Effects of Physical Activity Interventions in Youth
Review and Synthesis

Elaine J. Stone, PhD, MPH, Thomas L. McKenzie, PhD, Gregory J. Welk, PhD, Michael L. Booth, MPH, PhD

Introduction: Physical inactivity has been identified as an important public health concern for youth. School and community settings can be important infrastructures for promoting physical activity (PA). This paper reviews studies of physical activity in school and community settings among preschool through college-aged persons to determine characteristics and effects of interventions. Studies in progress are included.

Methods: Studies from 1980 to 1997 testing physical activity interventions in schools and community settings were identified by computerized search methods and reference lists of published reviews. Studies needed to have used a quantitative assessment of PA, used a comparison or control group, included participants who were preschool through college age, and be conducted in the United States or foreign school or community settings. Significance of effects was examined overall and for various types of interventions.

Results: Twenty-two school-based studies were reviewed, 14 completed and 8 in progress. Three studies were in countries other than the United States. The 8 studies in progress were all in the United States. Only 7 community studies were reviewed, all in the United States. Four studies were in progress. Several community studies involved a high percentage of African-American or Hispanic youth and their families. Studies showing the best results used randomized designs, valid and reliable measurements, and more extensive interventions. Some follow-up results showed PA was sustained after interventions ended.

Conclusions: The collection of school and community studies is limited for several age groups with none below third grade and only three at college age. There are few community studies. The most is known about upper-elementary-age-students, including the first multicenter randomized trial to report significant results for increasing moderate to vigorous physical activity (MVPA) in physical education (PE) and increase vigorous PA outside of school. A number of older study designs were weak and assessments less than optimal, but studies in progress are stronger. Special attention is needed for girls, middle schools, and community settings for all youth. More objective assessments are needed for measuring PA outside of school and in younger children, since they cannot provide reliable self-report.

Medical Subject Headings (MeSH): physical fitness, youth, intervention studies, community, schools, school-age population, African Americans, Hispanics, physical education and training, leisure activities (recreation) (Am J Prev Med 1998;15(4):298–315)

Introduction

The impact of behavior on health, with a special emphasis on children through young adults, is a central focus for the prevention agenda in the United States[1,2] and health policy internationally.[3–5] Physical inactivity has been identified as an independent risk factor for coronary heart disease (CHD) with the risk for CHD increased nearly twofold for persons who are physically inactive.[6] Reports have attributed 22%–30% of cardiovascular deaths, 20%–60% of cancer deaths, and 30% of diabetes deaths to sedentary lifestyles and dietary factors.[7] Tobacco use was the only more prominent behavioral contributor to mortality than physical inactivity and diet. Major reviews by Blair et al.[8] and Pate et al.[9] also identified physical inactivity as a serious problem and major public health concern for youth and adults.

During the 1990s there were a number of major conferences and reports that addressed physical activity. Some of these were the National Heart, Lung, and Blood Institute (NHLBI) workshop on *Physical Activity*

From the Division of Epidemiology and Clinical Applications, National Heart, Lung, and Blood Institute (Stone), Bethesda, Maryland 20892-7936; Department of Exercise and Nutrition Sciences, San Diego State University (McKenzie), San Diego, California 92120; Division of Childhood and Adolescent Health, The Cooper Institute for Aerobics Research (Welk), Dallas, Texas 75230; and National Centre for Health Promotion, Department of Public Health and Community Medicine, University of Sydney (Booth), New South Wales 2006 Australia.

Address correspondence to: Elaine J. Stone, PhD, MPH, Division of Epidemiology and Clinical Applications, National Heart, Lung, and Blood Institute, 6701 Rockledge Drive, Room 8134, MSC 7936, Bethesda, Maryland 20892-7936.

and Cardiovascular Health: Special Emphasis on Women and Youth in 1991[10]; the *International Consensus Conference on Physical Activity Guidelines for Adolescents,* in 1994[11]; *National Institutes of Health (NIH) Consensus Conference on Physical Activity* in 1995[12]; the *Surgeon General's Report on Physical Activity and Health* in 1996[13]; the first Centers for Disease Control and Prevention (CDC) *Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People* in 1997[14]; and the National Association for Sport and Physical Education (NASPE) *Physical Activity for Children: A Statement of Guidelines* in 1998.[15] These conferences and reports stressed the importance of focusing on children and adolescents by establishing infrastructures in schools and communities to promote healthy physical activity patterns. In addition, several international reports were released including, the World Health Organization's *Global School Health Initiative*[16] and the *Young and Active* report.[5] This latter report is a public health policy framework designed to maximize the opportunity for young British people to participate in a lifetime of regular health-enhancing physical activities.

Although the findings reported in the literature are not directly comparable, it is possible to develop an approximate estimate of the proportion of young people who are adequately active, trends across age, and differences between boys and girls. A study conducted in Austria, England, Finland, and Norway reported that 61% of 11 year olds and 50% of 15 year olds participated in one to six sessions per week of vigorous activity outside of school.[17] In comparison, a study of 6,500 Welsh 11 to 16 year olds found that less than 49% of the boys and 19% of girls engaged in vigorous activity for at least 30 minutes, three or more times per week.[18,19] The authors also reported that participation declined significantly with age. A survey of Italian girls aged 14 to 18 years found that only 6% to 10% regularly took part in sports or cycled regularly and that 60% to 70% reported no leisure-time physical activity.[20]

A national survey of Australian children and youth (aged 9 to 15 years) included a question on whether or not students were vigorously active three to four times per week for at least 30 minutes per session.[21] The study found that 50% of boys and 39% of girls were active at this level and that there was no apparent decline with age for either boys or girls. In another European survey, the Berlin-Bremen Study of Health Behavior in Childhood and Adolescence examined the frequency and duration of participation in vigorous and moderate activities among 932 seventh- and eighth-grade students.[22] They found that approximately 18% of students spent less than 30 minutes per week engaged in vigorous activity and approximately 30% spent 30 to 120 minutes per week in vigorous activities.

Armstrong and his colleagues assessed physical activity participation among 266 English children aged 11 to 16 years by monitoring heart rate on three school days and one Saturday.[23] They found that 23% of boys and 12% of girls had at least one 20-minute period of elevated heart rate over three school days and that 4% of boys and less than 1% of girls had three 20-minute periods of elevated heart rate on three school days. They also noted that girls are less active than same-aged boys and that there was a greater decline in physical activity participation across high school years among girls.

The Canada Fitness Survey of 1981 involved 23,000 respondents aged seven years and older.[24] Based on the criterion of three hours per week of physical activities of at least four METS intensity, approximately 75% of young people were sufficiently active. However, when the criterion of participation in vigorous activity for three hours per week was applied, less than 5% of children and youth were sufficiently active. Finally, the U.S. National Youth Risk Behavior Survey conducted in 1990 assessed more than 11,000 students in grades 9 to 12.[25] It was found that 50% of all boys met the criterion and that the proportion who were active did not vary by school year when the criterion of vigorous activity for at least 20 minutes on at least three days per week was used. In contrast, the proportion of girls who were active varied from 31% in grade 9 to 17% in grade 12.

Overall, despite the many methodologic differences in international surveys of youth physical activity, three consistent and general findings have emerged. First, a substantial proportion of children and adolescents are not sufficiently active; most surveys found less than 50% of adolescents were sufficiently active. Second, a considerably smaller proportion of girls than boys were sufficiently active. Third, activity participation declines with age during adolescence, although it is not clear at what age the decline commences and if the rate of decline is linear. There is a need worldwide to address gender differences in designing interventions especially beginning in middle school. Few of the studies (especially in the United States) addressed the gender issue to the extent needed or reported results separately for males and females. In addition, high-risk groups have many needs requiring special attention; these needs may be related to income, education, transportation, and cultural considerations.

Although the concept of risk factor tracking is well established,[26] a fairly recent concept is that behavioral risk factors also track and that they tend to cluster in health-promoting or health-compromising directions. Of the limited research findings reported, physical activity or inactivity tends to track during early childhood and less-active children tend to remain less active than the majority of their peers.[27] Another preschool study examined the effects of physical activity on the change in body fatness from preschool to first grade and reported that children with low activity levels

gained substantially more subcutaneous fat than did more-active children. This study followed children from preschool into adolescence and found that physical activity and sedentary behaviors track and that girls were already less active than boys in early elementary grades.[28] The Studies of Children's Activity and Nutrition (SCAN) longitudinal cohort research in 8 cities across the United States were conducted to advance measurement methodology to use with 3 and 4 year olds at baseline and to examine the determinants of eating and physical activity behavior.[27] Several of the SCAN cohorts are still being measured as adolescents.[28,29]

Since physical activity health behaviors track into adulthood,[30–33] it is important to review the evidence-based findings in school and community settings[34] for designing and implementing effective policy and programs to promote physical activity in young people.[35,36] The purpose of this paper is to review and synthesize the findings of studies testing interventions to increase physical activity in schools and other community settings for children through young adulthood. The completed studies are categorized by the following age groups: preschool, elementary, middle and high school, and college. In addition, review tables also are included for the school and community studies completed or currently in progress. Implications for future research, policy, and practice are addressed.

Methods

Identification of Studies

Studies from 1980 to 1997 were identified using Medline search through both MeSH heading and textwords. In addition, bibliographies from prior review articles, published studies, and recommendations from national and international colleagues were used. Only published articles in refereed journals and manuscripts accepted for publication were considered for the completed studies.

Criteria for Inclusion/Exclusion

The following criteria were used for including studies in this review: (1) quantitative assessment of physical activity, (2) the design used a comparison or control group (randomized or nonrandomized), (3) the participants were preschool through college age, (4) U.S. and foreign school or community settings, and (5) published in English. Studies with both physical activity and physical fitness measures were included; however, those with only fitness assessments were excluded. Pilot studies were generally not included in the tables.

A number of review articles in related areas have been published and, therefore not included. Some of these include studies of fitness,[30,37] school-based cardiovascular disease prevention,[38–41] physical activity,[42] school-based obesity,[43,44] family- and clinic-based obesity studies,[45,46] teaching physical education studies,[47] and community-based interventions.[48] In addition, important intervention studies on physical fitness that have been reported elsewhere include a study by Dwyer et al.[49] conducted in elementary schools in Australia and studies by Shephard and colleagues[50,51] that addressed fitness and academic performance. A few other studies reporting fitness were Taggart et al.,[52] Bush et al.,[53] Walter et al.,[54] Duncan et al.,[55] Vandongen et al.,[56] Lionis et al.,[57] Alexandrov et al.,[58] Arbeit et al.,[59] Tamir et al.,[60] Puska et al.,[61] and Ewart et al.[62,63]

Organization of Tables

Classification of age groups for youth varies across agencies and organizations. Grace and Patrick[64] published a summary of the numerous definitions of age groups. After reviewing the various definitions, we classified pre-schoolers as ages 3 to 5, and the rest of the age groups by the grade levels including elementary, middle, or high school as well as college (primarily undergraduate level). Table 1 includes completed school-based studies with the major results published or in press. Table 2 contains school studies in progress. In Table 1 studies are listed in chronological order by year of publication, while the studies in progress are listed by alphabetical order of the lead investigator. Community studies shown in Tables 3 and 4 follow the same organizational structure.

The first column of each table includes the name of the study and citation for the major results paper or papers. For example, in the case of the Go for Health study shown in Table 1, two papers are listed as major results papers since that is how the findings were reported. The Parcel et al. paper[65] contains the cognitive and behavioral results at the student level, and the Simons-Morton et al.[66] paper presents school-level-changes in PE and school lunch. For the CATCH and SPARK studies the first citations[67,68] are the overall results papers, and the second citations[69,70] refer to in-depth reporting of the physical activity, fitness, or physical education results.

Results

A total of 14 completed school-based studies met the inclusion criteria. Of these, 11 were U.S.[65,67,68,71–78] and 3 were foreign studies.[79–81] There are eight studies in progress in the United States (Table 2). One of these has published the design paper.[82] There are fewer studies in community settings than in schools. A total of 3 community studies in the United States are listed in Table 3[83–85] and 4 studies in progress[86–88] are dis-

Table 1. School-based physical activity intervention studies among elementary, secondary, and college-level students[a]

Study	Sample	Study design	Intervention	Physical activity target	Dependent variable(s)	Results
Elementary school-age interventions						
Know Your Body (KYB) Program, Los Angeles Marcus et al. (1987)[71]	· 1,400 students · 18 schools in Los Angeles · Multi-ethnic · Girls and boys · Cohort	· Quasi-exp · I-1 (7), I-2 (3), I-3 (5) and C (3) · Grades 4, 5	· Social influences and SCT · I-1 included KYB and screening, I-2 KYB screening only, I-3 KYB only · 2/45 min sessions/wk 3rd/5 mos	· Increase K and beliefs about health · Increase PA behavior	· Self-report K and beliefs · Self-report PA	· I-3 increased on K scales. · I-3 increased on PA
Oslo Youth Study Tell and Vellar (1987)[79]	· 562 students · 6 schools · Rural · Norway · Girls and boys · Cohort	· Quasi-exp · I (3) and C (3) · Grades 5, 6, 7 · FU Grade 7 · FU 12 yrs	· social influences and SM · Curriculum for diet, smoking, and PA based on KYB parents for diet, peer, policy · 2 yrs	· Increase K and attitudes for PA · Increase PA · Increase VO_2 maximum uptake levels · Change PE	· Self-report PA · Self-report K and A · Fitness VO_2 max (submax bike)	· Increased K · Increased frequency of vig PA (boys only) · Increased CV fitness for I boys · 12 yr FU increased PA
Go for Health Parcel et al. (1989)[65] Simons-Morton et al. (1991)[66]	· 409 students · 4 schools in one district/ TX · Multi-ethnic · Girls and boys · Cohort	· Quasi-exp · I (2) and C (2) schools · Grades 3, 4	· SLT · Curriculum, changes in PE, and school lunch · 2 yrs	· Increase K, A, and self-efficacy for PA · Increase MVPA during PE · Increase out-of-school PA	· Survey of K, A, self-efficacy · Observation of PA in PE · Self-report PA	· Increased K, A, and self-efficacy · Increased MVPA in PE · No increase in out-of-school PA
Southwest CV Curriculum Project Davis et al. (1995)[72]	· 2,018 students · 11 schools/ NM · Rural · Am-Indian · Girls and boys · Cohort	· Exp · I (5) and C (6) schools · Grade 5	· SLT, Social influences · Curriculum for PA, diet, smoking, lunch, PE, parent, peer · 2 semesters 2 times wk/11 wks	· Increase K for PA · Increase PA behavior	· Self-report K · Self-report PA	· Increased K · Increased PA
Nebraska School Study Donnelly et al. (1996)[73]	· 200 students · 2 schools/NE · Multi-ethnic · Rural · Girls and boys · Cohort	· Quasi-exp · I and C schools matched by ethnicity, SES · Grades 3, 4, 5	· SCT · Curriculum, changes in PE, lunches, policy · 2 yrs	· Reduce obesity and improve fitness by promoting PA · Improve PE	· PE (SOFIT) · PA checklist · Fitness test (1-mile run)	· 6% more PA during PE · 15% less PA out of school · No fitness change
CV Health in Children (CHIC) Harrell et al. (1996)[74]	· 1,274 students · 12 schools/ NC · Multi-ethnic · Rural · Girls and boys · Cohort	· Exp · I (6) and C (6) schools · Grades 3, 4	· SCT · AHA health curriculum and specially designed PE · 2 yrs 2 wks per yr for curriculum	· Reduce CVD risk factors in children by promoting PA and a healthy lifestyle	· PA checklist · Test of K · CV fitness (VO_2 max) · Body comp (% fat)	· Increased PA for I schools (23% vs. 15%) · Increased K for 1 group · No fitness change

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Table 1. School-based physical activity intervention studies among elementary, secondary, and college-level students[a]

Study	Sample	Study design	Intervention	Physical activity target	Dependent variable(s)	Results
Child and Adolescent Trial for CV Health (CATCH) Luepker et al. (1996)[67] McKenzie et al. (1996)[69]	· 5,106 students · 96 schools/ CA, LA, MN, TX · Multi-ethnic · Girls and boys · Cohort	· Exp · I (56) and C (40) schools · schools (28) randomized to family also · Grades 3, 4, 5 · FU grades 6, 7, 8	· SCT and Org Change · Curricula, lunch, PE, family, policy · 2½ yrs food service and PE 3rd/5 wk (15 sessions) 4th/12 wk (24 sessions) 5th/8 wk (16 sessions) 5th/4 wk (8 sessions)	· Increase MVPA in PE · Increase out-of-school PA · Improve CV fitness	· PA in PE (SOFIT) · Self-report PA (SAPAC) · Fitness test (9-min run)	· Increased MVPA during PE · Increased out-of-school vigorous PA for I schools (effect maintained at Grade 8 FU) · No fitness change
Sports, Play, and Active Recreation for Kids (SPARK) Sallis et al. (1997)[68] McKenzie et al. (1997)[70]	· 955 students · 7 schools/San Diego · 82% white · Upper and middle SES · Girls and boys · Cohorts (2)	· Quasi-exp · I (4) and C (3) · Grades 4, 5 · FU 1.5 yr each cohort	· SCT, SM · I-1 schools PE specialist-led PE (PES), I-2 schools used trained teacher-led PE (TT), C schools used teacher led PE. Self-management curriculum · 2 yrs for PE; 1 semester SM	· Increase PA in PE · Increase out-of-school MVPA · Improve fitness scores	· PA in PE (SOFIT) · Caltrac, self-report PA · Fitnessgram tests	· Both I-1 (PES) and I-2 (TT) provided more MVPA during PE (greater effects for PES) · No change out-of-school PA · No change in SM
High school age interventions						
Australia School Project Homel et al. (1981)[80]	· 3,200 students · 3 schools · New South Wales · Lower SES · Girls and boys	· Quasi-exp · 1 high school, 2 primary schools	· No theory stated · Curricula K-12, CVD screening (self-report), C screening only · 2 yrs	· Proportion who do more than 1-hr exercise outside school	· Self-report PA · Self-report K and A (high school only)	· Proportion of I > 1 hr PA outside school increased 17.5%; C > 6.5%
Slice of Life Perry et al. (1987)[75]	· 270 students · 1 school · Multi-ethnic · Girls and boys · Cohort	· Exp · I (6) and C (4) classes · Grade 9	· SLT · Curriculum led by peers/experts, policy changes · 1 semester/10 sessions	· Increase PA outside of PE · Increase K and A for PA	· Self-report of PA · K and A test for PA	· No effect of I on PA outside of PE · I Girls had better K and A toward PA

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played in Table 4. No foreign studies were identified for the community setting. Overall, there was a total of 17 completed studies in school and community settings and 9 in progress.

In addition to the studies listed in the tables that meet study inclusion criteria, there are several pilot or small studies with physical activity outcomes. They include an inner-city high school with family involvement[89] to improve cardiovascular health behavior and risk factors. A middle school study with Hispanic and African-American students reported significant positive effects from an aerobic dance-based PE intervention.[90] In addition, a study of third graders and their parents was conducted in rural schools in Northern California to promote physical activity[91] and reported significant increases in knowledge. A community-based pilot study by Resnicow and colleagues, Go Girls, is being conducted with adolescent African-American females to increase physical activity and improve dietary behaviors for weight control.

Table 1. School-based physical activity intervention studies among elementary, secondary, and college-level students[a]

Study	Sample	Study design	Intervention	Physical activity target	Dependent variable(s)	Results
Stanford Adolescent Heart Health Program Killen et al. (1988)[76]	· 1,447 students · 4 schools · Multi-ethnic · Girls and boys · Cohort	· Exp · I (2) and C (2) schools · Grade 10 · FU 2 months	· SCT · Curriculum PE, peers · 7 wks (3 × wk)	· Reduce risks of CVD and increase K of CVD risks · PA part of CVD risk	· PA checklist · CVD K test with PA	· Increased voluntary PA for I · Increased K for I
Project Active Teens Dale et al. (1988)[77]	· 599 students 1 (401) C (198) · 1 school/AZ · Multi-ethnic · Girls and boys · Cohorts (2)	· Quasi-exp · 2 cohorts · Grade 9 · FU 3 yrs, 2 yrs (Cohort 2)	· SCT and cognitive evaluation theory (self-reg) · Conceptual PE (CPE), PA labs, classroom curriculum · 2 semesters	· Reduce inactivity · Increase PA · Change PE course	· Inactivity · YRBS	· Reduced inactivity (more for girls) · Increased mod PA for boys · Increased wt activities for girls
College age interventions						
Active Recreation Tertiary Education Campuses (ARTEC) Leslie et al. (1998)[81]	· 2,729 students · 4 universities in Melbourne AU · Females and males	· Quasi-exp · I (2) and C (2) campuses · College mean age (24 yrs) · FU 1 yr	· No theory stated · I included free fitness testing, demonstrations, and on-campus media for PA · 5 wks	· Increase % students for PA · Increase total LTPA · Increase on-campus PA	· LTPA-EE · Time spent in LTPA · Time spent in PA on campus	· Increased total LTPA · Increased on-campus PA for I-1 only
Project GRAD (Graduate Ready for Activity Daily) Sallis, Calfas et al. (1998)[78]	· 338 students · 1 college, CA · Multi-ethnic · Females and males · Cohort	· Exp · I (CPE + self-management) or C (Health Ed) classes · Seniors	· SCT · CPE course for PA, SM training, peers, separate PA labs for active and non-active · 1 semester course	· Increase moderate and vigorous leisure physical activity plus strength and flex exercise	· Self-report PA (PAR) · Frequency of WT and Flex Exercise	· Effects on total EE for initially active women · WT and Flex for women · No effects for men

[a]A = attitude; AHA = American Heart Association; Am-Indian = American-Indian; C = control group; CALTRAC = Caltrac Activity monitor; CPE = Concepts-Based Physical Education; CV = cardiovascular; CVD = cardiovascular disease; EE = energy expenditure; Exp. = experimental; % fat = percent body fat; Flex = flexibility training; FU = follow-up; I = intervention group; K = knowledge; KYB = Know Your Body; LTPA = Leisure Time PA; MOD = Moderate intensity; MVPA = moderate-vigorous physical activity; PA = physical activity; PAR = Physical Activity Recall; PE = physical education; PES = PE specialist; SAPAC = Self-Administered Physical Activity Checklist; SM = Self-monitoring; SOFIT = System for Observing Fitness Instruction Time; SCT = Social Cognitive Theory; SES = Socioeconomic Status; SLT = Social Learning Theory; VO_2 = oxygen consumption; TT = trained teacher; WT = weight training; YRBS = Youth Risk Behavior Survey.

Synthesis of School-Based Studies

As shown in Tables 1 and 2, there was a total of 22 school-based studies with 14 completed and 5 in progress. One study each was conducted in Norway, in Wales, and in Australia. The rest were carried out in the United States. The 8 studies in-progress are all in the United States. Numerous foreign studies have been conducted; however, most used fitness measures and did not report physical activity findings.

No studies with a physical activity measure were identified for students below grade 3. Most of the studies were at the elementary level involving primarily grades 3, 4, 5, and 6 in some combination. The completed research at the elementary school level includes Know Your Body/Los Angeles, Oslo Youth Study, Go for Health, Southwest Cardiovascular Curriculum Project, Nebraska School Study, CHIC, CATCH, and SPARK. The ones in progress at this level are Pathways, OPPrA, and EWKM. No middle or junior high school studies were completed; however, the Oslo Youth Study crossed elementary and middle schools, and the CATCH III Follow-Up Cohort Study measured students in grades 6, 7, and 8. M-SPAN and Planet Health are the middle school studies in progress.

At the high school level most of the focus was on Grades 9 or 10. The completed studies are the Australia School Project, Slice of Life, the Stanford Adolescent Heart Health Program, and Project Active Teens. The two high school studies underway are LEAP and the

Table 2. Studies in progress: school-based youth physical activity intervention studies[a]

Study	Sample	Study design	Intervention	Physical Activity Dependent Target	Variable(s)	Results
Elementary school age interventions						
Pathways Caballero et al.	· 1,706 students · 41 schools AZ, NM, SD/ Rural · Am-Indians · Girls and boys · Cohort	· Exp · I (21) and C (20) schools · Grades 3, 4, 5	· SLT · Changes in PE, lunches, classroom curricula for grades 3, 4, 5, parents, peers, policy · 3 years	· Increase in PA · Increase in EE · Decrease % body fat	· % Body fat · Tritrac activity monitor · 1 day PA recall (PAQ)	· Feasibility Study · Baseline
Eat Well and Keep Moving(EWKM) Gortmaker et al.	· 479 students · 14 schools in Baltimore · 90% Af-Am · Girls and boys · Cohort	· Quasi-exp · I (6) and C (8) · Grade 4, 5	· SCT, social marketing, behavioral choice · Interdis. curriculum for nutrition and PA, food service, campaigns, parents, and staff wellness · 2 yrs	· Increase PA · Decrease TV viewing	· Repeat 1 day PA and TV recall · Self-report PA and TV viewing frequencies	· Submitted
Stanford Obesity Prevention for Pre-Adolescents (OPPrA) Robinson et al.	· 1,000 students · 13 schools/ CA · Multi-ethnic · Girls and boys · Cohort	· Exp · I (6) and C (7) schools · Grades 3, 4, 5 · FU Grade 6	· SCT, SM, and Org Change · Changes PE, lunches, curriculum, parents, policy · 3 yrs intervention; 12 wk high-risk program for overweight	· Increase MVPA in PE and outside school · Improve fitness · Reduce body fat in high-risk	· SOFIT during PE and self-report of PA (child/parent) · PACE · % body fat	· Baseline
Middle school age interventions						
Planet Health Gortmaker et al.	· 1,295 students · 10 schools/ MA · Multi-ethnic · Girls and boys · Cohort	· Exp · I (5) and C (5) · Grades 6, 7, 8	· SCT, Behavioral Choice · Interdisc. curriculum in math, science, lang. arts, soc. studies, PE · 2 yrs	· Decrease in TV viewing · Increase in MVPA	· Reduction in obesity · Self-report PA · TV viewing	· Submitted
Middle School Physical Activity and Nutrition (M-SPAN) Sallis et al.	· 24 schools/ San Diego · Multi-ethnic · Girls and boys · Cross-sectional	· Exp · I (12) and C (12) schools · Grades 6, 7, 8	· SCT · Staff dev for modifying PE, student advocacy groups, extracurr activities offered in the school, similar for diet · 2 year intervention	· Increase MVPA throughout the school day (PE and before and after school)	· PA during PE (SOFIT) · PA at school (SOPLAY) · Self-report of PA (subsample)	· Baseline

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Table 2. Studies in progress: school-based youth physical activity intervention studies[a]

Study	Sample	Study design	Intervention	Physical Activity Target	Dependent Variable(s)	Results
High school age interventions						
Lifestyle Education for Activity Project (LEAP) Pate et al.	· 2,800 students · 24 schools/ SC · Af-Am (35%) · Girls only · Cohorts (2)	· Exp · I (12) C (12) schools. · 2 cons. cohorts in Grade 9	· SCT, Org Change, SM · PE with Ed and SM units, curriculum, parent newsletters, student advocacy groups, policy · 2 semesters	· Increase MVPA in/out of school · CV fitness · Modify PE	· 3 day PDPAR · PWC-170 bike · CSA monitor during PA	· Baseline
Adolescent Computer-Based CVD Curriculum and Advocacy Robinson and Killen (1995)[82]	· 2,609 students · 6 schools/CA · Multi-ethnic · Girls and boys · Cohort	· Exp · I (3) and C (3) schools · Grade 9 · FU Grade 10	· SCT · Computer-based curriculum for PA, diet, and smoking, 15 sessions, 10 sessions advocacy training, peers, policy · 2 semesters	· Increase MVPA in and out of school · Decrease inactivity	· Checklist of aerobic activity · PA recall (Washburn)	· Submitted
College age interventions						
Teaching Exercise/Activity Maintenance (Project TEAM) Buckworth et al.	· 550 students · 1 college/OH · Multi-ethnic · Females and males · Cohort (2)	· Quasi-exp · I (3) and C (3) · Undergrad · FU 2 yrs	· SCT, Trans Theoretical, SM · Staged matched curriculum, SM and skills training, Peer Strategy Teams	· Increase total PA · CV fitness · Maintenance of posttest PA levels	· 7-day PAR · YRBS · PWC-170 bike	

[a]Af-Am = African American; A = attitude; C = control group; CSA = CSA activity monitor; CVD = cardiovascular disease; CV = Cardiovascular; EE = energy expenditure; FU = Follow-up; I = intervention group; K = knowledge; MVPA = moderate–vigorous physical activity; PA = physical activity; PACE = 20 min shuttle run; PAR = Physical Activity Recall; PDPAR = Previous Day Physical Activity Recall; PE = physical education; PWC = physical work capacity; SAPAC = Self-Administered Physical Activity Checklist; SCT = Social Cognitive Theory; SM = Self-Monitoring; SOFIT = System for Observing Fitness Instruction Time; SOPLAY = System for Observing Play and Leisure in Youth.

Adolescent Computer-Based Cardiovascular Curriculum and Advocacy. There are three college-level studies, and the ARTEC study conducted in Australia and Project GRAD are completed. TEAM is in progress.

Designs

Eight of the completed studies used random assignment designs and the other six were quasi-experimental (nonrandomized). CATCH was the only multicenter randomized trial; it had four field centers, a coordinating center, a steering committee for study administration, and oversight from a Data and Safety Monitoring Board (DSMB).[67,92] In contrast, six of the in-progress studies used random assignment designs with Pathways being a multicenter randomized trial.

Most studies randomized or assigned schools, rather than students to intervention conditions. The Australia School Project, Slice of Life, Project Active Teens, Project GRAD, and TEAM used classrooms or individual students. Most of the studies defined a cohort at baseline and these were the students involved in the final analyses except the Australia School Project, the Computer Modification Study, and M-SPAN. Follow-up, beyond the completion of the study, was included in only a few studies and it ranged from two months for the Stanford Adolescent Heart Project, one and a half years for SPARK, two years for TEAM, three years for CATCH, seven years for Class of 89, and 12 years for the Oslo Youth Study. A one-year follow-up was built into OPPrA and the Adolescent Computer-Based CVD Curriculum and Advocacy studies.

Table 3. Community-based physical activity intervention studies[a]

Study	Sample	Study design	Intervention	Physical activity target	Dependent variable(s)	Results
Family Health Project (FHP) Nader et al. (1989)[83]	· 206 families · San Diego · Biethnic · Girls and boys · Cohort	· Exp · I and C families/ 12 schools · Grade 5, 6 students · FU 2 years	· SLT · Curr to promote diet and PA · 12 wks/1.5 sessions per wk; 6 maintenance sessions	· Increase PA among families	· PA self-report · Fitness · K survey	· No effect on increasing PA · No gains in CV fitness · Increased K of CV health
Center-Based Program for Families Baranowski et al. (1990)[84]	· 94 families · Galveston, TX · Af-Am only · Lower SES · Girls and boys · Cohort	· Exp · I (54) and C (40) families · Grades 5–7 · 120 students	· SCT · I and C baseline health assessment. I group 1 education and 2 fitness sessions per wk · 14 wks	· Increase PA and CV health	· 7-day PAR · Fitness test (submax. bike)	· PA increased in both C and I adults · No effect on fitness · Participation (20%)
Class of 1989 and Minnesota Heart Health Program Study Kelder et al. (1993)[32]	· 2,376 students · 7 schools/ MN, ND, SD · 90% white · Girls and boys · Cross-sectional	· Quasi-exp · I (1) and C (1) communities · Grades 6–12 (annual waves) · FU 7 years	· SLT and SM · PA, diet, smoking curricula, parent, peers, policy · Varied by yr	· Increase PA · Increase CV health behaviors	· Self-report PA · Clustering of CV behaviors · Tracking of PA	· PA declined over time, but smaller declines at all grades for I. · Larger effect for females · PA tracked

[a]Af-Am = African American; C = control group; CV = cardiovascular; FU = follow-up; I = intervention group; K = knowledge; PA = physical activity; PAR = Physical Activity Recall; SCT = Social Cognitive Theory; SES = Socioeconomic Status; SLT = Social Learning Theory; SM = self-monitoring; wk = week.

Samples

The number of schools varied greatly with 96 in CATCH (across four study centers) and one school in the Australia School Project, Slice of Life, Project Active Teens, and Project GRAD. Of the studies in progress, the number of schools ranged from 41 to 7. The number of students in completed studies ranged from over 5,000 in CATCH to 200 in the Nebraska School Study. For the studies in progress, M-SPAN is conducting environmental changes in schools with approximately 1,000 students enrolled in each of the 24 middle schools from whom cross-sectional samples are selected for observations of PE classes and for self-report of physical activity. In comparison, EWKM has 479 students.

All of the studies included females and males and all the U.S. studies are multiethnic. The Southwest CV Curriculum Project and Pathways involved American Indian students. The Oslo Youth Study, the Southwestern CV Curriculum Project, the Nebraska School Study, CHIC, and Pathways involved rural settings.

Intervention Components

A number of studies used a multiple theoretical approach. Most of the studies used Social Cognitive Theory (SCT) or Social Learning Theory (SLT). Several used Social Influences, Self-Monitoring (SM), and Cognitive Evaluation Theory. CATCH, OPPrA, and LEAP also employed Organizational Change Theory.

A major theme in most studies completed or in progress was the use of multicomponent interventions versus a single factor approach. Some of the components included the PE programs and the classroom health curricula as well as out-of-school physical activity. Most of the studies included a dietary component and some also addressed smoking prevention.

The studies that focused only on physical activity, fitness and/or PE were SPARK, Project Active Teens, Project GRAD, LEAP, and TEAM. The other studies with a PE intervention were the CATCH, Go for Health, Oslo Youth Study, Pathways, OPPrA, Planet Health, and M-SPAN.

The interventions varied greatly in length and scope of sessions, ranging from just a few weeks in a semester

Table 4. Studies in progress: community-based physical activity intervention studies[a]

Study	Sample	Study design	Intervention	Physical activity target	Dependent variable(s)	Results
Way Cool Donnelly et al.	· 200 students · 6–11 yrs old · NE/KS · Multi-ethnic · Girls and boys	· Exp · I (100) and C (100) · Youth program (NYSP)	· SCT · Multi-level educational CD-ROM for encouraging PA · 5 weeks/3 hrs or more wk · Home-based	· Increase PA · Decrease inactivity · Change K and A	· 7 day PAR · Survey of K · Exercise A	
Hip Hop to Health Fitzgibbon et al. (1995)[86]	· 310 students · 6–10 yrs old · 202 parents · Af-Am only · Girls and boys · Cohort	· Exp · I-1, I-2 or C · 3 cohorts from inner city housing project	· SLT · I-1 parent and peer with KYB for PA and diet, I-2 used KYB alone, Housing project for students · 9 mos (24 sessions/wk)	· Increase levels of PA · Increase fitness	· 7-day PAR · 600 yd run · Strength and flexibility	· Results paper in preparation
On the Move Garcia et al. (1997)[87]	· 2,800 students · 12 schools/ MI · Multi-ethnic · Girls and boys · Cohorts	· Exp · I (2) and C (2) in 3 inner city districts · Grades 6, 7, 8	· SCT · PA programs before or after school, trained rec staff · 6 semesters; 3× per wk/20 wks per yr	· Increase PA before and after school to percent smoking · Increase fitness	· 5 Day PA Log · 600 yd. run · Strength and endurance	· Baseline
Active Winners Pate et al. (1997)[88]	· 227 · 2 towns/SC · Af-Am (77%) · Rural · Girls and boys · Cohort	· Quasi-exp · I (90) and C (137) students · Grades 5, 6 · FU Grade 7	· SCT · After school and summer program · 18 mos/4 days wk	· Increase PA out of school · Increase fitness	· PA 1 day recall (PDPAR) · PWC-170 · Intentions to exercise	· No increase in PA · No increase in fitness · Increase in intentions (girls only)

[a]Af-Am = African American; C = control group; FU = follow-up; Exp = experimental; I = intervention group; K = knowledge; KYB = Know Your Body; PA = physical activity; PAR = Physical Activity Recall; PDPAR = previous day physical activity recall; PWC = physical work capacity; Quasi-exp = quasi-experimental; SCT = Social Cognitive Theory; SLT = Social Learning Theory; SM = self-monitoring; wk = week.

to multi-year. Most of the studies used existing school staff who were given training to implement the interventions. The studies that used personnel other than existing school staff to deliver all or part of the interventions were SPARK (PE specialists), Southwest CV Curriculum Project (classroom teacher), Oslo Youth Study (parent nutrition counselor), Stanford Adolescent Heart Health Program (classroom teacher), and Project GRAD (classroom teacher). Only a few studies had parent, peer, or policy components.

Dependent Variables

Most of the studies measured knowledge, attitudes, and self-reported behaviors for physical activity. Except for the Nebraska School Study, OPPrA, Pathways, and Planet Health the studies identified increasing levels of physical activity as a primary outcome. The studies that also included fitness measures were the Nebraska School Study, Oslo Youth Study, CHIC, CATCH, SPARK, and Project GRAD. Of the studies in progress, a fitness measure is included in Pathways, OPPrA, and LEAP. Several studies used accelerometers (LEAP and Pathways). The Oslo Youth Study, CHIC, LEAP and TEAM used or plan to use the PWC-170-cycle ergometer test. The System of Fitness Instruction Time (SOFIT) was the most frequently used instrument to measure physical activity levels during PE.

Results

Improvements in knowledge and attitudes related to physical activity were generally found in the studies that measured these areas. Few positive findings were re-

ported on measures assessing out-of-school physical activity. Go for Health, SPARK, and Slice of Life found no significant increases. The Nebraska School Study reported less out-of-school physical activity for the intervention group but a significant increase in physical activity during school PE. The other studies that measured out-of-school physical activity and reported significant results in the desired direction were CATCH, the Oslo Youth Study, the Australia School Study, the Stanford Adolescent Heart Health Study, Project Active Teens (more for girls), the ARTEC, and Project GRAD (females only). The CATCH III Follow-Up Study of the cohort in Grade 8, found a significant difference for out-of-school vigorous physical activity that still existed after three years without further CATCH intervention with the students. A 12-year follow-up of the Oslo Youth Study participants into early adulthood (average of 25 years of age)[33] reported that early physical activity levels were predictors of this behavior in adulthood. There was a higher prevalence of regular vigorous exercise reported at follow-up for the intervention group than controls. Go for Health, the Nebraska School Study, SPARK, and CATCH reported significant increases for MVPA in PE classes.

The strongest evidence base is with students in the upper elementary grades and school environmental changes. As provided in the summaries in Tables 1–4, there are more studies completed or in progress for schools and fewer in community settings. Also, more studies have been conducted and are in progress in the United States than in other countries.

Synthesis of Community-Based Studies

As shown in Tables 3 and 4, only 7 studies were identified in the community setting that included physical activity measures. All of these were in the United States, with 3 completed and 4 currently underway. This group of studies is similar to the school setting in that no studies involving children in preschools, kindergarten, or early elementary grades were found. In addition, there were no studies of college-aged groups. The completed studies involving upper elementary-aged students and their families were the Family-Health Project and the Center-Based Program for Families. In addition, the Class of 89 measured students from Grade 6 to Grade 12. For the 4 studies in progress, the Hip Hop for Health includes 6–10 year olds and their parents, Active Winners involves 5th and 6th graders, Way Cool 6–11 year olds attending National Youth Sports Programs, and On the Move includes 6th, 7th, and 8th graders from inner-city schools.

Designs

Two completed community-based studies used random assignment of families and, one used a quasi-experimental design. Of the 4 studies in progress one randomized families, one randomized schools within districts, one randomized individual children, and one employed a quasi-experimental design with individual students attending assigned schools.

Samples

The samples varied greatly. Examples of studies that are being conducted in high-risk populations are listed in Table 4 and include Garcia et al., 1997[87]; Pate et al., 1997;[88] and the Hip Hop to Health, which aim to increase physical activity in children and their families living in inner-city housing projects. The Center-Based Program for Families involved African-American families, while the Family-Health Project included primarily Hispanic and Caucasian families. Over 90% of the students in the Class of 89 were Caucasian. The Hip Hop to Health involves inner city students aged 6 to 10 and parents, while the Active Winners study involves elementary-aged students who are predominately rural African-American. Way Cool involves multi-ethnic children attending National Youth Sports Programs in Nebraska and Kansas. Finally, the On the Move research is being conducted with multi-ethnic adolescents attending inner-city middle schools located in the Midwest.

Intervention Components

All 7 studies list theoretical models as a basis for their interventions. Four reported using Social Cognitive Theory and three Social Learning Theory with one also using Self-Monitoring (SM). All of the studies except Active Winners address physical activity and dietary behaviors. Active Winners focused on increasing physical activity and fitness levels outside of school. The Class of 89 addressed three cardiovascular health behaviors including smoking prevention. Four of the studies used the school setting and facilities to deliver the intervention, two used community facilities, and one used a community room in a housing project. A variety of community staff were trained to deliver the interventions and conduct measurements. The Class of 89, part of the larger Minnesota Heart Health Program field trial, used school and community staff.

Dependent Variables

Some studies measured knowledge. All studies but the Class of 89 and Way Cool measured both physical activity and fitness levels.

Results

For the three completed studies there were limited significant results. The Center-Based Program had only a 20% participation in the sessions at the end of the program. The Family Health Project reported significant increase in knowledge, but there were no significant increases in fitness or physical activity for either of these studies. The Class of 89 reported a decline in physical activity over the grades for both intervention and controls, but the decline was smaller at all grades in intervention schools. The intervention effect was larger for the girls. The findings showed that physical activity behaviors track over adolescent years and that health-enhancing or health-compromising behaviors tend to cluster for physical activity, dietary choices, and smoking behaviors.

In summary, few school and community-based studies of physical activity have been conducted, they included only a few age groups, and the results provide limited positive findings. Most of the research has been conducted with upper elementary schools and students, in whom the results of the first school-based multicenter randomized trial have been reported. A number of the studies used nonrandomized designs and the psychometrics for the measurement instruments for physical activity were not always provided.

Discussion

Research Design Issues

The designs and analytical strategies used in the more recent studies include more randomized trials, involve multicomponent interventions, and often address measurement of multiple behaviors and environmental changes. The absence of preschool and early primary grade studies appears to be due partially to the difficulty in measuring physical activity as well as delivering interventions. Multicomponent coordinated studies and programs usually are based on several theoretical models.

The majority of the studies reviewed addressed multiple behaviors with diet being the one coupled most often with physical activity. Multiple components research such as intervening in PE, school lunch, school policies, classroom curricula, and parents continue to emerge. CATCH is the first school-based multicenter randomized trial ever conducted.[67,92–94] Pathways is a multicenter trial in progress. The Trial of Activity for Adolescent Girls (TAAG) is a new initiative for a middle school multicenter trial.

Measurement Issues

To evaluate interventions designed to promote physical activity it is imperative to have an accurate measure of physical activity behavior. Interventions in children and adolescents are complicated in comparison to adults due to the increased difficulty in obtaining valid and reliable assessments. Partly because of measurement difficulties, many studies[56,61,95] did not include measures of physical activity and were therefore not included in the present review. Of those studies that did assessed physical activity in PE, several used the System of Fitness Instruction Time (SOFIT).[67,68,73]

The need for improved assessments of physical activity in children has been recognized as an important research priority and significant progress has been made in recent years. There are now several observational studies[96] and self-report instruments that have demonstrated adequate validity and reliability. Advances in activity monitoring devices have also made it easier to collect objective data on physical activity under free-living conditions.[97] While these devices may have greater validity than self-report forms, they are generally impractical for many intervention studies in which large numbers of children need to be assessed. One of the other problems created by PA assessment is that various studies use different instruments, making direct comparisons of intervention effects very difficult or impossible except for comparing percent changes. We cannot then determine the relative effectiveness of different approaches. A useful contribution to the field would be to pursue internationally-agreed on measures of PA among children and youth as is being done with adults.

While progress has been made with respect to activity assessments, much less work has been done to improve assessments of some of the underlying determinants of physical activity in children. These measures are typically included in intervention studies to learn what factors may be influencing children's activity behaviors.[65,67] In most cases, models or variables assumed to be salient in adults are adapted for use in children. Wording may be changed to accommodate differences in reading levels but the instruments rarely consider other developmental differences between children and adults (abstract vs. concrete thought patterns, sources of influences for appraisal). A promising, but underresearched area includes the role of fundamental motor skills (developed during elementary school years) in influencing later PA involvement. It would come under the heading of "behavioral capabilities" in Social Cognitive Theory but appears to have been considered rarely.

Most of the studies used Social Cognitive Theory followed by the closely related Social Learning Theory. Social Cognitive Theory is a sound theoretical model for a multilevel intervention that is integrated. The model specifies three domains to consider in the design of behavior change and prevention programs: personal, behavioral, and environmental factors. Several

studies also employed Organizational Change Theory, Social Influences, Behavior Modification, and Cognitive Evaluation Theory (Self-Regulation). CATCH was an example of how a theory-based model was used in the design and analyses, the measurements, student and parent interventions, school staff training, and the process evaluation system.

Maintenance

Only a few studies included a postintervention follow-up. The longest follow-ups were twelve, seven, and three years, respectively, for the Oslo Youth Study, Class of 89, and CATCH. All showed declining effects but still reported significant increases in physical activity versus the control students. The Class of 89[32] and the Oslo Youth Study reported that physical activity and inactivity track.[33] Recent findings from the CATCH III Follow-up Cohort Study show that there was still a significant difference between the intervention and control students for levels of physical activity three years after the intervention ended in fifth grade. More of the current studies have included follow-up periods, typically for one year.

Generalizability

Because effective programs can become institutionalized into the regular school curriculum, staff development, and other infrastructures, school-based physical activity/physical education have an inherent advantage in generalizability over interventions in other settings. This advantage stems from the fact that schools exist everywhere in the world, service millions of students, have existing school staff, training programs, and a funded infrastructure to support ongoing programs and to adopt new ones. School policies and mandates differ around the world, however. In the United States, there are state and districtwide mandates for school curricula, while in Australia curricula are state-based and are moving toward national uniformity. In some other countries there are national curricula. Worldwide there is a need to do a more effective job of training teachers and school administrators about health needs during their undergraduate and graduate training. Evidence for more effective community programs is needed before generalizability can be addressed. The status of school policies related to school health, including PE, is being monitored nationally in the United States on a regular basis (approximately every 5 years) and the findings provide trends in diffusion and adoption of programs and policies.[98]

Cost Analyses

When considering cost issues in school-based physical activity interventions, it is important to consider the relative and absolute costs. While there are absolute costs associated with the implementation of any program, the costs are generally no greater than what is typically required for standard programs or curricula. This advantage, once again, stems from the existing infrastructure that is available in schools. Community agencies can build into their program planning and deliver more physical activity promotion for youth and families. If it were part of their routine program mission, they also would have an existing infrastructure. CATCH is an example of research being designed to use only intervention materials and curricula as well as staff training that cost no more than what schools typically invest in a new program. Only school staff was used to deliver the interventions, all staff training adhered to the typical staff development models used by schools, and the program was designed to be flexible enough to be adapted to different cultural needs and school facilities. In contrast, the Stanford Tenth Grade Study and SPARK used some outside research staff to teach the curricula, so it is not known if regular school staff would have the same effect. In SPARK, the regular school teachers were used for two conditions, but since schools did not employ PE specialists, they were provided by the research team to test that arm of the study. For several studies cost analyses of the materials and training are available for dissemination to the field. Most of the studies have not conducted cost analyses studies.

Implementation

The implementation issues are often addressed via pilot studies prior to the main study. Some community studies appear to have a problem with attrition, and reduction of barriers in high-risk groups needs careful planning to optimize recruitment and participation. The same is true for parent programs coordinated as part of school interventions. Some of the implications from this review are offered in the following recommendations for future research and public health practice.

Recommendations for Research

- Develop more reliable and valid self-report measures of physical activity for different developmental age groups as well as more use of observations and objective measures in conjunction with self-report measures.
- Conduct more studies on increasing out-of-school activity levels.
- Conduct studies on the effectiveness of interventions to prevent the decline in physical activity in females and adolescents.
- Conduct studies on the effectiveness of intervention

approaches for diverse ethnic/racial groups, economically advantaged, special needs populations, and late teens through early twenties.
- Conduct studies on the effectiveness of environmental and policy changes to increase physical activity in school or community settings.
- Examine whether multiple-component interventions are more effective than single components.
- Conduct studies with more post-intervention follow-up.
- Conduct more studies with young children and families.
- Design studies that involve both genders to be able to report the effects of different interventions for males and females.
- Conduct studies comparing the population versus the high-risk approach (or a combination).
- Include process evaluation frameworks in the overall study design and protocols.
- Provide more precise descriptions of interventions and measurement procedures so that effectiveness of each of the segments in multicomponent studies can be identified and replicated.
- Design studies on whether restricting access to sedentary behaviors and reinforcing decreases in sedentary behavior increases physical activity.
- Convene an international committee to recommend common PA assessments so that findings can be compared.

Recommendations for Public Health Practice

- Establish school policies and environments to provide space, equipment, and supervision for before and after school and lunch and recess periods to promote physical activity.
- Provide appropriate resources for more emphasis on mastery of fundamental skills in children, since these are essential for exercising choices for leisure-time activities across the lifespan.
- Introduce more intramural and extramural activities that direct more resources to programs that service all students.
- Promote more programs and resources for family participation and opportunities for physical activity through school and community programs.
- Increase attention by community organizations and agencies to noncompetitive sports and recreational activities in order to meet the needs of a variety of youth, with special attention to preadolescent and adolescent girls.
- Increase training opportunities for teachers at the college-preparation stage, as well as after they are employed in the field, on the fundamentals and importance of physical activity.
- Provide more school–community linked physical activity programs that meet the needs and interests of girls as well as boys.
- Increase efforts to institutionalize programs shown to be effective, so that they are a routine part of school programs, policies, and resource allocations.

Public Health Implications

This review and synthesis of past and current studies on the effects of interventions on physical activity of youth adds to other reviews, reports, and policy statements to provide future directions for the field. Physical activity is a key component of public health promotion for young people as well as adults.

Since inactivity has been established as a modifiable risk factor for a number of disease conditions, the role of physical activity in the prevention of disease and the promotion of health has gained a prominent role in public health policy[1,13,14] in the United States and other countries.[16] Recommendations in support of organized physical activity for youth come from numerous professionals[99,100] organizations,[15,101] and agencies.[10,12] A recent review chapter on physical education contains a summary of the statements on physical activity, fitness, and health issues by national organizations and agencies[39] including the American College of Sports Medicine and the President's Council on Physical Fitness and Sports.

Schools worldwide provide unique existing community infrastructures because they serve a large number of children and adolescents year round, have facilities and equipment, as well as staff who either have expertise or can be given training to teach the skills and benefits of lifelong physical activity.[13,14,16,27] For example in the United States, there are 52.2 million students enrolled in K–12 public schools, and another 10% in private schools. There are over 86,000 public schools, including more than 50,000 at the elementary level.[102] In addition, there are over 2,000 four-year colleges as well as vocational and Head Start schools. Communities also have many agencies and facilities for promoting physical activity outside of school through sports and recreation programs. In 1997, over 22 million youth were in agency-sponsored sports, 14.5 million in recreational sports in recreation departments, and 2.3 million in sports clubs with fees in the United States alone.[103] The community resources and programs vary across countries.

The new *Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People*[14] lists ten recommendations for school and community programs to promote physical activity. These include policy, environment, physical education classes, health education curricula, extracurricular activities, parental involvement, and community programs as well as other

areas. Under extracurricular activities there is a recommendation to link schools and students to community physical activity programs and to develop effective systems for referring youth from schools to community agencies. Since some findings indicate that over 80% of physical activity occurs outside of school PE programs,[25] resources and linkages to the community are important. PE classes can teach behavioral skills and foster participation in community-based organized programs and sports. Family programs are important as well as policy implementation, environmental changes, and resource allocations by governmental agencies and organizations.[13,14,48]

Studies in community and family settings are extremely limited. Several new research initiatives are underway by the National Institutes of Health, Centers for Disease Control and Prevention (CDC), and other agencies and organizations. The Go Girls pilot study being conducted in six Atlanta housing projects with a three-year grant awarded to Emory University by the CDC Foundation. The Physical Activity and Nutrition (PAN) Program is an example of a new community study to provide information on effective approaches for working with high-risk populations of African-American girls to plan a field trial.

A recent review by Kohl and Hobbs[104] summarized factors related to youth and physical activity behaviors including some of the following important points: (1) activity levels have seasonal variation with the highest levels in summer and lowest in the winter; (2) children are more active on weekends than during the week; and (3) time outdoors is related to more activity. Godin and Shepard[105] reported that among junior high school students attitudes toward physical activity, prior experience in physical activity, and current activity habits contribute significantly to the intention to exercise. In addition, results from Swedish teenagers suggest that those who had more experience with physical activity and sports prior to age 15 had a higher psychological readiness for physical activity at 30 years of age.[106] In summary, there is a large body of literature on the potential interpersonal and environmental determinants related to physical activity in children and adolescents.[14,36,104,107,108] Along with the results of intervention studies reviewed, these factors provide guidance for designing future research studies and for current public health practice in the area of youth and physical activity promotion.

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