

9-2006

## Promoting Physical Activity in Children and Youth: A Leadership Role for Schools: A Scientific Statement From the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) In Collaboration With the Councils on Cardiovascular Disease In the Young and Cardiovascular Nursing

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**Publication Info**

*Circulation*, Volume 114, Issue 11, 2006, pages 1214-1224.

Pate, R. R., Davis, M. G., Robinson, T. N., Stone, E. J., McKenzie, T. L., & Young, J. C. (2006). Promoting physical activity in children and youth: A leadership role for schools: A scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. *Circulation*, 114(11), 1214-1224.

DOI: 10.1161/CIRCULATIONAHA.106.177052

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### A Scientific Statement From the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in Collaboration With the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing

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Schools have played a central role in the provision of physical activity to American children and youth for more than a century. Physical education (PE) has been an institution in American schools since the late 1800s,<sup>1</sup> and school sports have been a growing component of the educational enterprise since the early 1900s. Traditionally, students have engaged in physical activity during recess breaks in the school day and by walking or riding bicycles to and from school. However, as we move into the 21st century, alarming health trends are emerging, suggesting that schools need to renew and expand their role in providing and promoting physical activity for our nation's young people.

Over the past 20 years, obesity rates in US children and youth have skyrocketed. Among children ages 6 to 11, 15.8% are overweight ( $\geq 95$ th percentile body mass index [BMI] for age) and 31.2% are overweight or at risk for overweight ( $\geq 85$ th percentile BMI for age).<sup>2</sup> Among adolescents ages 12 to 19, 16.1% are overweight ( $\geq 95$ th percentile BMI for age) and 30.9% are overweight or at risk for overweight ( $\geq 85$ th percentile BMI for age).<sup>2</sup> The rapid increase in the prevalence of obesity in American young people has occurred concurrently with other disquieting trends. Between 1991 and 2003, enrollment of high school students in daily PE classes decreased from 41.6% to 28.4%.<sup>3</sup> Physically active transport to and from school has declined from previous generations; only one third of trips to school  $\leq 1$  mile and  $< 3\%$  of trips  $\leq 2$

miles are made by walking or biking.<sup>4,5</sup> Even recess has been reduced or eliminated in some elementary schools.<sup>6,7</sup>

Over the years, many public health, medical, and educational authorities have called on schools to give greater attention to provision of physical activity to students. It has often been recommended that PE programs be expanded, and for several decades professional organizations have indicated that the provision of "quality, daily physical education" should be a standard to which schools aspire.<sup>8–11</sup> Unfortunately, few American schools meet that standard, and little evidence indicates that progress has been made toward attaining that goal.<sup>3,12</sup>

The recent rapid increase in childhood obesity rates suggests that a reconsideration of the role of the schools in addressing this problem is necessary and appropriate. The American Heart Association recently issued a scientific statement on overweight in children and adolescents that drew attention to the severity of the problem and identified the importance of prevention and treatment.<sup>13</sup> The Institute of Medicine recently issued a report on prevention of childhood obesity that placed major emphasis on the potential role of schools.<sup>14</sup> Other leading organizations have recommended that schools adopt policies that require daily PE, elementary school recess, and physical activity opportunities before, during, and after school.<sup>15</sup> Over the past decade, several organizations have recommended that children and youth participate in  $\geq 60$  minutes of physical activity each day.<sup>16,17</sup>

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This statement was approved by the American Heart Association Science Advisory and Coordinating Committee on April 7, 2006. A single reprint is available by calling 800-242-8721 (US only) or writing the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596. Ask for reprint No. 71-0367. To purchase additional reprints: Up to 999 copies, call 800-611-6083 (US only) or fax 413-665-2671; 1000 or more copies, call 410-528-4121, fax 410-428-4264, or e-mail kelle.ramsay@wolterskluwer.com. To make photocopies for personal or educational use, call the Copyright Clearance Center, 978-750-8400.

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(*Circulation*. 2006;114:1214-1224.)

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*Circulation* is available at <http://www.circulationaha.org>

DOI: 10.1161/CIRCULATIONAHA.106.177052

Recently, an expert panel conducted a comprehensive review of the literature on physical activity in school-age youth and recommended that children and youth participate in  $\geq 60$  minutes per day of physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities.<sup>18</sup> The panel's report suggested that the  $\geq 60$  minutes can be accumulated throughout the day in school, during PE and recess, during intramural sports, and in before-school and after-school programs.<sup>18</sup>

It appears that the time has come to consider a markedly expanded role for schools in providing physical activity to our children and youth. Schools could become the central element in a community system that ensures that students participate in enough physical activity to develop healthy lifestyles. Although nutrition also clearly plays an important role in the promotion of health and prevention of obesity,<sup>13</sup> the present document focuses on physical activity. It describes a renewed and expanded role for schools in the area of physical activity. Furthermore, it addresses the current state of affairs and summarizes the evidence supporting schools' potential for effectively providing and promoting physical activity. In addition, this statement recommends several key changes in school policy and practice.

### The Current State of Affairs

The status of physical activity participation by children and youth in the United States and the status of the schools' promotion of physical activity are monitored systematically by the Centers for Disease Control and Prevention. The Youth Risk Behavior Surveillance System (YRBSS) is a survey of high school youth conducted regularly through national, state, and local education and health agencies.<sup>12</sup> The system collects self-reported data related to 6 health-risk behaviors, including physical activity, in nationally representative samples of youth. In addition, the School Health Policies and Programs Study (SHPPS) regularly assesses school health policies and programs at the state, district, school, and classroom levels.<sup>19</sup> It is likely that vigorous physical activity is overreported and moderate physical activity is underreported in the YRBSS data.<sup>20</sup> However, the YRBSS data are the only national surveillance data currently available for this population.

### Participation in Physical Activity

Children are more active than adults, but their activity levels decline as they move toward adolescence, and significant numbers of young people do not participate in recommended levels of physical activity.<sup>21</sup> The 2003 YRBSS provides documentation of the inadequate levels of physical activity among high school-age youth. Thirty-seven percent of students did not participate in  $\geq 20$  minutes of vigorous physical activity on  $\geq 3$  of the previous 7 days, and black, Hispanic, and female students were less likely than their white male counterparts to participate in vigorous physical activity at recommended levels. More than one third (38.2%) of students spent  $> 3$  hours per day watching television.<sup>12</sup>

### Physical Education

PE is a mandated part of the school curricula in most states,<sup>19,22</sup> and daily PE is recommended by numerous enti-

ties.<sup>5,21,23</sup> In addition to providing opportunities for physical activity, PE has traditionally pursued objectives that are not necessarily directly related to health outcomes. These include objectives in the cognitive, social, and emotional domains. According to the 2003 YRBS, 55.7% of high school students were enrolled in PE classes, 28.4% attended PE class daily, and 80.3% of those attending PE classes spent  $\geq 20$  minutes being active during class.<sup>12</sup> Enrollment in PE remained steady from 1991 through 2003; however, the percentage of students participating in daily PE classes decreased significantly from 1991 to 1995 (from 41.6% to 25.4%) and rose only slightly from 1995 to 2003 (from 25.4% to 28.4%).<sup>3</sup>

The 2000 SHPPS report addressed PE, standards and guidelines, evaluation, elementary school recess, intramurals, and interscholastic sports.<sup>19</sup> At the middle school level, the study found that only 6.4% of middle schools provided daily PE for the entire school year, whereas 15.5% offered daily PE (or its equivalent) for at least half the school year, and 34.4% offered it 3 days per week for at least half of the school year.<sup>19</sup> Only a few studies other than SHPPS have focused on middle school PE. One of those found that PE in middle schools ranged from a low of 54 hours per year (grades 6 to 8, South Carolina) to a high of 156 hours per year (grades 6 to 8, California).<sup>24</sup> Direct observations of individuals in PE classes in both elementary<sup>25,26</sup> and secondary<sup>27</sup> schools indicated that students typically engage in moderate-to-vigorous physical activity (3.0 to 5.9 METS)  $< 40\%$  of PE class time, far short of the 50% recommended by the *Healthy People 2010* objectives.<sup>5</sup>

### Enrollment Requirements

At the state level, 78.4% of states required elementary schools to provide PE, whereas 85.7% required middle schools and 82.4% required high schools to do so.<sup>19</sup> At the school level, a large majority ( $> 95\%$ ) of schools required that PE be offered in the curriculum. Requirements for student participation in PE, however, were lower in the higher grades. Forty percent of elementary schools required students to participate in PE, but only 5.4% of high schools required that seniors enroll.

### Time Requirements

Only 8% of elementary schools, 6.4% of middle/junior high schools, and 5.8% of senior high schools provided PE daily or allocated the recommended amount of time per week (150 minutes for elementary schools; 225 minutes for middle/junior and senior high schools).<sup>19</sup> Participation in PE also was reduced by substitutions of other activities for PE and student exemptions. Seventeen percent of elementary schools allowed exemptions from required PE courses because of competency test scores or participation in other school, community sports, or community service activities. At the middle and high school levels, 25.3% and 40%, respectively, allowed students to be exempt from PE for the same reasons, as well as for enrollment in other school courses and participation in school sports and vocational training.<sup>19</sup> Although these substitute activities provide physical activity in some cases, they do not replace the educational aspects of PE that are designed to develop the knowledge, behavioral skills,

and motor skills necessary to develop and maintain a physically active and healthy lifestyle.

### **Physical Education Content**

SHPPS reported that the content of PE included a wide array of activities, but traditional activities predominated. For example, 98.2% of schools taught group or team activities, 97.4% taught individual or partnered activities, 69.3% taught dance activities, and 12.5% taught aquatic activities.<sup>19</sup> Eighty-four percent of elementary schools, 77.4% of middle/junior high schools, and 79.5% of senior high schools reported following state or national standards in the PE curriculum.

### **Teacher Qualifications and Class Size**

A significant percentage of states, districts, and schools have established requirements for teacher qualifications and class size for PE. The majority of schools (80.6%) required newly hired PE teachers to have undergraduate or graduate training in PE or a related field, and 73.2% required new teachers to be state certified, licensed, or endorsed in PE.<sup>19</sup> Funding for staff development in PE was offered in 66% of the states and 80.7% of the districts. In 89.3% of the schools, physical educators had received staff development on at least 1 PE topic in the previous 2 years. However, the survey did not document whether or not teachers used the skills learned in PE staff development in their PE classes. Of the schools with PE requirements, 41.9% had a maximum student-to-teacher ratio. The average maximum ratio was 28:1 for elementary schools, 31:1 for middle/junior high schools, and 33:1 for senior high schools. Large class sizes, common in many PE programs, are associated with reduced levels of student physical activity.<sup>19</sup>

### **Recess, Intramurals, and Other School Programs**

SHPPS found that a majority (71.4%) of elementary schools provide regularly scheduled recess for grades K to 5.<sup>19</sup> Few states require that schools provide a recess break, but 46.3% of school districts require schools to do so. Recess periods do not necessarily require or even encourage activity; in fact, some schools cited injuries and supervision issues as reasons for restricting recess and physical activity during recess. Nearly half (49%) of schools offered physical activity clubs or intramurals, and more than half of students participated in at least 1 club or intramural team. Few schools offered transportation home after club or intramural programs, and these activities may be accessible only to students who can resolve transportation needs. The activities offered in intramural programs tend to be traditional sports programs. Although these programs have not been formally studied, physical activity professionals believe that the students who elect to participate tend to be those who are already more active.

### **School Sports**

Data from the 2003 YRBSS survey indicate that 57.6% of students in grades 9 to 12 played on at least 1 sports team during the prior year.<sup>12</sup> The National Federation of High School Activities Associations reports that 53% of all high school students, approximately 7 million students, participate in high school sports teams. Of this number, approximately 4 million are boys and 3 million are girls.

The SHPPS survey found that interscholastic sports teams were available in a majority of middle schools and high schools, but intramural activities or physical activity clubs were offered by only about half (49.0%) of those schools.<sup>19</sup> As a result, nonathletes have fewer school-based opportunities for after-school physical activity than do students who are interested in competitive athletics. The National Middle Schools Association reported that approximately 77% of middle schools offered interscholastic sports programs.

## **Evidence: Physical Activity During the School Day and Within the School Program**

### **Physical Education**

Perhaps because schools have been unable to provide sufficient time and resources for students to meet all the objectives of standard PE, the concept of “health-related PE” has been promoted.<sup>28,29</sup> A major goal of health-related PE is the development of lifelong physical activity. As such, the priority for PE is seen as providing opportunities for students to engage in enjoyable physical activity, to become physically fit, and to learn generalizable motor and behavioral skills.<sup>30</sup>

A number of carefully designed studies that incorporated health-related PE concepts and used physical activity in PE classes as the primary outcome have been conducted in the United States.<sup>31–33</sup> In most of these, PE was one component of a multidisciplinary and multifaceted intervention package. These studies moved beyond the focus on knowledge and attitudes that characterized earlier health behavior change studies and used behavioral models from social psychology as the theoretical underpinning for changing behaviors, including physical activity. Many also focused on a Coordinated School Health Program model, so that multiple environmental components and policies supported a topic addressed in the classroom.<sup>21,34,35</sup> In addition, the school-based research field advanced to using more robust research designs, selection of more appropriate theoretical models, improved measurement approaches, and more appropriate analysis strategies for the multiple health behaviors and multiple component programs being implemented. Studies that adopted these approaches to promotion of physical activity in schools included the Child and Adolescent Trial for Cardiovascular Health (CATCH),<sup>37,38</sup> Go for Health,<sup>27,39</sup> Lifestyle Education for Activity Program (LEAP),<sup>40,41</sup> Middle School Physical Activity and Nutrition (M-SPAN),<sup>42,43</sup> Pathways,<sup>44</sup> Sports, Play, and Active Recreation for Kids (SPARK),<sup>45,46</sup> and Trial of Activity for Adolescent Girls (TAAG).<sup>24,47</sup> Several comprehensive reviews summarize many of these studies.<sup>32,33,48,49</sup>

The majority of physical activity intervention studies have been conducted at the elementary school level and have involved grades 3, 4, 5, and 6 in some combination.<sup>32,48,49</sup> Most of these studies were designed to intervene on multiple cardiovascular disease behavioral risk factors—primarily physical activity, sedentary behaviors, and dietary behaviors. Most involved changes to PE, the classroom health curriculum, and the food service program and included some family, community, and policy change components. In most, existing school staff were trained to implement the interventions,



although the Stanford Adolescent Heart Health Program was implemented by project staff from outside the school, and SPARK was implemented by both outside PE specialists and school staff who were trained in the intervention.<sup>46,50</sup> Some programs increased both the number of minutes and the proportion of lesson time that students were vigorously active in PE classes.<sup>38,45</sup> For example, without a modification to either the frequency or the duration of lessons, moderate-to-vigorous physical activity during PE increased from 37% to 52% in CATCH intervention schools.<sup>38</sup>

Middle school studies include M-SPAN, Planet Health, and the Oslo Youth Study. In the M-SPAN intervention schools, moderate-to-vigorous physical activity in PE classes increased by 18%.<sup>42</sup> The results of Planet Health showed that the prevalence of obesity was reduced among girls, but not boys, as compared with controls, and that a reduction in TV-watching predicted a change in obesity.<sup>51,52</sup> The Oslo Youth Study addressed multiple cardiovascular health behaviors and used multiple intervention components in grades 5 and 7, with follow-up in grade 7 and at 12 years after the intervention. Results showed an increase in knowledge and in frequency of vigorous physical activity, which persisted to the 12-year follow-up for boys but not for girls.<sup>53</sup> Fitness also was increased for boys in the intervention group. TAAG, a national multisite randomized intervention study, is currently under way at 6 sites across the country. It is testing a school and community multicomponent intervention designed to prevent the decline in physical activity in middle school girls.<sup>47</sup>

Only a few studies have tested programs designed to promote physical activity in high school students. The Stanford Adolescent Heart Health Program was a curriculum-based program designed to improve physical activity, nutrition, smoking, and stress behaviors. Students in the intervention schools reported significant knowledge gains and increases in regular exercise.<sup>50,54</sup> Positive treatment effects also were observed for BMI, skinfolds, and resting heart rate. LEAP was a comprehensive physical activity intervention designed to change the instructional program and school environment to increase support of physical activity for ninth-grade girls. LEAP focused on 6 components of the Coordinated School Health Program model: PE, health education, school environment, school health services, faculty/staff health promotion, and family/community involvement. After the 1-year intervention, the prevalence of vigorous physical activity was significantly higher in the LEAP intervention schools than in the control schools.<sup>40</sup> Other high school studies that addressed physical activity through multiple component interventions include the Australia School Project<sup>55</sup> and Slice of Life.<sup>56</sup> The Class of 89 Study,<sup>57</sup> which was part of a larger community study, had multiple intervention components and addressed multiple cardiovascular health behaviors. It involved grades 6 to 12, with follow-up through grade 12. The results showed smaller declines in physical activity for intervention students, with the most significant effect on girls. The study also showed that physical activity tracks during youth (ie, high activity at one age is associated with high activity at an older age).

Most of the interventions to date have focused on increasing physical activity during the school day. It is possible that students who increase their physical activity levels during the school day may compensate by decreasing out-of-school physical activity. Additional research is needed to clarify the relationship between in-school and out-of-school activity. In addition, it has not yet been demonstrated that school-based interventions can reduce BMI or the prevalence of overweight.

Very few studies have examined the long-term effects of health-related PE interventions, either the maintenance of physical activity in study children or the maintenance of programs within a school.<sup>58,59</sup> SPARK-trained classroom teachers maintained student activity levels at about 89% of their intervention rates 1.5 years after intervention,<sup>45</sup> and some effects of the CATCH intervention remained after 5 to 7 years.<sup>60</sup> In both studies, moderate levels of physical activity were retained in school PE with more success than were vigorous levels, and this reduction in vigorous activity was accompanied by teachers' reducing fitness activities and increasing time for game play. In the CATCH study, <50% of the teachers conducting PE in the schools at follow-up had received CATCH PE training, suggesting that staff development in PE needs to occur regularly. A study of the sustainability of SPARK found that a large majority of schools that received SPARK training continued to implement the program up to 4 years after training.<sup>61</sup> Sustainability of interventions is associated with increased training, support within the school (especially from the principal), and availability of adequate equipment.<sup>61,62</sup>

The effects of different teacher preparation programs on the abilities of physical educators to develop and implement health-related PE programs also are not known. An evaluation of these programs is in order because PE currently provides students with insufficient amounts of physical activity and adults graduating from schools do not engage in sufficient physical activity. McKenzie and Kahan<sup>63</sup> have suggested that colleges' physical education teacher education (PETE) programs, in addition to teaching PE content and pedagogical skills, should expand to prepare future physical educators to develop natural linkages to physical activity and public health. An adoption of a public health approach would require a modification to the current traditional coursework, which emphasizes the biological sciences and school-based training experiences. It would require those who are preparing to become PE teachers to spend time in community-based settings, where they could master behavioral approaches to enhancing youth physical activity, practice communication and collaboration skills, and work with diverse learners.

### **Recess and Active Transport to School**

Although little research specifically documents the impact of recess, common sense suggests that, at the very least, providing a recess period gives an additional opportunity for physical activity. The research has suggested that recess has educational and developmental benefits.<sup>64,65</sup> Various organizations and experts have called for regular recess periods in elementary schools (eg, the American Association for the Child's Right to Play, the Centers for Disease Control and

Prevention, and the American Academy of Pediatrics). Guidelines for recess include not replacing PE with unstructured recess, scheduling recess periods so that they do not precede or follow PE, encouraging physical activity during recess, and ensuring the availability of safe facilities and equipment.

Little is known about the contribution of active transport to school to overall physical activity. Trips to school by walking and biking have decreased in recent years,<sup>66</sup> and most studies of walking to school have been based on parent reports.<sup>67,68</sup> A recent study used direct observation to determine the prevalence of walking and biking to school at 8 urban and suburban schools in 1 city. The vast majority of students rode a school bus or were driven to school; only 5% walked or rode a bike to school.<sup>69</sup> A small number of interventions have been designed to increase the prevalence of walking to school.<sup>70</sup>

### **School Sports**

Participation in sports has long been assumed to provide health benefits to young athletes. Despite some questions about this assumption,<sup>71–73</sup> a number of studies have shown that health benefits accrue to young people who participate in sports. An analysis of the 1997 YRBSS data found that students who reported participating in 1 or more sports teams were more likely to report multiple positive health behaviors and less likely to report negative health behaviors than students who did not participate in sports.<sup>74</sup> The association was stronger for white students than for black and Hispanic students. Other studies have found increased physical fitness and lower body fat<sup>75</sup> and lower prevalence of a number of health risk behaviors in students who participate in sports.<sup>76,77</sup> Some negative health behaviors may be associated with sports participation, and these associations may vary by race, ethnicity, and gender.<sup>74</sup>

School intramural and club programs at middle and high school levels have not been studied extensively. The available programs vary widely in terms of numbers of students served, types of activities offered, and the possible impact on physical activity levels. Issues that must be addressed in planning and implementing physical activity–based programs include transportation, qualified supervision, selection of activities to meet student needs and interests, and access to appropriate facilities, often in competition with interscholastic sport needs. Many programs are highly dependent on teacher interest and availability. Often teachers volunteer to sponsor or supervise student clubs. Although stipends are available for some student activity support, they may not be available for physical activity–based clubs. The additional potential liability of physical activity also may deter schools from sponsoring such activities.

Although interscholastic sports provide more than half of the student population with significant amounts of physical activity, the other half of the students may be very sedentary and represent those who most need greater amounts of physical activity. In fact, in large schools, access to interscholastic sports programs may be limited to a much smaller percentage of the student body. Most athletic teams are of similar size, and although large schools may offer more sports than smaller ones, the total number of students that can be

served does not increase proportionately to enrollment. In addition, highly competitive sports programs may not be reinforcing positive health aspects of sports participation. Teacher certification was once a prerequisite for school coaches, but this credential is now required in many fewer states. Coach qualifications are often focused on win-loss records. When education or training is required, it often focuses on care for and prevention of athletic injuries. However, efforts to promote higher qualifications and education for school coaches have increased recently.

### **Physical Activity in the Academic Classroom**

Recently, several programs have been designed to incorporate physical activity into the academic curriculum and allow students to be physically active during classroom instruction. One example is TAKE 10! Stewart et al<sup>78</sup> reported the results of a small study that evaluated exercise intensity levels and estimated energy expenditure by first, third, and fifth graders participating in TAKE 10! activities. Positive findings were reported for each age group. Pathways used a similar exercise break box designed to be used by the classroom teacher any time during the day as an in-classroom exercise break.<sup>79</sup> Process evaluation showed high rates of use by the classroom teachers implementing the activities.

### **Increased Emphasis on Academic Achievement**

With the adoption of the No Child Left Behind Act<sup>80</sup> and increases in mandated high-stakes testing across the United States, districts are attempting to allocate more time to “core” subjects such as math and reading. As a result, time for students to engage in physical activity during recess and during structured PE is being threatened. This is occurring in an unknown number of schools across the nation, even though studies have shown that no meaningful relationship exists between time allocated for PE and academic achievement.<sup>81</sup> Additionally, some intervention studies have shown that increasing time for structured PE did not reduce students’ academic achievement and may have even contributed to it.<sup>82,83</sup> Van der Mars recently reviewed studies in the area and concluded that, on the basis of the best available knowledge, it appears that (1) increased time in PE does not impede students’ classroom academic performance, (2) increased time in PE may contribute slightly to academic performance, and (3) decreased time for PE in favor of academic work does not necessarily result in improved academic performance.<sup>84</sup>

## **Evidence: Physical Activity Beyond the School Day**

### **Reducing Inactivity**

Two randomized controlled trials have shown some promise of classroom-based screen time reduction curricula to prevent inactivity and obesity. Gortmaker and colleagues<sup>52</sup> examined the effects of the 2-year Planet Health curriculum that focused on decreasing television viewing as well as decreasing high-fat food intake, increasing fruit and vegetable intake, and increasing moderate and vigorous physical activity among students in grades 6 to 8. In a 10-school randomized trial, boys and girls in the intervention schools reported reducing their television viewing more than controls. The

prevalence of obesity (defined by age-specific and sex-specific thresholds using a combination of BMI and triceps skinfold thickness) decreased significantly among intervention girls, but no significant effects on obesity were observed in boys. No significant changes occurred in self-reported physical activity. Although this study did not test the effects of reducing screen viewing behaviors alone, reductions in television viewing were associated with changes in obesity and were found to “mediate” the intervention effect in a regression analysis.<sup>52</sup>

Robinson<sup>85</sup> completed a school-based study specifically designed to examine the causal relationship between reducing screen time and body fatness. This randomized controlled trial involved third and fourth graders in 2 sociodemographically and scholastically comparable public elementary schools in San Jose, California. The 18-lesson Stanford Student Media Awareness to Reduce Television (SMART) classroom curriculum aimed to reduce television, videotape, and video game use, without specifically promoting more active behaviors as substitutes, therefore isolating the effects of reduced television viewing behaviors alone, apart from promotion of specific alternatives. Over a 7-month period, the curriculum was successful at significantly decreasing children’s television viewing and video game use, BMI, triceps skinfold thickness, and waist circumference, as compared with controls.<sup>85</sup> No statistically significant differences in reported levels of moderate and vigorous physical activity or a test of cardiorespiratory fitness were detected among schools.

Despite the lack of clear effects of school-based screen time–reduction curricula on physical activity, some results from other settings suggest that reducing screen time may play a role in promoting physical activity in children. In laboratory studies, for example, Epstein and colleagues have found that obese children increased physical activities when access to sedentary activities (including screen viewing) was limited<sup>86</sup> or when they were either negatively reinforced for sedentary activities or positively reinforced for limiting them.<sup>87</sup> Epstein and colleagues also examined the effects of manipulating sedentary behaviors among 13 nonobese 8- to 12-year-olds in their home settings. When time in sedentary behaviors was increased by an average of 50% above baseline, physical activity trended lower. However, when the children reduced their sedentary behavior time by about half, there was no associated change in physical activity.<sup>88</sup> Some additional evidence comes from a randomized controlled pilot and feasibility trial of counseling to reduce screen time among 28 families with 7- to 12-year-old black children receiving primary care at a low-income, urban community clinic. Ford et al<sup>89</sup> found that families randomized to receive counseling plus a behavioral intervention, including goal setting and an electronic television time manager, reported significant increases in organized physical activity and a trend toward greater increases in playing outside, as compared with families receiving brief counseling alone.

In sum, despite the demonstrated promise of screen time–reduction curricula to prevent obesity, experimental data do not yet support a direct link between screen time–reduction curricula and increased physical activity. Additional experi-

mental studies, using more sensitive and valid measures of physical activity, are needed to adequately test and better understand the effects, if any, of screen time–reduction curricula on physical activity.

### After-School Programs

The after-school time period represents one of the largest blocks of discretionary time in a child’s typical day. As a result, after-school programs are considered to have great potential to provide opportunities for increasing physical activity.<sup>14</sup> After-school programs to promote physical activity include competitive sports teams, clubs, classes or training, recreational and intramural sports, or nonathletic activities that involve physical activities (eg, outdoor education, some community service programs). 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<sup>90</sup> 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.

Despite the logic of offering more physical activity during after-school hours, data are not yet available to show that more after-school activity programs result in increases in total daily physical activity or associated health benefits. It is unknown whether students compensate for increased after-school physical activity by being less active during the rest of the day or during other days of the week. However, studies of structured vigorous physical training in obese children and adolescents during the after-school hours have demonstrated improvements in some physiological risk factors.<sup>91,92</sup>

### School–Community Linkages

Traditionally, the role of schools in providing and promoting physical activity has been during the school day (eg, PE, recess) and/or on the school campus immediately after school (eg, interscholastic and intramural sports). Although there have been exceptions, school-based programs usually have been sponsored by the schools themselves and supervised by school employees. However, enormous potential appears to exist for schools to expand their role in providing students with additional physical activity by building institutional relationships with community-based providers of physical activity. Such relationships could manifest in several ways. Schools can make their facilities available to community-based organizations during after-school, weekend, and summer periods. Also, schools can collaborate with community organizations in promoting physical activity programs to students and their parents. Because transportation can be a barrier to students’ participation in after-school programs, schools can collaborate with community organizations, including transit authorities, to ensure that students have the opportunity to participate in programs beyond the school day.

Although school–community linked physical activity programs offer much promise, little research has addressed the efficacy of such initiatives for increasing physical activity in children and youth. One notable exception is TAAG, a large-scale randomized trial involving 36 schools at 6 study



sites across the country and sponsored by the National Heart, Lung, and Blood Institute.<sup>47</sup> This large-scale study is examining the effects of a school–community linked intervention on overall physical activity in middle school girls. Intervention strategies emphasize enriching the after-school physical activity programming environment of middle schools, with particular focus on the needs and interests of girls. Although the results of this study are not yet available, experience gained in TAAG should provide important information on ways in which schools and community agencies can collaborate in meeting the physical activity needs of youth. Various efforts have been made to allow community programs to benefit from the availability of school facilities, but these efforts have not always resulted in positive linkages. There are many opportunities for collaborative programs and for schools to promote physical activity opportunities available in the community. Leveraging the resources of schools and organizations in the community can provide expanded opportunities for improving the health status of children and families.

### Policy and Practice Recommendations

Children and youth spend more time in schools than any other setting with the exception of their homes. Accordingly, if young people are going to engage in adequate amounts of physical activity, it is essential that schools systematically and effectively provide and promote participation in physical activity. Most schools already have programs that provide students with some physical activity, but population trends for obesity suggest that American children and youth need more physical activity than their current levels. Although parents, community agencies, and healthcare providers share the responsibility for ensuring that young people are physically active, schools are uniquely positioned to address this critical public health concern. The following recommended school policies and practices, if implemented nationally, would move America's schools into an appropriate position of leadership in providing our nation's children and youth with the physical activity they need for lifelong health.

1. Schools should ensure that all children and youth participate in a minimum of 30 minutes of moderate-to-vigorous physical activity during the school day; this includes time spent being active in PE classes. Additional physical activity should be provided through extracurricular and school-linked community programs.
2. Schools should deliver evidence-based health-related PE programs that meet national standards to students at all school levels. These programs should provide substantial amounts of moderate-to-vigorous physical activity (ie, 50% of class time) and should teach students the motor and behavioral skills needed to engage in lifelong physical activity.
3. States and school districts should ensure that PE is taught by certified and highly qualified PE teachers at all school levels.
4. States should hold schools accountable for delivering PE programs that meet national standards for quality and quantity (ie, 150 minutes per week for grades K to 8 and 225 minutes per week for grades 9 to 12). Specifically, each state should include PE in its core

educational accountability system and should incorporate PE into its system national standards for curriculum and instructional quality.

5. Schools should expand physical activity opportunities by providing clubs, lessons, intramural sports, and interscholastic sports programs that meet the physical activity needs and interests of all students. Coaches and other leaders of such programs should be well qualified and, where appropriate, certified.
6. Schools should promote walking and bicycling to school, and school leaders should work with local governments to ensure that students have safe routes for walking and bicycling to school.
7. Child development centers and elementary schools should provide children with at least 30 minutes of recess during each school day.
8. Schools should provide evidence-based health education programs emphasizing behavioral skills focused on increasing physical activity and decreasing sedentary behaviors.
9. Colleges and universities should provide professional preparation programs that produce teachers who are highly qualified to deliver evidence-based PE and health education programs.

### Summary

Schools are potentially attractive settings in which to promote positive health behaviors because students spend large amounts of time in the school environment, elements of the traditional school curriculum relate directly to health, and schools typically provide extracurricular programs that can promote health. Although schools are under increasing pressure to increase student scores on standardized tests, the recent dramatic rise in the prevalence of obesity in children and adolescents in the United States suggests that there is a pressing need for the nation's schools to systematically and effectively promote behaviors that will prevent the development of overweight. Physical activity is a key determinant of weight status. Disquieting trends in other segments of American society, such as increased "screen time" and decreased reliance on physically active transport, indicate that the schools should assume a leadership role in ensuring that young people engage in adequate amounts of physical activity each day. This statement advances policy initiatives that, if fully implemented, would position American schools as societal leaders in addressing an enormous public health challenge.

### Appendix

#### Terms and Definitions

*Physical activity*—any body movement produced by skeletal muscles that results in energy expenditure.<sup>93</sup>

*Moderate-to-vigorous physical activity*—activity that causes some increase in breathing and heart rate, an activity level usually associated (in a healthy person) with brisk walking, dancing, swimming, or cycling on flat terrain. Energy expenditure is usually at the level of  $\geq 3$  METS (metabolic equivalents), and the activity expends  $\geq 3.5$  kcal/min.<sup>93</sup>

*Exercise*—physical activity that is planned or structured, involving repetitive body movements done to improve or maintain one or more of the components of physical fitness (ie, aerobic fitness,

muscular strength, muscular endurance, flexibility, and/or body composition).<sup>93</sup>

*Physical fitness*—a set of physical attributes related to a person's ability to perform activities that require aerobic fitness, endurance, strength, and flexibility. A person's level of physical fitness is a determined by a combination of regular physical activity and genetic attributes.<sup>93</sup>

*Overweight*—Overweight in children and adolescents is defined as  $\geq 95$ th percentile BMI-for-age, meaning that 95% of children of the same age and gender have a lower BMI. "At risk of overweight" is defined as  $\geq 85$ th percentile and  $< 95$ th percentile BMI-for-age.<sup>94</sup>

*Physical education*—a school-based program that provides students with opportunities to be physically active and to acquire the skills and knowledge needed to establish and sustain an active lifestyle.<sup>95</sup>

*Health-related physical education*—a type of physical education program that emphasizes in-class participation in moderate-to-vigorous physical activity and mastery of motor and behavioral skills that promote lifelong physical activity.

*Prevalence*—the percentage of a population that is affected with a particular condition or disease at a given time.<sup>96</sup>

*Intervention*—a program or set of actions designed to modify a health outcome.

## Acknowledgment

The authors thank Gaye Groover Christmus, MPH, for expert editorial assistance in the preparation of this Scientific Statement.

## Disclosures

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit.

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Deborah Rohm Young	University of Maryland	None	None	None	None	None	None

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit.

## References

- Wuest DA, Bucher CA. Historical foundations of physical education and sport. In: Wuest DA, Bucher CA, eds. *Foundations of Physical Education and Sport*. 13th ed. Boston, Mass: WCB/McGraw Hill; 1999:146–193.
- Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *JAMA*. 2004;291:2847–2850.
- Centers for Disease Control and Prevention. Participation in high school physical education—United States, 1991–2003. *MMWR Morb Mortal Wkly Rep*. 2004;53:844–847.
- Centers for Disease Control and Prevention. Kids Walk-to-School: Resource Materials: Fact Sheet. Available at: [http://www.cdc.gov/nccdphp/dnpa/kidswalk/fact\\_sheet.htm](http://www.cdc.gov/nccdphp/dnpa/kidswalk/fact_sheet.htm). Accessed March 10, 2005.
- US Department of Health and Human Services. *Healthy People 2010*, conference ed. Washington, DC: US Department of Health and Human Services; 2000.
- Johnson D. Many schools putting an end to child's play. *New York Times*. April 7, 1998:A1.
- Waite-Stupinsky S, Findlay M. The fourth R: recess and its link to learning. *The Educational Forum*. 2001;66:16–25.
- American Heart Association. Exercise (physical activity) and children: American Heart Association scientific position. Available at: [www.americanheart.org/presenter.jhtml?identifier=4596](http://www.americanheart.org/presenter.jhtml?identifier=4596). Accessed August 1, 2006.
- American Academy of Pediatrics. Physical fitness and activity in schools. *Pediatrics*. 2000;105:1156–1157.
- Fletcher GF, Balady G, Blair SN, Blumenthal J, Caspersen C, Chaitman B, Epstein S, Sivarajan Froelicher ES, Froelicher VF, Pina IL, Pollock ML; Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association. Statement on exercise: benefits and recommendations for physical activity programs for all Americans. *Circulation*. 1996;94:857–862.
- National Association for Sport and Physical Education. *Physical Education Is Critical to a Complete Education*. Reston, Va: National Association for Sport and Physical Education; 2001.
- Grunbaum JA, Kann L, Kinchen S, Ross J, Hawkins J, Lowry R, Harris WA, McManus T, Chyen D, Dollins J; Centers for Disease Control and Prevention. Youth Risk Behavior Surveillance—United States, 2003 [published corrections appear in *MMWR Morb Mortal Wkly Rep*. 2004;53:536; *MMWR Morb Mortal Wkly Rep*. 2005;54:608]. *MMWR Surveill Summ*. 2004;53:1–96.
- Daniels SR, Arnett DK, Eckel RH, Gidding SS, Hayman LL, Kumanyika S, Robinson TN, Scott BJ, St Jeor S, Williams CL. Overweight in children and adolescents: pathophysiology, consequences, prevention, and treatment. *Circulation*. 2005;111:1999–2012.
- Institute of Medicine (US) Committee on Prevention of Obesity in Children and Youth. Kaplah JP, Liverman CT, Kraak VI, eds. *Preventing Childhood Obesity: Health in the Balance*. Washington, DC: Institute of Medicine; 2004:237–284.
- Model School Wellness Policies. National Alliance for Nutrition and Activity. Available at: <http://www.schoolwellnesspolicies.org>. Accessed May 3, 2005.
- Biddle S, Sallis JF, Cavill NA. *Young and Active? Young People and Health Enhancing Physical Activity—Evidence and Implications: A Report of the Health Education Authority Symposium, Young and Active?* London, UK: Health Education Authority; 1998.
- US Department of Health and Human Services, US Department of Agriculture. *Dietary Guidelines for Americans, 2005*. Washington, DC: US Department of Health and Human Services/US Department of Agriculture; 2004.
- Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM, Rowland T, Trost S, Trudeau F. Evidence based physical activity for school-age youth. *J Pediatr*. 2005;146:732–737.
- Burgeson CR, Wechsler H, Brener ND, Young JC, Spain CG. Physical education and activity: results from the School Health Policies and Programs Study 2000. *J Sch Health*. 2001;71:279–293.
- Pate RR, Freedson PS, Sallis JF, Taylor WC, Sirard J, Trost SG, Dowda M. Compliance with physical activity guidelines: prevalence in a population of children and youth. *Ann Epidemiol*. 2002;12:303–308.
- Centers for Disease Control and Prevention. Guidelines for school and community programs to promote lifelong physical activity among young people. *MMWR Recomm Rep*. 1997;46:1–36.
- National Association for Sport and Physical Education, American Heart Association. *2006 Shape of the Nation Report: Status of Physical Education in the USA*. Reston, Va: National Association for Sport and Physical Education; 2006.
- US Department of Health and Human Services, US Department of Education. *Promoting Better Health for Young People Through Physical Activity and Sports: A Report to the President from the Secretary of Health and Human Services and the Secretary of Education*. Washington, DC: US Department of Health and Human Services/US Department of Education; 2000.
- Moe SG, Pickrel J, McKenzie TL, Strikmiller PK, Coombs D, Murrie D. Using school-level interviews to develop a multisite PE intervention program. *Health Educ Behav*. 2006;33:52–65.
- Nader PR. Frequency and intensity of activity of third-grade children in physical education. *Arch Pediatr Adolesc Med*. 2003;157:185–190.
- McKenzie TL, Feldman H, Woods SE, Romero KA, Dahlstrom V, Stone EJ, Strikmiller PK, Williston JM, Harsha DW. Children's activity levels and lesson context during third-grade physical education. *Res Q Exerc Sport*. 1995;66:184–193.
- Simons-Morton BG, Taylor WC, Snider SA, Huang IW, Fulton JE. Observed levels of elementary and middle school children's physical activity during physical education classes. *Prev Med*. 1994;23:437–441.
- Sallis JF, McKenzie TL. Physical education's role in public health. *Res Q Exerc Sport*. 1991;62:124–137.
- Pate RR, Hohn RC, eds. *Health and Fitness Through Physical Education*. Champaign, Ill: Human Kinetics; 1994.
- McKenzie TL. Health-related physical education: physical activity, fitness and wellness. In: Silverman SJ, Ennis D, eds. *Student Learning in Physical Education: Applying Research to Enhance Instruction*. Champaign, Ill: Human Kinetics; 2003.
- Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, Stone EJ, Rajab MW, Corso P. The effectiveness of interventions to increase physical activity: a systematic review. *Am J Prev Med*. 2002;22(4 suppl):73–107.
- Stone EJ, McKenzie TL, Welk GJ, Booth ML. Effects of physical activity interventions in youth: review and synthesis. *Am J Prev Med*. 1998;15:298–315.
- Hayman LL, Williams CL, Daniels SR, Steinberger J, Paridon S, Dennison BA, McCrindle BW; Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. Cardiovascular health promotion in the schools: a statement for health and education professionals and child health advocates from the Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation*. 2004;110:2266–2275.
- Allensworth DD, Kolbe LJ. The comprehensive school health program: exploring an expanded concept. *J Sch Health*. 1987;57:409–412.
- Committee on Comprehensive School Health Programs. Building the infrastructure for comprehensive school health programs in grades K-12. In: Allensworth DD, Lawson E, Nicholson L, Wyche J, eds. *Schools and Health*. Washington, DC: National Academy Press; 1997:237–270.
- Deleted in proof.
- McKenzie TL, Nader PR, Strikmiller PK, Yang M, Stone EJ, Perry CL, Taylor WC, Epping JN, Feldman HA, Puckner RV, Kelder SH. School physical education: the effect of the Child and Adolescent Trial for Cardiovascular Health (CATCH). *Prev Med*. 1996;25:423–431.
- McKenzie TL, Stone EJ, Feldman HA, Epping JN, Yang M, Strikmiller PK, Lytle LA. Effects of the CATCH physical education intervention: teacher type and lesson location. *Am J Prev Med*. 2001;21:101–109.
- Parcel GS, Simons-Morton BG, O'Hara NM, Baranowski T, Kolbe LJ, Bee DE. School promotion of healthful diet and exercise behavior: an integration of organizational change and social learning theory interventions. *J Sch Health*. 1987;57:150–156.
- Pate RR, Ward DS, Saunders RP, Felton G, Dishman RK, Dowda M. Promotion of physical activity in high-school girls: a randomized controlled trial. *Am J Public Health*. 2005;95:1582–1587.
- Dishman RK, Motl RW, Saunders R, Felton G, Ward DS, Dowda M, Pate RR. Enjoyment mediates effects of a school-based physical activity intervention. *Med Sci Sports Exerc*. 2005;37:478–487.



42. Sallis JF, McKenzie TL, Conway TL, Elder JP, Prochaska JJ, Brown M, Zive MM, Marshall SJ, Alcaraz JE. Environmental interventions for eating and physical activity: a randomized controlled trial in middle schools. *Am J Prev Med.* 2003;24:209–217.
43. McKenzie TL, Sallis JF, Prochaska JJ, Conway TL, Marshall SJ, Rosengard P. Evaluation of a two-year middle-school physical education intervention: M-SPAN. *Med Sci Sports Exerc.* 2004;36:1382–1388.
44. Davis SM, Clay T, Smyth M, Gittelsohn J, Arviso V, Flint-Wagner H, Rock BH, Brice RA, Metcalf L, Stewart D, Vu M, Stone EJ. Pathways curriculum and family interventions to promote healthful eating and physical activity in American Indian schoolchildren. *Prev Med.* 2003;37(6 pt 2):S24–S34.
45. McKenzie TL, Sallis JF, Kolody B, Faucette FN. Long-term effects of a physical education curriculum and staff development program: SPARK. *Res Q Exerc Sport.* 1997;68:280–291.
46. Sallis JF, McKenzie TL, Alcaraz JE, Kolody B, Faucette N, Hovell MF. The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. *Am J Public Health.* 1997;87:1328–1334.
47. Stevens J, Murray DM, Catellier DJ, Hannan PJ, Lytle LA, Elder JP, Yong DR, Simons-Morton DG, Webber LS. Design of the Trial of Activity for Adolescent Girls (TAAG). *Contemp Clin Trials.* 2005;26:223–233.
48. Baranowski T, Klesges LM, Cullen KW, Himes JH. Measurement of outcomes, mediators, and moderators in behavioral obesity prevention research. *Prev Med.* 2004;38(suppl):S1–S13.
49. Resnicow K, Robinson TN. School-based cardiovascular disease prevention studies: review and synthesis. *Ann Epidemiol.* 1997;7(S7):S14–S31.
50. Killen JD, Telch MJ, Robinson TN, Maccoby N, Taylor CB, Farquhar JW. Cardiovascular disease risk reduction for tenth graders: a multiple-factor school-based approach. *JAMA.* 1988;260:1728–1733.
51. Gortmaker SL, Cheung LW, Peterson KE, Chomitz G, Cradle JH, Dart H, Fox MK, Bullock RB, Sobol AM, Colditz G, Field AE, Laird N. Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children: eat well and keep moving. *Arch Pediatr Adolesc Med.* 1999;153:975–983.
52. Gortmaker SL, Peterson K, Wiecha J, Sobol AM, Dixit S, Fox MK, Laird N. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. *Arch Pediatr Adolesc Med.* 1999;153:409–418.
53. Tell GS, Vellar OD. Physical fitness, physical activity, and cardiovascular disease risk factors in adolescents: the Oslo Youth Study. *Prev Med.* 1988;17:12–24.
54. Killen JD, Robinson TN, Telch MJ, Saylor KE, Maron DJ, Rich T, Bryson S. The Stanford Adolescent Heart Health Program. *Health Educ Q.* 1989;16:263–283.
55. Homel PJ, Daniels P, Reid TR, Lawson JS. Results of an experimental school-based health development programme in Australia. *Int J Health Educ.* 1981;24:263–270.
56. Perry CL, Klepp K, Halper A, Dudovitz B. Promoting healthy eating and physical activity patterns among adolescents: a pilot study of Slice of Life. *Health Educ Res.* 1987;2:93–103.
57. Kelder SH, Perry CL, Klepp KI. Community-wide youth exercise promotion: long-term outcomes of the Minnesota Heart Health Program and the Class of 1989 Study. *J Sch Health.* 1993;63:218–223.
58. Marcus BH, Dubbert PM, Forsyth LH, McKenzie TL, Stone EJ, Dunn AL, Blair SN. Physical activity behavior change: issues in adoption and maintenance. *Health Psychol.* 2000;19(1 suppl):32–41.
59. Trudeau F, Laurencelle L, Tremblay J, Rajic M, Shephard RJ. Daily primary school physical education: effects on physical activity during adult life. *Med Sci Sports Exerc.* 1999;31:111–117.
60. McKenzie TL, Li D, Derby CA, Webber LS, Luepker RV, Cribb P. Maintenance of effects of the CATCH physical education program: results from the CATCH-ON study. *Health Educ Behav.* 2003;30:447–462.
61. Dowda M, Sallis JF, McKenzie TL, Rosengard P, Kohl HW. Evaluating the sustainability of SPARK physical education: a case study of translating research into practice. *Res Q Exerc Sport.* 2005;76:11–19.
62. Kelder SH, Mitchell PD, McKenzie TL, Derby C, Strikmiller PK, Luepker RV, Stone EJ. Long-term implementation of the CATCH physical education program. *Health Educ Behav.* 2003;30:463–475.
63. McKenzie TL, Kahan D. Impact of the Surgeon General's Report: through the eyes of physical education teacher educators. *J Teaching Physical Educ.* 2004;23:300–317.
64. Jarrett OS, Maxwell DM, Dickerson C, Hoge P, Davies G, Yetley A. Impact of recess on classroom behavior: group effects and individual differences. *J Educ Res.* 1998;92:121–126.
65. Pellegrini AD, Davis PD. Relations between children's playground and classroom behaviour. *Br J Educ Psychol.* 1993;63:88–95.
66. McCann B, DeLille B. *Mean Streets 2000: Pedestrian Safety, Health and Federal Transportation Spending.* Washington, DC: Surface Transportation Policy Project; 2000.
67. Centers for Disease Control and Prevention. School transportation modes—Georgia, 2000. *MMWR Morb Mortal Wkly Rep.* 2002;51:704–705.
68. Centers for Disease Control and Prevention. Barriers to children walking and biking to school—United States, 1999. *MMWR Morb Mortal Wkly Rep.* 2002;51:701–704.
69. Sirard JR, Ainsworth BE, McIVER KL, Pate RR. Prevalence of active commuting at urban and suburban elementary schools in Columbia, SC. *Am J Public Health.* 2005;95:236–237.
70. Rossi G, Moretti R, Pirone M, Locatelli W. Promoting physical activity: going to school by the Piedibus (walking school bus) [in Italian]. *Epidemiol Prev.* 2004;28:346–349.
71. Aaron DJ, Dearwater SR, Anderson R, Olsen T, Kriska AM, Laporte RE. Physical activity and the initiation of high-risk health behaviors in adolescents. *Med Sci Sports Exerc.* 1995;27:1639–1645.
72. D'Elio MA, Mundt DJ, Bush PJ, Iannotti RJ. Healthful behaviors: do they protect African-American, urban preadolescents from abusable substance use? *Am J Health Promot.* 1993;7:354–363.
73. Skolnick AA. Studies raise doubts about benefit of athletics in reducing unhealthy behavior among adolescents. *JAMA.* 1993;270:798, 800.
74. Pate RR, Trost SG, Levin S, Dowda M. Sports participation and health-related behaviors among US youth. *Arch Pediatr Adolesc Med.* 2000;154:904–911.
75. Ara I, Vicente-Rodriguez G, Jimenez-Ramirez J, Dorado C, Serrano-Sanchez JA, Calbet JA. Regular participation in sports is associated with enhanced physical fitness and lower fat mass in prepubertal boys. *Int J Obes Relat Metab Disord.* 2004;28:1585–1593.
76. Winnail SD, Valois RF, Dowda M, McKeown RE, Saunders RP, Pate RR. Athletics and substance use among public high school students in a southern state. *Am J Health Stud.* 1997;13:187–194.
77. Kulig K, Brener ND, McManus T. Sexual activity and substance use among adolescents by category of physical activity plus team sports participation. *Arch Pediatr Adolesc Med.* 2003;157:905–912.
78. Stewart JA, Dennison DA, Kohl HW, Doyle JA. Exercise level and energy expenditure in the Take 10! in-class physical activity program. *J Sch Health.* 2004;74:397–400.
79. Going S, Thompson J, Cano S, et al. The effects of the Pathways Obesity Prevention Program on physical activity in American Indian children. *Prev Med.* 2003;37:S62–S69.
80. The No Child Left Behind Act. Pub Law No 107–110 (2002).
81. Wilkins JL, Graham G, Parker S, Westfall S, Fraser RG, Tembo M. Time in the arts and physical education and school achievement. *J Curriculum Studies.* 2003;35:721–735.
82. Sallis JF, McKenzie TL, Kolody B, Lewis M, Marshall S, Rosengard P. Effects of health-related physical education on academic achievement: project SPARK. *Res Q Exerc Sport.* 1999;70:127–134.
83. Shephard RJ, Volle M, Lavallée H, LaBarre R, JeQuier J, Rajic M. Required physical activity and academic grades: a controlled longitudinal study. In: Ilmarinen J, Valimaki I, eds. *Children and Sport.* Berlin, Germany: Springer Verlag; 1984:58–63.
84. van der Mars H. Physical education time and academic achievement. In: Kirk D, O'Sullivan M, McDonald D, eds. *Handbook of Physical Education.* Thousand Oaks, Calif: Sage Publications. In press.
85. Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. *JAMA.* 1999;282:1561–1567.
86. Epstein LH, Smith JA, Vara LS, Rodefer JS. Behavioral economic analysis of activity choice in obese children. *Health Psychol.* 1991;10:311–316.
87. Epstein LH, Saelens BE, Myers MD, Vito D. Effects of decreasing sedentary behaviors on activity choice in obese children. *Health Psychol.* 1997;16:107–113.



88. Epstein LH, Paluch RA, Consalvi A, Riordan K, Scholl T. Effects of manipulating sedentary behavior on physical activity and food intake. *J Pediatr*. 2002;140:334–339.
  89. Ford BS, McDonald TE, Owens AS, Robinson TN. Primary care interventions to reduce television viewing in African-American children. *Am J Prev Med*. 2002;22:106–109.
  90. Robinson TN, Killen JD, Kraemer HC, Wilson DM, Matheson DM, Haskell WL, Pruitt LA, Powell TM, Owens AS, Thompson NS, Flint-Moore NM, Davis GJ, Emig KA, Brown RI, Rochon J, Green S, Varady A. Dance and reducing television viewing to prevent weight gain in African-American girls: the Stanford GEMS pilot study. *Ethnic Dis*. 2003;13:S1-65–S1-77.
  91. Gutin B, Owens S, Okuyama T, Riggs S, Ferguson M, Litaker M. Effect of physical training and its cessation on percent fat and bone density of children with obesity. *Obes Res*. 1999;7:208–214.
  92. Gutin B, Barbeau P, Owens S, Lemmon CR, Bauman M, Allison J, Kang HS, Litaker MS. Effects of exercise intensity on cardiovascular fitness, total body composition, and visceral adiposity of obese adolescents. *Am J Clin Nutr*. 2002;75:818–826.
  93. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity. Physical activity for everyone: physical activity terms. Available at: <http://www.cdc.gov/nccdphp/dnpa/physical/terms/index.htm>. Accessed July 14, 2006.
  94. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity. BMI—body mass index: BMI for children and teens. Available at: [http://www.cdc.gov/nccdphp/dnpa/bmi/childrens\\_BMI/about\\_childrens\\_BMI.htm](http://www.cdc.gov/nccdphp/dnpa/bmi/childrens_BMI/about_childrens_BMI.htm). Accessed July 14, 2006.
  95. National Association for Sport and Physical Education. National Standards for Physical Education. Available at: <http://www.aahperd.org/NASPE/template.cfm?template=publications-nationalstandards.html>. Accessed August 1, 2006.
  96. Merriam-Webster Online Dictionary. “Prevalence,” definition No. 2. Available at: <http://www.m-w.com/dictionary/prevalence>. Accessed July 14, 2006.
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KEY WORDS: AHA Scientific Statements ■ exercise ■ pediatrics  
■ physical activity ■ prevention