-2, 3-5, 6-8, and 9-12. The state does not require or recommend a specific curriculum framework or curriculum materials.	NO STATE POLICY	Bachelor's degree, with two semester hours of first aid and health. For prospective teachers in high school, the state requires a bachelor's degree, with at least 24 semester hours in health coursework	Beginning with students who are freshman in the fall of 2013, .5 units of physical education is required for high school graduation (2009) .	NO STATE POLICY	Statute 13-36-4 (2003) gives the school board power to delegate the control, supervision, and regulation of any high school interscholastic activities to any voluntary, non-profit association Statute 13-36-7 (2003) deems any student enrolled in a public school district eligible to participate in any interscholastic activity sponsored by the SD High School Activities Association.		The Board of Education has produced a Model Wellness Policy (2005) based on science, research, and existing practices from exemplary states and local school districts around the country." The policy encourages school districts to establish and maintain a coordinated school health program that addresses all components of school health, including mental health services and school health services, which are not addressed in the model.

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TENNESSEE		Physical education is a required subject for Tennessee students in grades K-8.	Rules of the State Board of Education, Minimum Requirements for the Approval of Public Schools 0520-1-3-.05 (2008) states modifications for students with disabilities. In addition, the rule permits school districts and schools to allow students to substitute JROTC for their required Lifetime Wellness credit in high school.	Lifetime Wellness: Grades: 9 – 12 (2007) and Physical Education Grades 9-12 provide the required curriculum standards for health, physical fitness education and wellness in high school.	Physical fitness assessment guidelines can be found at the Tennessee Department of Education web site Lifetime Wellness: Grades 9-12 (2007).	Bachelor's degree, a supervised physical education internship or student teaching experience in both K-4 and 5-12 settings, and a major in physical education.	Graduation requirements spec ify 1.5 credits of physical education and wellness.	although not specifically requ iring recess, 49-6-1021 (2006) requires each local education agency to integrate a minimum of ninety minutes of physical activity per week into the instructional school day for elementary and secondary school students	Rules of the State Board of Education, Minimum Requirements for the Approval of Public Schools 0520-1-3-.05 (2008) states interscholastic athletics shall not be substituted for the wellness requirement.		The Tennessee State Board of Education Physical Activity Policy 4.206 (2005) requires each school district's School Health Advisory Council to annually administer CDC's SHI: A Self-Assessment and Planning Guide and report a summary to the state.

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TEXAS		Education Code 28.002 (2007) requires students in grades K-5 daily physical activity for at least 30 minutes throughout the school year. This may be accomplished through the physical education curriculum or daily recess. Students in grades 6-8 are required to participate for at least 30 minutes for at least four semesters. If this is impractical due to scheduling or other factors, the district may require a student to participate in moderate or vigorous physical activity for 135 minutes per week or 225 minutes per two weeks on a block schedule.	State Board of Education Administrative Code 74.11 (1997) allows for temporary or permanent medical exemption. It also gives school districts permission to allow a student to substitute certain physical activities for credit towards the high school graduation requirements. Waivers may be granted for credit to individual students for involvement in high quality private or commercially sponsored programs (minimum of 5 hours per week) and those in Olympic-level physical training (15 hours per week). The Graduation Requirements state that the following activities can be substituted for the PE requirement: drill team, marching band, cheerleading, ROTC, athletics, dance I-IV, and approved private programs and certain career and technical education courses.	Education Code 28.002 (2009) requires a physical education curriculum that is sequential, developmentally appropriate, and designed, implemented and evaluated to enable students to develop the motor, self-management and other skills necessary to participate in physical activity throughout life. State Board of Education Administrative Code 74.1 (2004) requires each school district offering K-12 to adopt a physical education curriculum. State Board of Education Administrative Code 116.1 to 116.52 (1998) describe the Texas Essential Knowledge and Skills for Physical Education.	Education Code 38.101 (2007) requires a school district to assess the physical fitness of students enrolled in grades 3-12. Students with a disability are exempted from this requirement. Education Code 38.103 (2007) requires the school district to provide summarized results to the Department of Education.	NONE SPECIFIED	One credit of physical education to receive a high school diploma according to State Board of Education Administrative Code 74.51 (2003).	No state policy. However, Education Code 28.004 (2003) requires the local school health advisory council to consider and make policy recommendations to the district concerning the importance of daily recess for elementary school students.	TAC 76.1001 (2003) states that an extracurricular activity is an activity sponsored by the school district that is not necessarily directly related to instruction of the essential knowledge and skills but may have an indirect relation to some areas of the curriculum.	Transportation Code 201.614 (2001) establishes a Safe Routes to School Program within the Department of Transportation	The state Department of Agriculture, Food and Nutrition Division, has implemented mandatory guidelines via the Texas Public School Nutrition Policy (2004) that local wellness policies are required to meet (but are encouraged to surpass).

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UTAH		According to R277-700.3 (2004), the State Board of Education requires instruction in physical education in grades K-2 (as a part of integrated curriculum), grades 3-6, 1 credit in physical education in middle school	NONE SPECIFIED	The Physical Education Core - Secondary (2005) and Physical Education Core - Elementary (1997) and sets standards for students in grades K-12 to receive instruction in physical education and activity	NO STATE POLICY	The minimum requirement for prospective physical education teachers in elementary grades prior to licensure is a bachelor's degree, with no additional coursework in health. For prospective teachers in middle or high school, a candidate is require to have a major or state endorsement in physical education, in addition to a bachelor's degree.	1.5 credits in physical education for high school graduation.	NO STATE POLICY	NO STATE POLICY		The Utah legislature passed a resolution urging schools, school districts, health care providers, community-based organizations, businesses, and families work with the Legislature to establish comprehensive wellness policies to help prevent and reduce the prevalence of overweight children and adolescents
VERMONT		16 VSA 906 (1998) requires public schools to provide students with a physical education course of study, although duration and frequency are not specified. The Nutrition and Physical Fitness Guidelines (2005) **recommend** 150 minutes per week of physical education for elementary students and 225 minutes per week for middle and high school students.	NONE SPECIFIED	The Vermont Physical Education Grade Expectations (2004) sets health knowledge and skills standards for students in grades preK-12. Standard 2 requires students to learn to identify healthy behaviors and learn the benefit of exercise.	The Vermont Physical Education Grade Expectations (2004) requires student assessment in physical education **(Fitnessgram** or other nationally accredited test) for grades 5-12.	Board Rules 5441 and 5445 and 5440-08 (2005) require Bachelor's degree in physical education and a practicum in physical education at the appropriate grade level.	The State Board of Education Manual of Rules and Practices (2006) requires One year of physical education for high school graduation	The Nutrition and Physical Fitness Guidelines (2005) **recommend** daily recess for all students pre-K through 8. The Guidelines also recommend that recess and physical activity breaks not be taken away as a form of discipline.	NO STATE POLICY		A collaborative between the Commissioner of Education and the state school boards association that created the Nutrition and Fitness Policy Guidelines (2004), a model school fitness and nutrition policy consistent with the 16 V.S.A. 216 (2004).

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VIRGINIA		Code 22.1-207 (1991) requires that "physical and health education shall be emphasized throughout the public school curriculum but the statute does not specify grades levels or amounts of instructional time.	NONE SPECIFIED	The Health Education Standards of Learning (2008) requires students in grades K-10 to be able to explain good health and the benefits of physical activity and fitness, and the role of regular physical activity	The Physical Education Standards of Learning (2008) requires a standardized physical assessment of students in grades 4-12.	8VAC20-21-280 (1998) The minimum requirements are graduation from a teacher preparation program in health and physical education or completion of a major in health and physical education or 45 semester hours of coursework in the areas specified in the code.	8VAC20-131-50 (2000) requires 2 credits in health and physical education (out of 22) in order to graduate.	State Board Rule 8VAC20-131-200 (2006) requires elementary schools to provide students with daily recess during the school year as determined appropriate by the school.	Code 22.1-276.3 (2005) requires any organization governing interscholastic activities among public high schools to develop, implement, and enforce rules stating that any school athletic team member determined to have used anabolic steroids.		The Superintendent of Public Instruction issued a memo asking each school division [district] to report on the status of the local wellness policy as part of the required School Health Advisory Board Annual Report."

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WASHINGTON		RCW 28A.230.040 (1984) requires every student in grades 1-8 to receive instruction in physical education. RCW 28A.210.365 (2007) states that it's a goal of Washington state to ensure that by 2010 all students in grades 1-9 should have at least one hundred fifty minutes of quality physical education every week.	RCW 28A.230.040 allows only those students who have a physical disability, religious belief or participates in directed athletics to be excused from receiving instruction in physical education. RCW 28A.210.365 (2007) states that it's a goal of Washington state to ensure that beginning with the 2011-2012 school year, any district waiver or exemption policy from physical education requirements for high school students should be based upon meeting both health and fitness curricula concepts as well as alternative means of engaging in physical activity, but should acknowledge students' interest in pursuing their academic interests.	The Essential Academic Learning Requirements for Health and Fitness (2003) sets requirements for physical education for grades for grades 5, 8 and high school.	Fitness assessments mandatory in 2008-9 for middle and high school grades and in 2009-10 for elementary grades.	The minimum requirement Bachelor's degree. The minimum requirement for prospective physical education teachers in high school is a bachelor's degree, with at least 30 semester hours in physical education.	WAC 180-51-061 (2001) beginning July 1, 2004, students who enter the 9th grade or begin the equivalent of a four-year high school program, will be required to complete 2 credits of health and fitness courses (out of 19 required credits). Details are also provided in High School Graduation Requirements (2004).	NO STATE POLICY	NO STATE POLICY		RCW 28A.210.360 (Senate Bill 5436, 2004) requires districts to adopt local wellness policies and mandated the creation of a model policy and recommendations consistent with and above the federal requirements by a broad-based advisory committee.

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WEST VIRGINIA		Code 18-2-7a (2005) requires students in elementary school to participate in at least 30 minutes of physical education at least three days a week, at least one full period of physical education in middle school	Code 18-2-7a (2005) allows the state to grant waivers to school districts regarding physical education time requirements. The waiver allows districts to develop alternative programs if schools do not have the required number of certified physical education instructors or adequate physical setting to meet the state requirements.	State Board Policy 2520.6 (2003) provides content standards and objectives for physical education, but does not mandate any specific curriculum	Code 18-2-7a requires the State Board to prescribe a program within the existing health and physical education program which incorporates fitness testing, reporting, recognition, and fitness events and incentive programs which requires the participation in grades 4-8 and the required high school course."	Per Board Policy 5202 (2004), the minimum requirement for prospective physical education teachers in elementary, middle, and high school grades prior to licensure is physical educators is a bachelor's degree.	At least one full course credit of physical education for students in high school,	NO STATE POLICY	Board Policy 2436.10 (1984) outlines the requirements for participating in nonacademic activities in grades 7-12.		State Board of Education Policy 4321.1 (2008) and Statute 126-86-12 (2008) outline requirements of local wellness policies that county boards of education are required to follow. These exceed the federal requirements.
WISCONSIN		Statute 121.02 (2001) and school district standards requires physical education at least three times per week for grades K-6, weekly for middle school, and three courses during high school in grades 9-12.	NONE SPECIFIED	The Department of Public Instruction provides guidance for schools in their voluntary Physical Education Standards (2010). Schools are not required to use a specific curriculum program.	NO STATE POLICY	To qualify for a license to teach physical education, an applicant must complete a program that incorporates Wisconsin's model academic standards for physical education and assists prospective educators in developing specific competencies according to Administrative Code PI 34.30 (2000).	Code PI 18.03 (1986) and Statute 118.33(1) a (1) requires 1.5 credits in physical education to be completed over three years.	NO STATE POLICY	NO STATE POLICY		The Department of Public Instruction published School Wellness Policy: Broadening the Policy" (2005) that puts pertinent state statutes and policies into context within Section 204 requirements and promotes a coordinated school health plan approach to wellness based on CDC guidance documents.

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WYOMING		Rule 5218, Chapter 31 (2003) requires all public school children in grades 1-8 to be proficient in physical education as mandated by the State Board in the Wyoming Health Education Content and Performance Standards (2008). No State Requirements	NONE SPECIFIED	The Wyoming Physical Education Content and Performance Standards (2008) sets benchmarks for standards that students must master in the grade spans of K-4, 5-8, and 9-12. While a curriculum framework is provided, specific courses, materials, or instructional methodology are not mandated by the state.	NONE SPECIFIED	The minimum requirement for prospective physical educators in the elementary and middle grades prior to licensure is a bachelor's degree, with 27 hours in the applicable content area. For prospective teachers in high school, the state requires a bachelor's degree, with an endorsement in physical education as specified in Section 12 of Rule 4897, Chapter 7 (2002).	Proficiency in physical education is also required for graduation from high school.	NO STATE POLICY	NONE SPECIFIED		NO STATE POLICY

SOURCE: NASBE State School Health Policy Database (available at http://www.nasbe.org/healthy_schools/hs/ [accessed March 5, 2013]).

D

Workshop and Panel Public Sessions

Physical Activity and Physical Education in the School Environment

September 20 - 21, 2012
Keck Center of the National Academies
500 5th Street, NW, Washington, DC

Meeting Goals

- To provide the committee with viewpoints from individuals in academia and from individuals who are "on the ground" acting as practitioners on physical activity and physical education programs in the school environment

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September 20, 2012

Room 100

11:00 am	**Registration**
11:30	***Welcome and Opening Remarks*** Harold W. (Bill) Kohl, PhD, Committee Chair* University of Texas Health Science Center-Houston and University of Texas at Austin
	The Current Status of Physical Activity-Related Programs, Practices, and Policies in Schools Sandy Slater, PhD, University of Illinois at Chicago* Amy Eyler, PhD, Washington University in St. Louis*

Panel I

12:00 **Programmatic Approach: Physical Education**

Moderator: Jayne Greenberg, EdD, Miami Dade County Public Schools*

Panelists:

Dolly Lambdin, EdD	Abby Rose, MEd, MA
University of Texas at Austin	Namaste Charter School, Chicago

Panel II

1:00 **Programmatic Approach: Physical Activity during Recess and Breaks**
Moderator: Kenneth Powell, MD, Retired, Georgia Department of Human Resources*

Panelists:

Thomas McKenzie, PhD	Erin Donoghue, MEd
San Diego State University	Chicago Public Schools

Public Forum (Preregistration Required)

2:00 **Moderator:** Bill Kohl, Committee Chair

Registered Speakers:

1. Jennifer A. Weber, MPH, RD
   Office of Child Health Policy and Advocacy, Nemours
2. Melissa Maitin-Shepard, MPP
   American Cancer Society Cancer Action Network
3. Shellie Pfohl, MS
   President's Council on Fitness, Sports & Nutrition
4. Lisa Perry, MEd
   Alliance for a Healthier Generation

2:30 Break

Panel III

2:45	**Programmatic Approach: Classroom Physical Activity & Sedentary Activity Reduction**
	Moderator: Charles Hillman, PhD, University of Illinois at Urbana-Champaign*
	Panelists:
	Joseph Donnelly, EdD University of Kansas — Don Disney, MS, MA Dallas, TX

Panel IV

3:45	**Programmatic Approach: Active Transport To and From School** **Moderator:** Emma Sanchez-Vaznaugh, ScD, San Francisco State University*
	Panelists:
	Noreen McDonald, PhD University of North Carolina at Chapel Hill — Gillian Hotz, PhD University of Miami Miller School of Medicine

Panel V

4:45	**Programmatic Approach: Before and After School Physical Activity Programs Including Intra- and Extramural Sports** **Moderator:** Darla Castelli, PhD, University of Texas at Austin*
	Panelists:
	Michael Beets, PhD University of South Carolina — Becky Ciminillo YMCA of Central Ohio
5:45	**CLOSING REMARKS** Bill Kohl, Committee Chair
6:00	Adjourn

September 21, 2012

Room 105

10:30 am ***Welcome, introductions, and purpose of open session***
Bill Kohl, Committee Chair

Physical Activity (or Inactivity)/Physical Education and Psychosocial Health
David Dzewaltowski, Ph.D., Kansas State University

Discussion

12:00 Adjourn

December 13, 2012

The National Academy of Sciences
Board Room
2101 Constitution Avenue, NW
Washington, DC 20418

PURPOSE: Conduct open session on the Physical Activity Guidelines for Americans Mid-Course Report

8:30 am Briefing on the Physical Activity Guidelines for Americans Mid-Course Report

Katrina L. Butner, PhD
Office of Disease Prevention and Health Promotion
Department of Health and Human Services

9:15 Discussion

9:30 Adjourn

E

Committee Member Biosketches

Harold W. Kohl, III, Ph.D., M.S.P.H., (*Chair*) is professor of epidemiology and kinesiology in the School of Public Health, Division of Epidemiology, Human Genetics and Environmental Sciences, Michael & Susan Dell Center for Healthy Living at the University of Texas Health Science Center–Houston, and in the Department of Kinesiology and Health Education at the University of Texas–Austin. He is founder and director of the University of Texas Physical Activity Epidemiology Program, where he is responsible for student training, research, and community service related to physical activity and public health. Previously, Dr. Kohl directed physical activity epidemiology and surveillance projects in the Division of Nutrition, Physical Activity, and Obesity at the U.S. Centers for Disease Control and Prevention (CDC). His research focuses on epidemiology related to physical inactivity, physical activity and health in children and adults. Dr. Kohl also studies the effect of the built environment on physical activity and is currently researching a planned development that implements "smart growth" techniques designed to support physically active lifestyles. He was previously a member of the IOM Committee on Accelerating Progress in Obesity Prevention and the IOM Committee on Fitness Measures and Health Outcomes in Youth. He received an M.S.P.H. in epidemiology and biostatistics from the University of South Carolina School of Public Health and a Ph.D. in community health studies from the University of Texas Health Science Center–Houston School of Public Health.

Darla M. Castelli, Ph.D., is associate professor of physical education pedagogy in the Department of Kinesiology and Health Education at the University of Texas at Austin. She has been working with school-age youth in physical activity settings for more than 20 years, leading several physical activity interventions (e.g., FIT Kids, Active + Active Healthy = Forever Fit, Fitness4Everyone). Dr. Castelli has received teaching awards in both the public school, Maine Physical Education Teacher of the Year, and higher education, University of Illinois Teaching Excellence Award. As a fellow in the AAHPERD Research Consortium and past Young Scholar award recipient from NAKPEHE and AEISEP, her study of children's physical activity and cognitive health has been funded by the National Institutes of Health, Robert Wood Johnson Foundation, American Dietetic Foundation, and U.S. Department of Education. She presented her work at U.S. Congress and Senate Briefings in Washington, DC in support of the FIT Kids Act. Dr. Castelli is currently a member of the IOM Committee on Fitness Measures and Health Outcomes in Youth. She received a B.S. from Plymouth State University, an M.S. from Northern

Illinois University, and a Ph.D. in physical education pedagogy from the University of South Carolina.

Ang Chen, Ph.D., is professor in the Department of Kinesiology at the University of North Carolina at Greensboro. He is an experienced researcher in children and adolescent motivation for physical activity, learning on physical education, physical activity and physical skill assessment, and program evaluation. Dr. Chen's studies examine relationships among curriculum, learner motivation, and physical activity outcomes such as caloric expenditure in physical education. Specifically, he uses motivation theories to develop innovative physical education curriculum that encourages behavior change and enhances child and adolescent knowledge about physical activity. His recent research has focused on cognition- and motivation- based intervention on physical activity behavior change in children and adolescents. Dr. Chen has been a principal investigator and co-investigator in several federally funded, large-scale, multi-year physical education intervention studies with students in elementary and middle schools. He has published approximately 60 research articles and delivered more than 90 research presentations at national and international conferences. He received a M.Ed. from Shanghai Institute of Physical Education (currently Shanghai University of Sport) of China and a Ph.D. from the University of Maryland at College Park.

Amy A. Eyler, Ph.D., is an assistant professor at the George Warren Brown School of Social Work at the University of Washington in St. Louis in the program of public health. Dr. Eyler conducts research as part of the Prevention Research Center (PRC) in St. Louis and is responsible for evaluation activities for core PRC projects about policy and environmental changes for chronic disease. She continues to procure external research funding and teaches several courses including Health Policy and Research Methods. She is the principal investigator and coordinator of the Physical Activity Policy Research Network, which integrates the work of research sites across the U.S. studying the nature and extent of physical activity policy in a variety of settings. She also leads a project on the evaluation of state policies influencing childhood obesity. She received a B.S. in community health and an M.S. in health promotion and disease prevention from Ohio University, and a Ph.D. in public health from Oregon State University.

Scott Going, Ph.D., is interim department head and professor in the Department of Nutritional Sciences and director of the Center for Physical Activity and Nutrition at The University of Arizona. His research interests include development of methods for body composition assessment, changes in body composition during growth in children and with aging in older adults and related health and functional outcomes, and the effects of exercise and diet on bone, soft tissue composition, functional capacity, fitness and health. His research is funded by The National Institutes of Health, the U.S. Department of Agriculture, the U.S. Department of Education, and the Science Foundation of Arizona. He is currently investigating the effects of exercise, diet and obesity on bone macroarchitecture and strength in girls, the effects of exercise on strength, body composition and functional capacity in patients with osteoarthritis and rheumatoid arthritis, and muscle loss with aging, hip geometry and fracture risk in postmenopausal women. He also leads projects aimed at promoting physical activity and healthy diet for obesity prevention in children and weight loss in adults. Dr. Going has led the development of assessment protocols and activity interventions for multisite school and community-based studies. Dr. Going recently led the Schools Team of the Pima County Communities Putting Prevention to Work initiative which sought to increase physical activity and improve nutrition in Arizona schools to reduce childhood obesity. Dr. Going's work in the area of pediatric obesity and health has contributed to health-related obesity standards for children and adolescents. Dr. Going is a Fellow in the National Academy of Kinesiology. He received his B.S. in physical education from the University of Maine, and M.S. and Ph.D. in Exercise Physiology from The University of Illinois.

Jayne D. Greenberg, Ed.D., is the district director of physical education and health literacy for Miami-Dade County Public Schools. Dr. Greenberg is responsible for overseeing staff in physical education, health education, safety education, JROTC, driver education, adapted physical education, sports programs for students with disabilities, and the learn to swim program. Specifically, she develops and implements curriculum, instructional materials, outside programming, grant writing, and professional development, and she also designs facilities and equipment specifications for construction projects. Dr. Greenberg is also a current council member of the President's Council on Fitness, Sports and Nutrition. Previously she served as special advisor on youth fitness to the President's Council on Physical Fitness and Sports; president of the Florida Alliance of Health, Physical Education, Recreation, Dance, and Sport; and chair of the Sport Development Committee for the United States Olympic Committee, USA Field Hockey. Dr. Greenberg was named as the 2005 National Physical Education Administrator of the Year by the National Association of Sport and Physical Education. She has secured more than $20 million in federal and foundation grants for educational programs, including the Carol M. White Physical Education for Progress grant. She received a B.S. in physical education from the University of Massachusetts, Amherst, and received an M.S. in physical education and sports psychology and an Ed.D. in curriculum and instruction (instructional leadership and physical education) from Florida International University in Miami, Florida.

Charles H. Hillman, Ph.D., received his doctoral degree from the University of Maryland in 2000, and then joined the faculty at the University of Illinois, where he is currently a Professor in the Department of Kinesiology and Community Health. He also holds appointments in the Department of Psychology, the Department of Internal Medicine, the Neuroscience Program, the Division of Nutritional Sciences, and the Beckman Institute for Advanced Science and Technology. He directs the Neurocognitive Kinesiology Laboratory, which has the mission of determining lifestyle factors that improve cognition, maximize health and well-being, and promote the effective functioning of individuals as they progress through the human lifespan. Dr. Hillman has published more than 80 journal articles, 10 book chapters, and co-edited a text on neuroimaging in exercise and sport sciences. His work has been funded by the National Institute for Child Health and Human Development (NICHD), the National Institute on Aging (NIA), the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), and Abbott Nutrition. Dr. Hillman's primary research emphasis is to better understand factors that relate to increased neurocognitive health and effective functioning of individuals across the lifespan. He has predominantly focused his research on preadolescent children with the goal of understanding how both single bouts of exercise and chronic physical activity participation promote basic changes in brain health that may lead to better cognition and scholastic performance. From a neuroimaging perspective, he has investigated the relationship of physical activity to underlying processes involved in attention, memory, and academic performance. Generally, results from this line of research have suggested that physical activity benefits cognitive operations during tasks that require greater amounts of goal-directed action; an effect that is less pronounced for other, less-complex aspects of cognition. Accordingly, his research indicates that physical activity may have a greater influence on cognitive processes that are more effortful, rather than a general benefit to overall cognitive function.

Philip R Nader, M.D., is emeritus professor of pediatrics at the School of Medicine at the University of California at San Diego (UCSD). Dr. Nader has been engaged in research in health behavior and the influence of families, schools, and communities on child health since the early 1970s. He has led and participated in several multi-disciplinary research teams examining both longitudinal descriptive and randomized population-based interventions for improving physical activity and nutrition. He was a visiting scholar at the Stanford University Institute for Communication Research, a Fogarty International Center fellow, and an investigator on Pacific Rim Indigenous Health. He continues his active community role in San Diego with the San Diego County Childhood Obesity Initiative, and the NICHQ/HRSA Region 9 Healthy Weight Collaborative. He wrote a book and companion curriculum in English and Spanish for parents and providers: *A Legacy of Health: You Can Prevent Childhood Obesity, Practical Ideas from Pregnancy to Adolescence*. Dr. Nader received his M.D. from the University of Rochester.

Kenneth E. Powell, M.D., M.P.H., is the retired chief of Chronic Disease, Injury, and Environmental Epidemiology Section in the Division of Public Health at the Georgia Department of Human Resources in Atlanta. He was an epidemiologist with the Centers for Disease Control and Prevention (CDC) for 25 years and with the Georgia Department of Human Resources for nearly 8 years. Dr. Powell initiated the CDC's epidemiologic work in physical activity and health by leading a consolidation of the scientific literature and setting the public health research agenda. He served on the Physical Activity Guidelines Advisory Committee for the U.S. Department of Health and Human Services (HHS) and is a member of the Physical Activity Work Group for the Task Force for the Guide to Community Preventive Services. He also participated in the development of the first nationwide surveillance of physical activity and the development of the physical activity–related objectives for the HHS *Healthy People 2000.* He is a fellow of the American College of Physicians, American College of Epidemiology, and American College of Sports Medicine. Dr. Powell was a member of the IOM Committee on Progress in Preventing Childhood Obesity and of the Transportation Research Board/IOM Committee on Physical Activity, Health, Transportation, and Land Use. He received an A.B. from Harvard College, an M.P.H. from Harvard School of Public Health, and an M.D. from Northwestern University Medical School. He received postgraduate clinical training in internal medicine at the University of Colorado and the University of Utah.

Leah E. Robinson, Ph.D., is associate professor in the Department of Kinesiology at Auburn University. Her research focuses on three complementary areas: motor skill development, physical activity, and cardiometabolic health. Specifically, Dr. Robinson investigates a) the effects of various environmental and behavioral influences on motor skill competence, physical activity participation, and cardiometabolic health in pediatric populations, and b) the implementation of school-based interventions to promote motor skills and physical activity. She is the principal investigator on a Robert Wood Johnson Foundation–Active Living Research grant entitled "School reform: The role of school and physical education policy on children's physical activity in Alabama's Black Belt Region," and has been funded by the National Institutes of Health and Alabama State Department of Education. Dr. Robinson also completed two National Institutes of Health National Heart, Lung, and Blood Institute fellowship training programs in Behavioral Sleep Medicine (2011-2013) and Cardiovascular Health Disparities (2008-2010). It is essential to identify ways to promote movement while motivating children and youth to be physically active. Thus, the long-term goal of her work is to create environments within schools and communities that contribute to the overall health and development of young and school age children. Dr. Robinson is a Fellow in the AAHPERD Research Consortium and the ACSM Leadership and Diversity Training Program. She is a Holmes Scholar and has received several honors for her scholarship, including The Ohio State University College of Education and Human Ecology New Leader Award (2011), the Mabel Lee Award (2011), the Lolas E. Halverson Motor Development and Learning Young Investigator Award (2010), and the Hally Beth Poindexter Young Scholar (2009). She received a B.S. in physical education and Biology from North Carolina Central University, an M.S. and Ph.D. in sport and exercise science from the Ohio State University.

Emma Sanchez-Vaznaugh, Sc.D., M.P.H., is an assistant professor in the Department of Health Education at San Francisco State University. She received her B.S. from University of San Francisco, MPH from San Francisco State University, and doctorate of science in Social Epidemiology from Harvard University, School of Public Health. Dr. Sanchez-Vaznaugh served as a Kellogg Health Scholar post-doctoral fellow at the Center on Social Disparities in Health, University California, San Francisco-Berkeley. Dr. Sanchez-Vaznaugh is a social epidemiologist whose research focuses on three interrelated strands: social inequalities in health; the extent to which environments and policies impact (or not) population patterns of disease overall and according to race or ethnicity, immigrant and socioeconomic status. Dr. Sanchez-Vaznaugh's research includes studies on the impact of school-based nutrition and physical education policies on population patterns of childhood obesity and fitness overall and across racial or ethnic groups, and the potential role of nearby school environments in the variability of obesity and fitness levels among children attending public schools. She has received research support from The Robert Wood Johnson Foundation's Salud America! research network to prevent obesity among Latino children and Healthy Eating Research, the W.K. Kellogg Foundation, and Kaiser Permanente. Dr. Sanchez-Vaznaugh presently receives research support that focuses on multilevel influences on childhood obesity disparities from the National Heart Lung and Blood Institute.

Sandy Slater, Ph.D., is research assistant professor of health policy and administration at the University of Illinois at Chicago. Dr. Slater's research interests include school and community-level studies designed to examine and reduce modifiable disease risk factors such as physical inactivity, obesity, tobacco use, and substance abuse in minority and underserved populations. She is principal investigator on an NIH grant to study how the built environment and related policies influence adolescent physical activity and ultimately overweight and obesity. As part of the grant she is examining the importance of school and community physical activity settings and opportunities for physical activity on youth physical activity levels, overweight, and obesity. She is also a co-investigator on a national study funded by the Robert Wood Johnson Foundation, the Bridging the Gap program, that aims to improve understanding of how policies, practices and other environmental factors affect youth diet and physical activity. Dr. Slater was recently named a 2012-2013 UIC Institute for Health Research and Policy Research Fellow for her ongoing commitment to the institute's research quality, intellectual community and interdisciplinary mission. Dr. Slater received an M.S. in public service management from DePaul University and a Ph.D. in public health sciences from the University of Illinois at Chicago.

Nicolas Stettler, M.D., M.S.C.E., is a senior managing scientist in the Health Sciences Center for Chemical Regulation and Food Safety at Exponent in Washington, DC. As a pediatrician and epidemiologist trained in nutrition, Dr. Stettler has more than two decades of experience in the scientific and clinical aspects of nutrition, in particular as they relate to child health, obesity, and associated cardiovascular risk factors. A former member of the American Academy of Pediatrics Committee on Nutrition, Dr. Stettler has experience in creating, reviewing, and commenting on the scientific aspects of professional organizations or governments policies related to child and infant nutrition. Through his medical training and teaching of clinical epidemiology at the University of Pennsylvania, where he was associate professor of Pediatrics and Epidemiology, he has a broad understanding of various scientific and clinical aspects of human health and disease. Dr. Stettler's technical expertise includes child nutrition, clinical epidemiology, analyses of existing surveys and medical databases, nutrition epidemiology, measurements of energy balance, obesity treatment and prevention, pediatric clinical care, tropical medicine, child growth and development, WIC and school nutrition policies, food and menu labeling, and public health nutrition. His clinical experience includes caring for the complex medical and nutritional issues of children with various health conditions, including obesity, hypercholesterolemia, cancer, metabolic diseases, diabetes, acute critical conditions, or prematurity. He also served on the IOM Committee on Nutrient Relationships in Seafood: Selections to Balance Benefits and Risks. He received an M.S.C.E. in clinical epidemiology from the University of Pennsylvania and an M.D. from Lausanne Medical School in Switzerland.

Gail Woodward-Lopez, M.P.H., R.D., is associate director of the Atkins Center for Weight & Health at the University of California, Berkeley. She has more than 20 years of experience developing, implementing and evaluating public health programs. The focus of her current work is the evaluation of school and community based programs to prevent childhood obesity. She has served on the evaluation team for two multisector, place-based obesity prevention initiatives and has lead various statewide and multistate projects to evaluate school wellness policy implementation and school nutrition legislation. Currently, she heads up the strategy level evaluation of Kaiser Permanente's Healthy Eating Activity Living initiative in Northern California and focuses on school and community environmental measures for the national, NIH-funded Healthy Communities Study. She is bilingual, has worked extensively with the Latino community in California and Latin America, and has served as a consultant for several international agencies. In addition to publications of her research findings, she published a book on the determinants of obesity and several comprehensive literature reviews on the effectiveness of nutrition and physical activity interventions to improve academic performance, behavior and health outcomes. She received an M.P.H. from the University of California, Berkeley.