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Exercise—Promoting healthy lifestyles in children and adolescents

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Abstract. Regular physical activity is an important component of a healthy lifestyle in children and adolescents. However, despite the noted short- and long-term health benefits associated with physical activity, monitoring and surveillance studies show that a significant percentage of children and adolescents fail to meet the recommended guideline of 60 minutes or more of moderate-to-vigorous physical activity daily. This review examines key evidence from the public health and health promotion literature on promotion of health-enhancing physical activity in children and adolescents. We describe best practice in three key behavior settings—schools, homes, and health care settings. In school-based settings, it has been shown that physical education programs can be modified to increase the percentage of class time engaged in moderate-to-vigorous physical activity. In the home setting, there is evidence that teaching parents to establish and monitor physical activity goals and provide appropriate rewards for meeting these goals results in gains in physical activity and/or physical fitness. In health care settings, evidence from two studies suggests that physician-based counseling coupled with stage appropriate written materials can be effective among adolescent youth.

Regular physical activity is essential for good health and optimal growth and development in children and youth. A number of comprehensive reviews have concluded that regular physical activity is positively associated with a number of positive health outcomes, including improved cardiovascular fitness, increased bone mass, and improved psychological well-being, while inversely associated with negative health outcomes, such as obesity, hypertension, and cigarette smoking.[1–3] Moreover, because several health outcomes associated with physical activity track from childhood into adulthood, regular physical activity during childhood and adolescence can be of critical importance in the prevention of chronic disease later in life.[4,5] Table 1 provides a summary of the associations between physical activity and selected health outcomes in children and adolescents.

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On the weight of this evidence, an expert panel of clinicians and public health scientists recently issued guidelines for children and youth's participation in physical activity. For desired health and behavioral outcomes, it was recommended that school-aged youth (6–18 years) participate daily in 60 minutes or more of moderate to vigorous physical activity.[6] The term *moderate-to-vigorous physical activity* (MVPA) refers to physical activities requiring an energy expenditure of at least four metabolic equivalents (METs) (one MET equals the energy cost associated with quiet sitting) or approximately 40% to 60% of maximal oxygen uptake (VO_2 max). Exemplar activities include brisk walking, running, cycling, and playing outdoors. Importantly, the recommended 60 minutes or more of MVPA does not need to be achieved in a single sustained bout of activity. It can be achieved through intermittent physical activity and accumulated in a variety of different settings (eg, physical education class, recess, intramural sports, and

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Table 1 Summary of the associations between physical activity and health outcomes in children and youth*

Outcomes	Strength of association	Dose of physical activity required
Blood pressure	↔/−	No indication
Blood lipids	+/−	No indication
Adiposity	—	Long duration, moderate intensity
Skeletal health	++	Weight bearing exercise important
Psychological health	+	No indication
Cardiorespiratory fitness	+	Vigorous sustained activity

—, repeatedly documented inverse association; −, weak or mixed evidence of an inverse association; ↔, evidence of no association; +, weak or mixed evidence of a positive association; ++, repeatedly documented evidence of a positive association.

*Based on Trost and colleagues.[2]

before and after school programs). For youth who have not been routinely active, a gradual approach to the 60-minute goal is recommended. Increasing physical activity by 10% per week was recommended as an appropriate progression.

Despite the benefits of regular physical activity, a significant percentage of children and youth do not participate in the level of physical activity recommended by experts. The results of the most recent national Centers for Disease Control and Prevention Youth Risk Behavior Survey indicate that only 36% of US high school students meet the 60-minute MVPA guideline. Of concern, the prevalence of meeting the 60-minute guideline was higher among male (44%) than female (28%) students, and higher in white (39%) compared to African-American (30%) and Hispanic (33%) students.[7] Insufficient physical activity is also a concern among elementary and middle school students. Results of the national Youth Media Campaign Longitudinal Survey, conducted by the Centers for Disease Control and Prevention, indicated that 62% of children aged 9 to 13 years did not participate in any organized physical activity (ie, with a coach, instructor, or leader) during their nonschool hours and that 23% did not engage in any free-time physical activity. The prevalence of participating in physical activity during nonschool hours was not different between males (38.3%) and females (38.6%), but was substantially higher among white (47%) than Hispanic (26%) and African-American (24%) students.[8]

The widespread problem of physical inactivity, along with the continued increase in the prevalence of childhood obesity,[9] underscores the need to promote healthy lifestyles in children and adolescents through regular participation in physical activity. In this review, we briefly summarize key evidence related to promoting physical activity in young people. The discussion will be delimited to what we consider to be the three most important behavior settings to promote physical activity in this population group—schools, homes, and health care settings. Our goal is not to provide an exhaustive review of the physical activity intervention literature, but to highlight what is considered best practice or the most promising approach in each of the three settings. For more comprehensive information on this topic, the reader is referred to the excellent reviews by Ward and colleagues[10] and van Sluijs and colleagues.[11]

Schools

Schools are an ideal setting to promote physical activity because they (1) reach most children and adolescents; (2) have trained personnel with an interest in promoting health; (3) have an organization structure and facilities that can be used to promote physical activity; and (4) have a capacity to interact with community-based physical activity providers and other community groups.[12] Comprehensive reviews of the school-based intervention literature have concluded that behaviorally oriented health and physical education curricula can be successfully implemented and that teacher behavior in physical education can be modified to increase student physical activity during physical education classes.

Stone and colleagues[13] reviewed the results of 22 physical activity intervention studies conducted in school and/or community settings. Intervention studies targeting upper elementary school children were generally successful in increasing the amount of physical activity performed during physical education; however, very few studies reported positive changes in out-of-school physical activity. The majority of studies were successful in increasing knowledge and positive attitudes toward physical activity.

More recently, the US Task Force on Community Preventive Services[14] conducted a systematic review of 14 published studies evaluating the effectiveness of strategies to increase the amount of class time engaged in MVPA. In the five studies measuring physical activity during physical education, all reported increases in the number of minutes spent in MVPA, the percent of class time spent in MVPA, and the intensity level of physical activity during class. All 14 studies reported an increase in physical fitness. Across all studies, the median increase in physical fitness was 8%. Based on strong evidence of effectiveness, the Task Force issued a recommendation to implement programs that increase the length of, or activity levels in, school-based physical education classes. The following sections provide a brief summary of three of the most significant and widely disseminated school-based physical activity promotion programs.

SPARK

The Sports Play and Active Recreation for Kids (SPARK) program was designed to promote MVPA and teach movement skills in elementary school-aged children. SPARK also included a self-management program that taught behavior change skills to promote physical activity outside of school, and included a family component with homework and newsletters to promote parent–child interaction and support for physical activity. The program was implemented by physical education specialists or trained teachers, and students in these classes were compared with those in control schools. At the end of the study, students in the specialist-led and teacher-trained classes spent more time being physically active than students in control classes. After 18-months of follow-up, trained classroom teachers continued to use the curriculum and maintained increased student physical activity levels.[15,16] The SPARK program has been disseminated nationally in the United States with training completed in over 3000 schools.[17,18] The program has been extended to include students in kindergarten through grade 5, as well as a component for preschool children. More information about how to implement the SPARK program can be found at www.sparkpe.org.

CATCH

The Child and Adolescent Trial for Cardiovascular Health (CATCH) study was a multicenter randomized trial that tested the effectiveness of a comprehensive cardiovascular health promotion program in 96 elementary schools from four geographic regions in the United States.[19] A primary focus of the intervention was to increase the amount of physical activity performed during physical education, but also included a food-service component and a tobacco-control component. CATCH PE worked with school physical education specialists to modify classes so that students would spend more time in MVPA and less time being inactive. The curriculum promoted cooperative nonexclusionary games and activities and enjoyment of physical activity. Compared with control schools, intervention schools provided a significantly greater percentage of physical education time engaged in MVPA.[19] Notably, students in the intervention schools also reported significantly greater out-of-school vigorous physical activity, an effect that was maintained after 3 years of follow-up.[20] The CATCH physical activity program has subsequently been disseminated to more than 1800 schools in Texas, potentially reaching 850,000 students. More information about how to implement the CATCH program can be found at www.catchinfo.org.

LEAP

The Lifestyle Education for Activity Program (LEAP) study was designed to promote physical activity among adolescent girls by creating a school environment that supports the physical activity needs and interests of adolescent girls. Implemented in 12 high schools in South Carolina, the LEAP intervention provided a choice-based, gender-segregated physical education curriculum (LEAP PE) that helped participants build physical activity self-efficacy, increase enjoyment of physical activity, and develop behavioral skills (eg, goal setting, self-monitoring, enlisting social support) needed to live a physically active lifestyle. LEAP PE offered a variety of lifetime activities that were popular with young women, including aerobic, dance, weight training, and self-defense. At the end of the second year of implementation, 45% of girls in the 12 LEAP intervention schools, compared with 37% in the 12 control schools, reported vigorous physical activity during an average of one or more 30-minute time blocks per day during a 3-day period.[21] Consistent with theoretical considerations, it was found that enjoyment of physical education and physical activity self-efficacy were related to the positive increase in physical activity behavior.[22,23] Of note, girls completing the LEAP curriculum remained significantly more active than girls in the control schools some 4 years after the program was implemented.[24]

Home

Children and adolescents spend considerable amounts of time outside of school. Consequently, the home environment is a key influence on youth physical activity behavior.[12] Parents in particular exert a strong influence over their children's physical activity behavior by acting as role models, providing encouragement, paying fees and registrations for sport and physical activity programs, and providing transportation to sport and physical activity settings.[10] Although successfully engaging parents in the behavior change process is an extremely difficult undertaking,[10,11] a number of home-based intervention programs have been modestly successful in increasing physical activity and improving fitness.

Taggart and colleagues[25] demonstrated that a home-based activity program targeting parents can increase physical activity levels in sedentary children. Parents were trained to monitor their child's physical activity levels, administer fitness tests, and implement family contingency contracts, which were negotiated between the parent and child. Contingency contracts stipulated rewards such as social praise, joint parent participation in physical activity, and free time. Children received their reward when they met the weekly goal for activity points (calculated by the type and duration of the activity). At the completion of the 12-week program, there was a 49% increase in time spent in physical activity, a 100% increase in activity points gained, and significant improvements in back strength and endurance.

Hopper and colleagues[26] evaluated the efficacy of including a significant parent component in a school-based

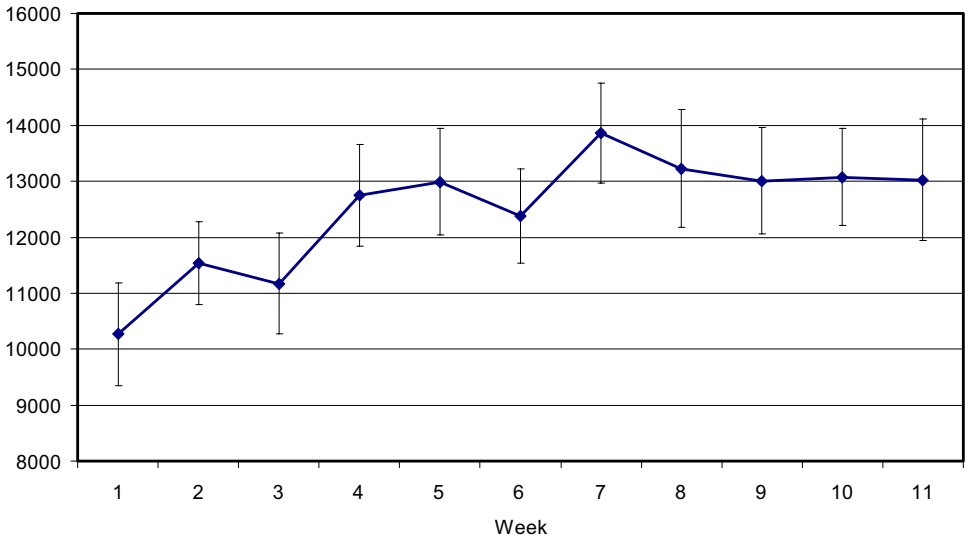

Figure 1 Increases in daily steps during the 10-week home-based physical activity intervention.

physical activity and nutrition promotion program. Third-grade children were randomly assigned to an intervention group or a control group. The school-based intervention consisted of 20 weeks of physical education (three 30-minute sessions a week) and nutrition (two 30-minute sessions a week) instruction occurring in the classroom. The family component involved parents and children participating in a range of exercise and nutrition activities that paralleled the school-based lessons—parent and child physical activities to earn points, heart-healthy recipes, setting physical activity and nutritional goals, and distinguishing between daily and occasional foods. Students in the control group received no additional instruction in physical education and nutrition beyond what was taught in their usual curriculum. Although the program did not result in significant improvements in physical fitness (mile run time), students in the intervention condition exhibited significant increases in exercise and nutrition knowledge as well as significant decreases in total fat intake.

Daughters and Mothers Exercising Together compared the effectiveness of a physical activity intervention that targeted mothers and daughters exercising together.[27] Mother-daughter dyads were randomly assigned to either a community-based or a home-based 12-week intervention program. Dyads in the community-based condition completed the intervention at a fitness facility under the supervision of exercise leaders. In contrast, dyads in the home-based condition received a detailed packet of information consisting of a calendar of recommended activities, pictures of various physical activities, and tips for overcoming barriers. Both approaches to a mother-daughter exercise program were successful at increasing participation in aerobic, muscle strength, and flexibility activities.

Trost and colleagues[28] conducted a study to explore the feasibility of a home-based, moderate-intensity physical activity intervention incorporating self-monitoring with an electronic pedometer. The effects of the program on insulin sensitivity and other components of the insulin-resistance syndrome were also evaluated. Twenty obese children (mean age 11.8 ± 2.3 years; body mass index [calculated as kilograms divided by meters squared] 34.5 ± 4.9) completed the 10-week program. Prior to the start of the physical activity program, each participant was visited by an exercise specialist and given instructions on how to wear and operate a pedometer. Participants were asked to wear the pedometer during waking hours for the next 7 days and were instructed not to make any changes to their normal daily routines. Data from the initial 7-day monitoring period was used to establish a baseline level for the 10-week activity program. Following administration of a semi-structured interview to identify physical activity preferences and time spent in sedentary pursuits, the exercise specialist provided a personalized plan to maximize opportunities for incidental activity (eg, travel to school, shops, etc.) and planned activities (eg, 15-minute brisk walk). Parents were also given pedometers and encouraged to participate with their child. Lastly, participants along with their parent(s) completed a behavioral contract specifying a "steps per day" goal for the next 2 weeks. Subsequent visits by the exercise specialist during every second week of the program served to collect the pedometer data, establish a new pedometer goal for the ensuing 2 weeks, and to discuss any problems or barriers to physical activity.

During the course of the 10-week program, mean steps per day increased from 10,363 ± 927 to 13,013 ± 1131 (Fig. 1). Differences from baseline were statistically significant from week 4 onward. On average, participants increased their daily step counts by 36%. Notably, insulin sensitivity and parental support for physical activity also improved substantially (Fig. 2). The results indicate that a home-based physical activity program that includes positive reinforcement, parental support, problem-solving, and self-monitoring via pedometer is feasible among obese children

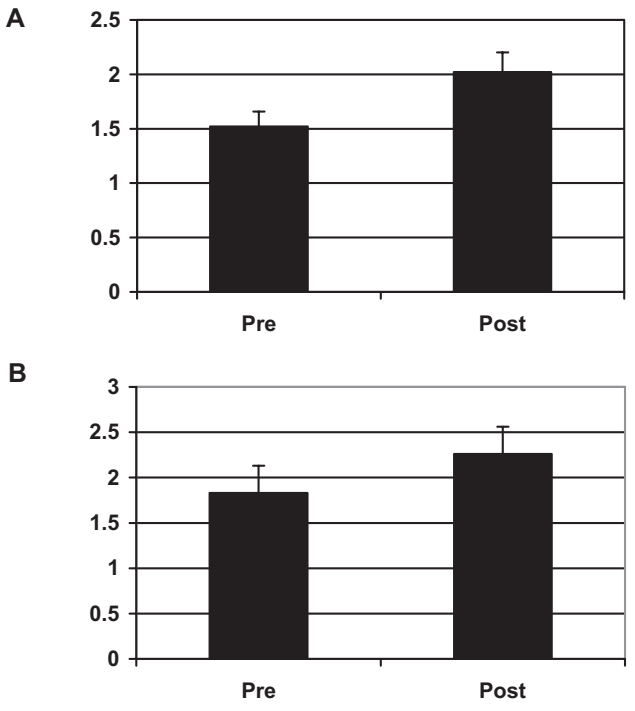

Figure 2 Pre to post changes in insulin sensitivity (A) and parental support (B) as a result of a home-based physical activity intervention.

and is effective in increasing physical activity and improving insulin sensitivity (Figs. 1 and 2).

Health care settings

Professionals who provide primary care are viewed as highly credible sources of health information. Thus, pediatricians and other health care professionals are in a unique position to promote physical activity in young people. Health care professionals can promote physical activity in their young patients by (1) directly counseling youth on the benefits of exercise and helping them formulate a plan to become physically active; (2) teaching parents how to provide emotional and tangible support for their children's physical activity; and (3) becoming an advocate for school-based and community-based physical activity programs.[10,12] Although numerous studies have evaluated the effectiveness of primary care-based physical activity interventions in the adult population,[29] very few studies have systematically evaluated this approach in children and adolescents.

Patrick and colleagues[30] showed that with physician-based counseling, physical activity levels can be increased and sedentary behaviors can be reduced in adolescents. Approximately 900 adolescents between the ages of 11 to 15 years were randomized into the Patient-Centered Assessment and Counseling for Exercise + Nutrition (PACE+) intervention or a sun exposure protection control group (information regarding sun exposure protection was provided). The PACE+ intervention involved a computer-based assessment of physical activity, sedentary behavior, and dietary habits, which was completed in the waiting room. Using the stage of change theoretical framework,[31] the computer expert system identified the participants' stage of readiness to change their nutrition and physical activity behaviors. The results of this computer-assisted evaluation guided the participants to develop stage-appropriate, tailored behavior-change plans for physical activity and nutrition behaviors. A summary report was provided to a physician or nurse practitioner, and during a brief 3- to 5-minute counseling session, they addressed their concerns pertaining to the report, affirmed or modified the plan, and encouraged participation in the program. The participants then received monthly mail and telephone counseling for 12 months. One year after the intervention, the PACE+ group significantly reduced their sedentary behavior (television viewing) from 4.3 to 3.4 hours/day in girls and 4.2 to 3.2 hours/day in boys. Additionally, boys in the PACE+ group reported more active days per week (4.4 days/week) compared to the control group (3.8 days/week). More information about how to implement the PACE and PACE+ programs can be found at www.paceproject.org.

Ortega-Sanchez and colleagues[32] showed that the duration, frequency, and intensity of leisure time physical activity among adolescents can be increased through a physician-based counseling intervention. Participants were initially categorized as active, partially active, or inactive. Active individuals reported participating in sports or exercising for at least 30 minutes, three times per week; partially active individuals reported participating in sports or exercising less than 3 days a week or less than 30 minutes per day; inactive individuals reported no participation in sports or exercise. Active adolescents were provided with "reinforcement counseling," where physicians offered positive reinforcement for healthy lifestyles, explained the benefits provided by lifelong exercise and/or sport, and encouraged continued participation in exercise and/or sport. Partially active adolescents were provided with "increased counseling," where physicians explained the health benefits provided by lifelong exercise and/or sport, explained to them how exercise and/or sport practice is useful for health maintenance, informed them of the frequency, duration, and/or intensity not being satisfied, and provided ways to reach these recommendations. Lastly, inactive adolescents were provided with "initiation counseling," where physicians explained the health benefits provided by lifelong exercise and/or sport, encouraged their initiation of an exercise and/or a sport, and explained the frequency, duration, and intensity required for the exercise and/or sport chosen. Compared to the control group, who received no physical activity counseling, the intervention groups combined had 43% more adolescents classified as physically active. Additionally, after 1 year of follow-up, physical activity among intervention participants was 49% higher in duration, 34% higher in frequency, and 30% higher in intensity than controls.

Table 2 Centers for Disease Control and Prevention recommendations for promoting lifelong physical activity in schools, homes, and health care settings[33]

Recommendation 3. Physical education: Implement physical education curricula and instruction that emphasize enjoyable participation in physical activity and that help students develop the knowledge, attitudes, motor skills, behavioral skills, and confidence needed to adopt and maintain physically activity lifestyles.
Provide planned and sequential physical education curricula from kindergarten through grade 12 that promote enjoyable, lifelong physical activity.
Use physical education curricula consistent with the national standards for physical education.
Use active learning strategies and emphasize enjoyable participation in physical education class.
Develop students' mastery of and confidence in motor and behavioral skills for participating in physical activity.
Provide a substantial percentage of each student's recommended weekly amount of physical activity in physical education classes.
Promote participation in enjoyable physical activity in the school, community, and home.
Recommendation 6. Parental involvement: Include parents and guardians in physical activity instruction and in extracurricular and community physical activity programs, and encourage them to support their children's participation in enjoyable physical activities.
Encourage parents to advocate for quality physical activity instruction and programs for their children.
Encourage parents to support their children's participation in appropriate, enjoyable physical activities.
Encourage parents to be physically active role models and to plan and participate in family activities that include physical activity.
Recommendation 8. Health Services: Assess physical activity patterns among young people, reinforce physical activity among young people, counsel inactive young people about physical activity, and refer young people to appropriate physical activity programs.
Regularly assess the physical activity patterns of young people, reinforce physical activity among active young people, counsel inactive young people about physical activity, and refer young people to appropriate physical activity programs.
Advocate for school and community physical activity instruction and programs that meet the needs of young people.

Summary

A significant proportion of children and adolescents are less active and in need of effective programs and policies to promote physical activity. In this review, we summarized evidence-based physical activity–promotion strategies that can be readily implemented in schools, homes, and health care settings. In school-based settings, it has been shown that physical education programs can be modified to increase the percentage of class time engaged in moderate-to-vigorous physical activity. Key strategies include providing in-service training opportunities to improve instructional practices and increase the use of cooperative games and activities that include all students. Offering a wider variety of developmentally appropriate physical activities that cater to the needs and interests of all students is also an important strategy. Not only should physical educators teach movement skills, but they should also teach key behavioral skills, such as goal setting, self-monitoring, and enlisting support for physical activity. In the home setting, there is evidence that teaching parents to establish and monitor physical activity goals and provide appropriate rewards for meeting these goals results in gains in physical activity and/or physical fitness. Encouraging parents to exercise with their children and coordinating home visits from an exercise specialist are also promising strategies. Despite having great potential, little is known about how to effectively promote youth physical activity in health care settings. Evidence from two studies suggests that physician-based counseling coupled with stage-appropriate written materials can be effective among adolescent youth. Nevertheless, traditional barriers such as time constraints, lack of reimbursement, and lack of training continue to be problematic. The strategies described in this review are succinctly summarized by recommendations 3, 6, and 8 from the 1997 *CDC Guidelines for School and Community Programs to Promote Lifelong Physical Activity among Young People*.[33] These are displayed in Table 2.

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