

Physical Education's Role in Public Health

James F. Sallis and Thomas L. McKenzie

The public health community is becoming increasingly interested in the potential contributions of school physical education to child health. School physical education is seen as an ideal site for the promotion of regular physical activity because up to 97% of elementary school children participate in some sort of physical education program. For maximal public health benefit, school physical education programs should prepare children for a lifetime of physical activity. This public health goal for physical education may require some changes in current approaches. Physical educators are challenged to collaborate with public health professionals in developing and evaluating school physical education programs that will improve the health of the nation's youth.

Key words: physical education, public health, CVD, children, exercise

School physical education is an integral part of the American educational system. This is evidenced by findings that 97% of elementary school children are enrolled in physical education programs in Grades 1 through 6, although only about 50% are enrolled by the end of high school (Ross, Dotson, Gilbert, & Katz, 1985; Ross, Pate, Corbin, Deply, & Gold, 1987). Historically, physical education has been justified on the basis of broad and diverse goals in physical, social, and moral development. In fact, the major emphasis has been on competitive sports, beginning as early as the third grade and continuing throughout high school (Ross et al., 1985, 1987). Until recently the large-scale fitness testing programs assessed sport-related skills rather than health-related fitness (Ross et al., 1987).

This sport-focused use of the resources devoted to physical education programs and interscholastic athletics is increasingly being questioned by health and physical education professionals. The American Academy of Physical Education (Malina, 1987), the American Academy of Pediatrics Committees on Sports Medicine and School Health (1987), and the American College of Sports Medicine (1988) have recently issued strongly worded statements highlighting the need for school physical education programs to adopt health-related physical activity goals. In a society in which adult sedentary behavior contributes substantially to the epidemic

of cardiovascular and other chronic diseases, there is a rationale for shifting the orientation of physical education to a health focus. Moreover, school physical education is the only major institution that can address the health-related physical activity needs of virtually all children. The Year 2000 Health Objectives for the Nation (U.S. Public Health Service, 1991) includes a number of objectives for youth physical activity and school physical education programs that will guide national policies for the 1990s. Physical educators should be involved in developing and implementing policies and programs derived from them.

In a recent review, Simons-Morton, O'Hara, Simons-Morton, and Parcel (1987) convincingly argued increasing children's physical activity is a more important public health goal than improving physical fitness. We accept Simons-Morton et al.'s (1987) conclusion that regular physical activity is important for children and proceed to consider how school physical education has a special role in promoting children's physical activity. This role is defined, and physical educators are challenged to join with public health professionals in developing and evaluating health-related physical education programs.

This paper analyzes the contributions physical education can make to the health of children and adults. Physical education has not historically been viewed as a public health program, but the reasons to consider it as such are compelling. In the past few years physical educators and health educators have begun to evaluate the effects of various physical education programs on health variables (Simons-Morton, Parcel, O'Hara, Blair, & Pate, 1988). This work signals a paradigm shift with broad implications for the way physical education is viewed by health professionals, educators, and the public. In this paper we review the reasons for this paradigm shift, trace its progress to date, and recommend additional changes in the goals and methods of physical education derived from an application of public health principles.

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Benefits of Physical Activity

The documented health benefits of physical activity for adults are fueling the drive for changes in school physical education (Simons-Morton, Parcel, O'Hara, Blair, & Pate, 1988). Physical inactivity is a major risk factor for cardiovascular diseases (CVD) (Berlin & Colditz, 1990; Powell, Thompson, Caspersen, & Kendrick, 1987) and promotes premature mortality (Paffenbarger, Hyde, Wing, & Hsieh, 1986). Even though epidemiologic data suggest adults could cut their risk of CVD in half by being regularly active (Berlin & Colditz, 1990; Powell et al., 1987), at least 40% of American adults are extremely sedentary (Caspersen, Christenson, & Pollard, 1986; Stephens, Jacobs, & White, 1985). The hypothesis is improved physical education programs for children could help prevent the next generation of adults from becoming so sedentary. Because CVD kills more people in Western countries than any other disease, a reasonable but untested hypothesis about the benefits of physical education that could influence up to 97% of the population deserves serious consideration from researchers and policy makers.

One rationale for changing physical education programs is to establish patterns of regular activity in children that will carry over to adulthood. But regular physical activity can have health benefits in childhood as well. American children have high levels of obesity, serum cholesterol, and blood pressure. In studies of children in Iowa (Lauer, Connor, Leaverton, Reiter, & Clarke, 1975), Los Angeles (Wheeler, Marcus, Cullen, & Konugres, 1983), and New York City (Williams, Carter, Wynder, & Blumenfield, 1979), 28, 48, and 33% of children, respectively, had at least one elevated CVD risk factor. Numerous studies have indicated children who are more fit and more active tend to be leaner and have lower blood pressure levels (reviewed by Montoye, 1985). Physical activity is also associated with higher levels of beneficial HDL-cholesterol in children (Thorland & Gilliam, 1981). These associations between physical activity and risk factors are similar for adults and children (Sallis, Patterson, Buono, & Nader, 1988), so it appears children can reduce their risk for later heart disease through regular physical activity.

Because risk factor levels in childhood predict risk factor levels in young adulthood (Cresanta, Burke, Downey, Freedman, & Berenson, 1986), decreasing risk factors in children is an important health consideration in itself. Childhood obesity may be a particularly important risk factor in need of intervention. From 1963 to 1980 the prevalence of obesity increased 54% (defined by skinfold measurements, in 6- to 11-year-old children [Gortmaker, Dietz, Sobol, & Wehler, 1987]). Lack of physical activity probably contributed to this increase. Because physical activity effectively promotes long-term weight loss in obese children (Epstein, 1984) and adolescents (Becque,

Katch, Rocchini, Marks, & Moorehead, 1988), increasing physical activity in children could play a role in preventing further increases in childhood obesity.

Other potential health benefits are more speculative. Physical activity in childhood and young adulthood is believed to enhance the uptake of calcium in the bones. High peak calcium content and slower loss of bone calcium are promoted by physical activity, so fractures during later life should be prevented (Chestnutt, 1990), and bone health throughout life should be improved (Smith, Smith, & Gilligan, 1990). Some scientists believe development and maintenance of muscular strength and flexibility will prevent back pain and other injuries in adulthood (Jopling, 1988). However, the strongest argument for a health-related physical education focus appears to be prevention of CVD.

CVD accounts for more than half of all deaths in the U.S. each year. If physical education programs can contribute to the prevention of this number one killer, existing physical education programs should be reoriented.

Current Levels of Physical Activity

Among professionals and the lay public there has been widespread concern about the fitness of American children. Yet children have substantially higher levels of cardiovascular fitness than adults (Simons-Morton et al., 1987), and there is insufficient evidence to conclude cardiovascular fitness levels have declined during the past few decades (Pate & Shephard, 1989). According to Simons-Morton et al. (1987) increasing cardiorespiratory fitness was not a health priority for children because health-related aspects of fitness do not seem to carry over to adult life. They recommended emphasis on the carryover of physical activity from childhood to adulthood. This recommendation has been echoed frequently (American Academy of Pediatrics Committees on Sports Medicine and School Health, 1987; American College of Sports Medicine, 1988; Ross et al., 1987). However, Simons-Morton et al. (1987) were criticized for their failure to consider all aspects of health-related fitness (Bar-Or, 1987; Corbin, 1987; Cureton, 1987; Seefeldt & Vogel, 1987). There is concern that physical education could become too focused on CVD prevention and neglect other important health benefits of physical activity. Even granting the importance of all fitness components and the deficiencies in knowledge of activity-CVD relationships, the primary health benefits from childhood physical activity will most likely come in preventing or delaying morbidity and mortality from CVD.

The data on the cardiovascular benefits of physical activity are much stronger than that on any other health benefits, which is the basis for the present focus on

promoting primarily "heart healthy" physical activity through physical education. However, promoting heart healthy activities in physical education does not preclude improving other components of health-related fitness.

It is well accepted that physical activity has significant health benefits, but the levels of activity required in childhood to achieve these benefits are not understood at this time. For adults at least 20 min of vigorous exercise three times per week are needed to improve fitness. The same standard appears to apply for children (Simons-Morton et al., 1987). But improving fitness and decreasing health risk are two distinct goals. For adult men, over 2,000 calories per week in physical activity leads to important reductions in risk of death (Paffenbarger et al., 1986), but how this caloric expenditure standard would apply to children is unclear. In adults the dose-response relationship is such that moderate levels of physical activity confer substantial benefit in terms of preventing CVD and decreasing mortality (Leon, Connett, Jacobs, & Rauramaa, 1987; Paffenbarger et al., 1986; Slaterry, Jacobs, & Nichaman, 1989). The greatest health benefit appears to be gained when moving from sedentary to moderate levels of fitness or activity, and a diminishing benefit occurs when moving from moderate to vigorous levels of fitness or physical activity (Blair, Kohl et al., 1989; Paffenbarger et al., 1986). Less direct evidence of the effects of moderate physical activity on children is available, but activities such as walking are effective in the treatment of childhood obesity (Epstein, 1984). The majority of research and practice in physical education emphasizes vigorous activities that promote fitness, but even moderate intensity activities are likely to promote favorable health outcomes in children.

Investigators differ as to the adequacy of children's levels of physical activity. Based on data regarding the minimum level of physical activity required for health benefits in adults, Blair, Clark, Cureton, and Powell (1989) applied these estimates to children. Children's self-reports of physical activity indicated 90% or more were active at the level required for health benefits. Based on a recommendation children should obtain moderate to vigorous physical activity on a daily basis (Haskell, Montoye, & Orenstein, 1985), Simons-Morton et al. (1990) found 35% of third and fourth grade students reported

fewer than one episode per day of physical activity lasting at least 10 min. The most parsimonious conclusion at the present time is data on the level of physical activity needed for health benefits in children are insufficient.

Given the lack of criteria for desired levels of physical activity, it still may be instructive to determine how physically active children are. Several studies have assessed small numbers of children with objective measures such as direct observation and heart rate (HR) monitoring.

Preschool children are often considered particularly active, but free-play activity in young children has been reported in only two studies (see Table 1). In a U.S. preschool, 33 children were observed at recess (Sallis, Patterson, McKenzie, & Nader, 1988). Only 11% of time was spent in vigorous activities, although another 31% was spent in moderate intensity activities. A study of Czechoslovakian children in a day camp setting found boys spent 67% of their time and girls spent 60% of their time during an entire day with heart rates greater than 150% of resting values (Kucera, 1985). Although 60-67% of time in activity sounds like a large percentage, the heart rate criterion was only about 120 b·min⁻¹, which can be achieved by young children at low intensities of physical activity. Given the small samples and limitations of methods, it must be concluded the level of activity of preschool children in unstructured situations is unknown.

Several studies have monitored school-age children over entire days (see Table 2). Three studies using heart rate monitoring produced somewhat similar results. Two of these reported the time spent at heart rates over 140 b·min⁻¹ (Gilliam, Freedson, Geenen, & Shahraray, 1981; Sallis, Buono, Roby, Micale, & Nelson, 1991), which is approximately 70% of age-predicted VO₂max and corresponds to American College of Sports Medicine (1991) recommendations for intensity of conditioning activities. Gilliam et al. (1981) found 6-7-year-old children spent about 46 min at that heart rate (HR) level. Sallis et al. (1991) found similar levels in 10-12-year-olds, but time above HR > 140 dropped to 28 min in 13-17-year-olds. This finding was similar to the decrease in activity with age reported by Verschuur and Kemper (1985). They found 12-13-year-olds spent 30 min at HR > 150, with a decline to 15 min in 17-18-year-olds.

Thus, estimates of time school age children spend in

Table 1. Objective measures of children's physical activity levels: preschool children

Study and Subjects	Methods	Results
Kucera (1985) N = 40; 4-year-olds	Monitored HR 8 a.m. to 6 p.m. day camp in unstructured activities	% of time with HR > 150% of baseline (mean HR = 160 b·min ⁻¹) 67% for boys 60% for girls
Sallis et al. (1988) N = 33; 4-year-olds	Observed during 30-min unstructured recess at preschool	58% time in sedentary behavior 31% time in moderate activities 11% time in vigorous activity

moderate-to-vigorous intensity activity varied from 15 to 45 min per day. Although these results indicate most children are active and are meeting American College of Sports Medicine (1990) recommendations for adult activity levels, the HR data reported did not consider the continuity of activity. Continuity is an important dimension of children's activity because children often display repeated bursts of activity rather than sustained movement. When "activity intervals" lasting at least 10 min were defined, the average boy and girl between the ages of 10 and 17 were found to spend 10–35 min per day in sustained moderate to vigorous activity (Sallis et al., 1991). Over a 12-hour day, this represents only 1.4 to 4.9% of time devoted to physical activity. These estimates should be interpreted in the context that activity levels appear to decline during the teen years (Rowland, 1990; Sallis et al., 1991; Verschuur & Kemper, 1985) and throughout adulthood (Stephens et al., 1985). There is little room for decline from 35 min per day. Although 2% of the day in physical activity is a small amount of time, this minimal level may be sufficient to provide important health benefits (Blair, Clark et al., 1989). This question will continue to be debated.

The question of whether children in the U.S. are too sedentary is controversial, but few disagree children could benefit from being more active. The next step is to consider what interventions can be devised to increase their physical activity levels. Any discussion of this topic must address the only institution currently responsible for promoting physical activity for all children: physical

education in schools. Because children receive a majority of their physical activity outside of physical education (Ross & Gilbert, 1985; Ross & Pate, 1987; Simons-Morton et al., 1990), a comprehensive approach to promoting children's physical activity must go beyond the confines of the school campus. Because of its almost universal reach, the school will remain the centerpiece of youth-oriented physical activity programs. Youth sport and recreation programs provide valuable support to some children, but school physical education is required for all. Families must share the responsibility and religious organizations and other agencies may play a role, yet the promotion of children's physical activity is squarely in the purview of school physical education. To limit the scope of the discussion and focus prevention efforts on young children, only elementary school physical education is considered in detail here. However, some points raised in this paper also apply to physical education in secondary schools.

Status of Elementary Physical Education Programs

Considering the large proportion of children involved in elementary physical education programs, it is essential to evaluate what these programs are doing to meet the health needs of children and how effective they are. In elementary school about 50% of the children have physical education three or more times per week, and the

Table 2. Objective measures of children's physical activity levels: school-age children

Study and subjects	Methods	Results
Hovell et al. (1978) N = 274; 3rd–6th graders	observed during unstructured recess at schools	Children were only two-thirds as active as adults who were observed performing conditioning activities.
Gilliam et al. (1981) N = 30; 6–7-year-olds	monitored HR 8 a.m. to 8 p.m. in summer	46.5 min with HR > 140 b·min ⁻¹ 16.5 min with HR > 160 b·min ⁻¹
Verschuur & Kemper (1985) N = not reported; 12–18-year-olds	monitored HR 24 hours on two school days	min with HR > 150 b·min ⁻¹ : 30 in 12–13-year-olds 15 in 17–18-year-olds
Baranowski et al. (1987) N = 24; 3rd–5th graders	observed for 12 hours each of two school days	10% of children had at least one bout of 20-min nonstop activity per day. 48% had at least one bout of 14-min activity with 0 or 1 stop per day.
Parcel et al. (1987) N = 48; 3rd and 4th graders	observed during unstructured recess at schools	Children were vigorously active only 6.9% of the time.
Sallis et al. (1991) N = 102; 5th, 8th, and 11th graders	monitored HR 8 a.m. to 8 p.m. on school days	minutes with HR > 140 b·min ⁻¹ 44 in 5th graders 28 in 8th graders 28 in 11th graders

average child is scheduled to spend over 100 min per week in physical education class (Ross et al., 1985, 1987). Although half of elementary children take physical education at less than an acceptable frequency, the amount of time spent is considerable if children are at least moderately active most or all of their scheduled classes.

Assessing the quality as opposed to the quantity of elementary physical education is difficult, but one gross indicator is availability of trained physical education specialists. It is assumed trained physical educators are more effective than classroom teachers who have little or no training in physical education, and some data support this assumption (Faucette & Hillidge, 1989). The data on access to specialists are in conflict. The National Children and Youth Fitness Study II (Ross et al., 1987) indicated specialists were conducting most elementary physical education lessons, but Randall (1986) suggested too few specialists were employed to make this possible. The National Children and Youth Fitness Study II (Ross et al., 1987) asked elementary teachers how many physical education sessions per week were held with specialists and classroom teachers. Teachers reported 79% of physical education class meetings were led by a specialist.

Randall (1986) surveyed employment of physical education specialists. We calculated the student/specialist ratios for each reporting state. The number of states in each category are shown in Figure 1. We assumed a specialist teaching 10 classes per day with 30 students each could handle about 500 students each week if classes were taught three days per week (i.e., 50 class sessions per week \times 30 students per class = 1,500 student contacts; 3 contacts per week = 500 students per week). The average student/specialist ratio was 638:1 in elementary schools and 196:1 in secondary schools. Only 14 states reported ratios of 600:1 or less. Therefore less than 30% of states even approach adequate staffing for physical education specialists. Eight states had ratios of greater than 1,000:1, and 13 states did not report. California, the most popu-

lous state, did not report, but we estimate 85-95% of elementary school physical education in this state is taught by classroom teachers.

A more definitive method of assessing the quality of physical education programs is to assess what occurs in class. Three sources of data are presented on this question. The five physical education activities most frequently reported by third through fifth grade teachers in National Children and Youth Fitness Studies I and II are shown in Table 3. If one considers lifetime activities as "those that may readily be carried into adulthood because they generally need only one or two people" (Ross et al., 1985, p. 76), then jumping rope, jogging, and calisthenics are the only lifetime activities on the list. However, the prominence of active sports such as soccer and basketball indicate teachers are attempting to keep children active.

When elementary physical education classes are directly observed, relatively little physical activity is seen. Parcel et al. (1987) observed physical education classes taught by specialists and coded the activity levels of children. They found in a 30-min class, the average child was vigorously active for only 2 min. Faucette, McKenzie, and Patterson (1990) observed 226 physical education classes taught by classroom teachers and categorized the time devoted to different kinds of activities. Most classes consisted of game play in which only a few children were

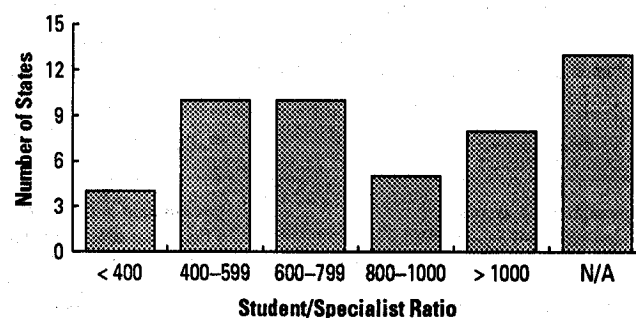


Figure 1. Student/specialist ratio in U.S. elementary schools.

Table 3. Most frequent physical education activities reported by teachers in the National Children and Youth Fitness Studies I and II

Rank	Grade 3	Grade 4	Grade 5
1	Soccer	Soccer	Calisthenics/ exercises
2	Movement experiences	Basketball	Jogging
3	Jumping rope	Gymnastics	Basketball
4	Gymnastics	Kickball	Kickball
5	Basketball	Jumping rope	Dodgeball

Note. Adapted from Ross et al., 1985, 1987.

active while the remainder waited their turn. Only 5% of the classes had fitness activities as the major focus.

The conclusions from this overview are (a) adequate time is not available for at least 50% of the children in elementary physical education, (b) during the scheduled time children are not very active and are not being prepared for lifetime physical activity, and (c) most classes are taught by those not trained in the subject matter. Objective measures regarding the quality of physical education present a less optimistic picture than teacher reports.

Review of Health-Related Physical Activity Interventions

Those who design health-related physical education programs should be familiar with the successes and failures of previous efforts to promote children's physical activity. Some school-based programs have involved physical education classes and some have not. Other programs have targeted the family as the agent of influence.

School-Based Programs

The need to improve the health-related functions of elementary physical education has been recognized for some time. While Cooper et al. (1975) first reported the

effects of a jogging program on the fitness levels of high school students, numerous studies with elementary school students indicate physical education programs emphasizing cardiovascular fitness can be implemented. Some controlled studies of health-related physical education are shown in Table 4. Increases in activity at school were documented by self-report (Shephard et al., 1984), direct observation (Simons-Morton, Parcel, & O'Hara, 1988), and heart rate monitoring (Geenen, Gilliam, Crowley, Moorehead-Steffens, & Rosenthal, 1982; MacConnie, Gilliam, Geenen, & Pels, 1982). At least four studies found children who participated in health-related physical education improved their cardiovascular fitness (Duncan, Boyce, Itami, & Puffenbarger, 1983; Dwyer, Coonan, Leitch, Hetzel, & Baghurst, 1983; Maynard, Coonan, Worsley, Dwyer, & Baghurst, 1987; Siegel & Manfredi, 1984). Decreases in skinfold thicknesses in experimental groups have also been reported (Dwyer et al., 1983; Maynard et al., 1987).

Simons-Morton, Parcel, and O'Hara (1988) trained physical education specialists to implement health-related physical education. The amount of class time spent in fitness activities during the first year of intervention (40%) was twice the level of control schools (21%). This indicates experienced specialists can be trained to make substantial changes in their teaching practices.

When a health-related physical education curriculum is implemented by trained specialists, improvements in

Table 4. School-based health-related elementary physical education studies

Study and subjects	Methods	Results
Shephard et al. (1980) N = 300, 10-12-year-olds	Intervention and control schools. 5 hours per week of endurance exercise.	Intervention group reported more physical activity at school and out of school.
MacConnie et al. (1982) N = 59, 6-7-year-olds	Intervention and control schools. 4 sessions per week for 8 months. Variety of aerobic activities.	Higher heart rates during physical education and more time throughout the day at heart rates greater than 160 b·min ⁻¹ .
Dwyer et al. (1983) Maynard et al. (1987) N = 57, 10-year-olds	Usual PE, skill-oriented PE, or health-oriented PE. 75 min per week of aerobic activities.	Improvements in physical working capacity and decreases in skinfolds.
Duncan et al. (1983) N = 34, 5th graders	Intervention and control class. 90 min per week for 9 months. Variety of aerobic activities.	Improved mile run time from pre to post. Intervention-Control differences still significant at end of summer.
Siegel & Manfredi (1984) N = 169, 3rd graders	Intervention and control classes. 4 half-hour sessions per week. Calisthenics, running, and skill-oriented PE.	Improvements in run times.
Simons-Morton, Parcel, & O'Hara (1988) N = 1,250, 3rd and 4th graders	Intervention and control schools. Variety of aerobic activities plus sports and skills practice.	Increased time devoted to fitness activities and child activity during PE.

Note. Adapted from Simons-Morton, Parcel, O'Hara, Blair, & Pate, 1988.

health-related outcomes can be expected. Even when more time is devoted to physical education, academic performance has been found not to suffer (Maynard et al., 1987; Shephard et al., 1984).

When school health promotion programs have targeted physical activity without directly influencing physical education classes, the results have been much less encouraging. Coates, Jeffery, and Slinkard (1981) reported the results of a diet and physical activity program designed to reduce CVD risk factors in fourth and fifth grade students. Behavioral self-management procedures were designed to help children identify and change health-related behaviors. The six-session physical activity component targeted increasing activity during the daily recess. There was no evidence the program had any effects on physical activity that were directly observed during recess, but there were significant intervention effects on dietary behavior.

Walter, Hofman, Vaughan, and Wynder (1988) described the five-year results of the "Know Your Body" comprehensive heart health promotion program that did not specifically target changes in physical education. The curriculum for fourth through eighth grade children focused on diet, physical activity, and cigarette smoking by trained classroom teachers. At the end of five years of intervention, there were significant changes in total cholesterol, dietary intake, and health knowledge, but no intervention effects on the measure of fitness.

Intensive health-related school physical education programs have been shown to improve children's levels of physical activity and decrease their CVD risk factors. However, behavior change programs without physical education components do not seem effective in increasing physical activity or fitness in elementary school students.

Family-Based Programs

Family members influence each other's physical activity in many ways (Sallis & Nader, 1988), and the effectiveness of school-based programs may be improved by involving families in promoting their children's physical activity. There have been several attempts to promote childhood physical activity in which family involvement was a key factor. Nader and colleagues (Nader et al., 1983; 1989) conducted two studies in which families of fifth and sixth grade children were recruited through the schools. Adults and children worked together to modify their dietary and physical activity behaviors. Though intervention subjects improved blood pressure, dietary behaviors, and health knowledge, neither study showed an effect on the physical activity or fitness of adults or children.

Another family-oriented program with Black American families was also not successful in increasing physical activity (Baranowski et al., 1990). When a pediatrician attempted to begin an exercise program for

healthy but inactive patients, most parents thought their children were active enough (Rowland, 1986). Of 24 inactive children targeted, most did not start the program and only 2 completed the four-month supervised regimen.

These different programs indicate important barriers to the success of family-based approaches to child physical activity promotion, but the nature of those barriers has yet to be identified. More effective methods of family involvement must be developed.

The most successful family-based program to date identified low-fit fourth through sixth grade children at school and solicited parental involvement in a home reinforcement program (Taggart, Taggart, & Siedentop, 1986). Twelve of 17 targeted families participated in the 12-week program. Parents worked with behavioral consultants who trained and assisted them in developing effective reinforcement programs to promote physical activity. Virtually all of the children increased both activity and fitness. The availability of appropriate facilities for activity and weekly contact with consultants were thought to enhance the program's effectiveness. However, this is more of a clinical than a public health approach to increasing physical activity, because an intensive individualized treatment was applied to a highly selected population.

The Epstein (1984) intervention for obese children has substantial similarities with the Taggart et al. (1986) program for low-fit children. The Epstein (1984) program involved devising behavioral contracts between parents and children, and this diet and exercise intervention produced weight losses that were maintained up to ten years (Epstein, Valoski, Wing, & McCurley, 1990). The success of the Taggart et al. (1986) and Epstein (1984) programs suggests training parents in reinforcement techniques is an effective method. Methods for applying such principles on a broader basis need to be developed.

How family interventions could be integrated into school-based programs is unclear, but homework activities were effective in promoting changes in children's diets (Perry et al., 1988). Whether and how school physical education can incorporate family interventions remains to be seen, but this is a fruitful area for program development and research.

Public Health Analysis of Elementary Physical Education

Health-Related Physical Education Should Be a High Priority

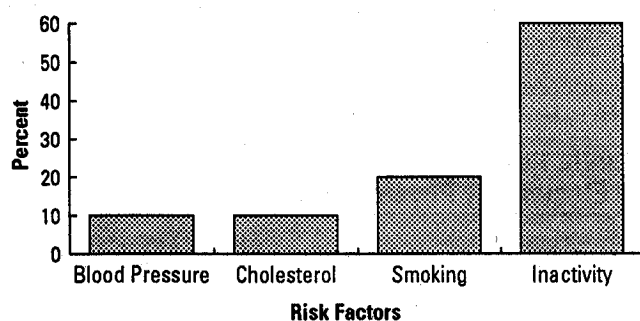
The goal of public health is to achieve the largest impact on the health status of the entire population. The concept of "population attributable risk" is useful in setting public health priorities. This refers to the excess number of deaths in the population that can be attributed

to a particular cause. Population attributable risk is affected by the absolute risk of the disease, the strength of the risk factor (i.e., relative risk), and the prevalence of the risk factor. The data on physical activity and CVD in adults allow us to consider the population attributable risk for CVD related to physical inactivity. Because CVD causes more than half of all deaths in the U.S., the absolute risk of the disease is high. Two comprehensive reviews of the association between physical activity and CVD mortality (Berlin & Colditz, 1990; Powell et al., 1987) concluded inactive adults are at least twice as likely to die of CVD as active adults. This relative risk of about 2.0 is approximately the same as the relative risk of the other major CVD risk factors: cigarette smoking, high blood pressure, and high serum cholesterol. Therefore, the relative risk of physical inactivity is high. As can be seen in Figure 2, the prevalence of inactive lifestyles is higher than that of any other risk factor (Centers for Disease Control, 1987).

This analysis suggests the population-attributable risk from physical inactivity is very high. Primarily because of the prevalence of inactive lifestyles, it appears more lives could be saved by changing physical activity habits of the population than by changing any other major CVD risk factor. Therefore, increasing the level of physical activity should be a major public health goal. If physical activity promotion in children can have effects that carry over into adulthood, then such programs should also be given a priority.

Physical education in schools is an ideal point of intervention because virtually all children participate. Thus, an institution already exists that can potentially make large contributions to reducing the CVD epidemic in developed nations. The goals of public health regarding CVD prevention and the goals of physical education regarding the promotion of physical activity are similar and compatible. Few institutions in the U.S. can be so easily adapted to meet the important current and future health needs of the population.

Figure 2. Percentage of U.S. adults with CVD risk factors.



Note. Risk factors are defined as: Blood Pressure = systolic blood pressure > 150 mm Hg, Cholesterol = total cholesterol > 268 mg/dl, Smoking = smoke at least one pack of cigarettes per day, Inactivity = less than 20 min of physical activity three times per week.

Physical Education Should Prepare Children for an Active Adulthood

There is a major barrier to physical education contributing to the prevention of CVD. School physical education directly controls activity in class, but the most important outcome is increased physical activity in adulthood. There is no obvious and direct connection between the two, but the public health interest in physical education assumes a good foundation in physical activity in childhood will promote carryover to adulthood. Powell and Dysinger (1987) reviewed the literature on the association between physical activity in childhood or adolescence and activity patterns in adulthood. Their findings as well as those of four recent studies (Brill, Burkhalter, Kohl, Blair, & Goodyear, 1989; Dennison, Straus, Mellits, & Charney, 1988; Dishman, 1988; Sallis et al., 1989) are shown in Table 5.

The most parsimonious conclusion from these studies is the findings conflict. Because all of the studies have shortcomings, no one study can be considered definitive. The case could be made that all of the studies cited are irrelevant to the issue of the long-term effects of health-related physical education. That is because physical education and the other types of youth activities studied were typically oriented toward team sports. It is unclear why participation in team sports should predict involvement in adult activities that tend to be more solitary. Sallis et al. (1989) found those who were most active as children were not more active as adults but were more likely to watch sports on television ($r = .38$). This is a logical outcome for a sports-oriented physical education program. A sports-oriented physical education program may not influence adult activity levels, yet a health-oriented physical education program that teaches carryover activities would be more effective in preparing children for lifetime physical activity. From a public health perspective, this hypothesis needs to be studied because, if correct, the benefits implementing such a program are great.

Moderate and Vigorous Intensity Activities

What types of physical activities should be recommended for children? Most of the emphasis in health-related youth fitness is on vigorous aerobic activities. However, if one is interested in establishing regular physical activity patterns that promote health rather than increase fitness, some evidence supports moderate-intensity activities as a particularly desirable intervention target (American College of Sports Medicine, 1991).

Apart from the health benefits reviewed above, moderate-intensity activities appear to be better maintained over time than vigorous activities, and they are more acceptable to those segments of the population that do not engage in vigorous activities. Adults who

engage in moderate-intensity exercise are less likely to drop out over a one-year period than vigorous exercisers (Sallis et al., 1986). Vigorous exercise declines dramatically over the adult age range, but moderate-intensity activity is performed frequently at all ages, and women are as active as men in these activities (Hovell et al., 1990; Sallis et al., 1985).

Studies of obese children suggest moderate-intensity activities that can be incorporated into a daily lifestyle (e.g., walk to the store instead of riding in a car) are more effective at maintaining weight loss than vigorous exercise. Epstein, Wing, Koeske, Ossip, and Beck (1982) showed weight loss over a two-year period was superior in the group that did lifestyle exercise than in the group that did vigorous exercise. Only the lifestyle group maintained their fitness gains. These effects were replicated in a later study (Epstein, Wing, Koeske, & Valoski, 1985).

These studies suggest for long-term public health impact regular moderate-intensity activity may be a more appropriate goal than vigorous exercise. Moderate activities confer important health benefits, are appropriate for children and adults of all ages, and are more likely to be

maintained. This recommendation is not meant to discourage children from engaging in vigorous exercise. The intent is to expand the range of activities to be considered health-promoting so children are given more options in developing a pattern of regular physical activity that meets their needs.

Wide Dissemination of Programs Is Needed

Effective and innovative programs must be practical if they are to impact a large proportion of the population. A good case in point is smoking prevention programs. Contemporary smoking prevention programs based on teaching adolescents to refuse offers of tobacco have been shown in most studies to be effective at reducing smoking initiation rates between 25 and 50% over one to three years (Flay, 1985). The superiority of such programs over the older fear-based programs has been known for over 10 years. However, relatively few school districts have adopted these effective psychosocial programs as part of their health curricula. Barriers to wide dissemination have not yet been addressed. Health-related physical

Table 5. The association between physical activity or sports participation in youth and adult activity

Study and subjects	Method	Results
Montoye et al. (1959) 1,191 male Michigan State alumni	Cohort study	No association observed
Brunner (1969) 60 middle-aged professional males	Case-control study	No association observed
Harris (1970) Male Penn State employees	Case-control study	Observed association is likely confounded by education
Bucher (1974) 3,875 adults	Cross-sectional survey	Observed association is likely to be confounded by age and sex
Paffenbarger et al. (1984) 16,936 male Harvard alumni	Cohort study	Association is observed between activity in college and later life
Dennison et al. (1988) 453 males, 23–25 years old	Cohort study	Measured fitness at ages 10–11 and 15–18 predicted adult activity
Dishman (1988) 265 middle-aged white males	Cross-sectional survey	No association observed
Sallis et al. (1989) 2,053 males and females	Cross-sectional survey	No association observed
Brill et al. (1989) 345 former athletes and 75 nonathletes, male aged 25–60	Prospective study with retrospective reports of athletic history	Athletic history not related to physical fitness at baseline assessment or to exercise adoption rates over follow-up (mean of 56 months)

Note. Adapted from Powell & Dysinger, 1987.

education programs must be designed from the beginning with the end user in mind, in this case either a classroom teacher or physical education specialist. Not only must programs be practical, but once they are shown to be effective, they need to be disseminated to school districts.

Public health benefits from health-related physical education programs will be determined by (a) the effectiveness of the program in promoting long-term patterns of physical activity, and (b) the number of children who participate in the program. Health-related physical education programs should focus on maximizing the participation of all children, whether they are athletically gifted, clumsy, disinterested, or obese. Physical education in schools is the only preparation most children will have in how to develop an active lifestyle, so it is important to use physical education to increase motivation and teach relevant skills to all children to prepare them for lifetime physical activity.

To summarize, three main issues relevant to developing health-related elementary physical education programs are suggested by consideration of public health principles.

1. Activities and skills taught to children should have the potential for carryover to adult life.
2. Moderate intensity activities should be an intervention target.
3. Potential for dissemination of health-related physical education programs to teachers and students throughout the nation should be considered.

A Public Health Role and Goal for Physical Education

Our challenge to physical educators is to adopt a new role and pursue a public health goal for school physical education. The new role for physical education professionals is to become a part of the team of public health professionals responsible for improving the health of the American people. School physical educators should collaborate with other public health professionals regarding program development and research. Professionals from a wide variety of disciplines have adopted a public health viewpoint without losing their professional identities. Dietitians are involved in improving the American diet. Psychologists are involved in developing effective methods of changing a variety of behaviors that influence health. Anthropologists are developing methods for improving the health practices of diverse cultural groups. School health educators are expanding their roles from teaching health facts to altering health behaviors. Exercise physiologists are identifying and promoting the proper types of physical activity for prevention, treatment, and rehabilitation of diseases. Physical

educators, who have responsibility for teaching children physical activity skills, also have a great deal to contribute to public health. Defining physical education as a public health science, as well as a cognitive, social, and physiological science, serves to enhance the roles, influences, and opportunities for physical education professionals.

The public health goal for physical education is to prepare children for a lifetime of regular physical activity. This is not a new goal. It has been proposed many times over the years (Corbin, 1986; Siedentop, 1980). The American College of Sports Medicine (1988) strongly endorses the goal of lifetime physical activity for school physical education. The American Academy of Pediatrics Committees on Sports Medicine and School Health (1987) call for school physical educators to make a commitment to change physical education programs to maximize their impact on public health. Physical education should focus on promoting the development of a regular pattern of physical activity outside of class that has the potential to carry over into adulthood. School physical education designed to promote lifetime activity would likely emphasize generalizable movement skills useful for team sports in childhood and for more common adult activities later on. For example, throwing skills may be useful for baseball in youth and for volleyball and tennis in adulthood. Pacing skills during running could be applied during childhood and adulthood, and they could be generalized to cycling and cross-country skiing. The design of curricula to meet public health goals should become an active topic of theory, debate, and research in physical education.

Public-health oriented school physical education that prepares students for lifetime activity should teach activity planning skills as well as movement skills. Just because students enjoy physical activity and become skilled does not necessarily mean they will become more active outside of school. In modern America there are many barriers to regular physical activity, such as the lure of television and video games, the existence of unsafe neighborhoods, and lack of appropriate facilities. Childhood may not be too early to learn to systematically plan for physical activity, and physical activity planning skills are certainly relevant to the public health goal. A lifetime activity goal is a departure from the predominant current practice of physical education (Ross et al., 1985, 1987), but it is meant to expand, not replace, current goals. While influencing physical activity outside of class is not easy to achieve, if attained it will benefit millions of children by reducing their risks of several chronic diseases and improving their quality of life. If physical educators accept the challenge of this goal, several issues must be addressed.

The primary question concerns the implications of this goal for the content of physical education programs. How much will current practices have to be changed? Will other more traditional goals of physical education

have to be abandoned, deemphasized, or modified? How much time should be devoted to improving each component of health-related fitness? If generalizable movement and activity planning skills are emphasized in physical education, will there be time for other activities? Will children become bored with fitness activities? What changes in the training of physical educators will be needed? It is inappropriate to try to answer these questions now because the research data are inadequate. These questions are just starting to be seriously debated, and empirical studies are required to provide data needed to guide important curriculum choices. At this time there are no clear-cut answers as to what an effective health-oriented physical education program would look like, especially one that attempts to influence children's physical activities outside of school.

Physical educators should debate these issues, develop model curricula, and most important, conduct rigorous research on the effects of health-oriented school physical education programs. Investigations of the immediate and long-term cognitive, social, behavioral, and physiological outcomes of health-oriented physical education programs are needed. Public health professionals are already beginning to study these issues. Physical educators should be, and are, involved in such studies, not only because these studies have important implications for the health of children, but also because they will help determine the future evolution of the field.

This paper has focused on the contribution elementary physical education can make to the health of children, but much of it applies to secondary physical education as well. Limiting attempts to promote lifetime physical activity to the elementary level will be effective only if movement and planning skills are refined and reinforced throughout the educational career of students. The importance of the commitment of secondary physical education to public health goals is suggested by survey data indicating the end of high school or college may be the time when physical activity is decreasing most rapidly (Stephens et al., 1985). Thus, high school and college physical educators may have the best opportunity to prepare students to maintain patterns of regular physical activity. The large number of physical education specialists in secondary schools (Randall, 1986) is an important resource. With training and curriculum changes they can be prepared to reorient their programs to a health-promoting approach to physical education. Secondary school students are better prepared developmentally to plan their own extracurricular programs than elementary school students, so more success in promoting out-of-school physical activity can be anticipated. A likely barrier to the reorientation of secondary teachers is the emphasis placed on competitive sports in physical education (Ross et al., 1985).

If physical educators do not accept the public health role and the goal of preparing children for a lifetime of

physical activity, they will likely have diminishing influence over school physical education programs in the U.S. The Public Health Service's (1991) Year 2000 Objectives for the Nation include several goals dealing directly with the quality and quantity of physical education. These objectives were developed by public health professionals with input from a few interested physical educators. The objectives were not systematically developed or promoted by any physical education organization. This is evidence physical educators are beginning to lose influence over important policy developments in their field. It is also evidence of increasing interest in school physical education on the part of public health professionals.

When physical education professionals and organizations develop programs and strategies to improve public health, then they will be a significant force in the development of health-related physical education programs for the nation's youth. If the public health role and goal are resisted, those in the physical education community may not only lose a valuable opportunity to positively influence the health of the nation, they may also lose some control over their own field. Given financial pressures and the return to educational "basics," support for physical educational programs could be lost altogether (American Academy of Pediatrics Committees on Sports Medicine and School Health, 1987). The increasing interest of the public health community in physical education is a golden opportunity to improve the effectiveness, status, and possibly funding of school physical education. The opportunity should be seized, and a solid, lasting partnership between public health and physical education should be cemented.

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