# Health Impact Assessment (HIA) of Potential Modifications to Physical Education Requirements in California


## Health Impact Assessment Group
## UCLA School of Public Health
*(http://www.ph.ucla.edu/hs/health-impact)*


## June 9, 2007


**Project Personnel**
Jonathan Fielding, M.D., M.P.H., M.B.A., Project Principal Investigator
Antronette Yancey, M.D., M.P.H., Project Co-Principal Investigator
Brian Cole, Dr.P.H., Project Team Leader, co-lead author
Riti Shimkhada, M.P.H., Lead analyst, co-lead author
Georgina Agyekum, M.P.H., Research Assistant
Sandra Hoffman, M.P.H., Research Assistant
Amy Cornbleet, M.P.H., Research Assistant



**Funding for this report was provided by a grant from the California Endowment.**

## Table of Contents

**List of Tables**



**List of Figures**



**List of Boxes**

# Executive Summary

## Overview

Rates of childhood obesity and sedentary lifestyle have increased rapidly in the past decade, contributing to a growing burden of lifelong chronic disease, disability and early mortality (Koplan, Liverman, & Kraak, 2005). Because the causes of these problems are complex and multifactorial, corrective strategies will need to address many contributing factors at many levels and in different settings.

One of the most obvious opportunities to increase physical activity among children and youth is physical education (P.E.) in schools. The State of California mandates a minimum number of minutes of physical education instruction in public schools, but compliance is uneven, particularly in the elementary grades (California Center for Public Health Advocacy (2006a). The trend in schools has been towards less physical education, not more (California Department of Education, 2005a; National Association for Sport and Physical Education, 2006b). Furthermore, in a typical P.E. class most students are not active most of the time (UCLA Center to Eliminate Health Disparities and Samuels & Associates, 2007). Of the different policy options available to remedy this situation, which are most likely to have the biggest impact on students' physical activity levels? Which policy option will particularly effect those students who are least active and have the fewest opportunities outside of school for physical activity?

As part of the California Endowment's Healthy Eating Active Communities (HEAC) Initiative, this Health Impact Assessment (HIA) examines state policies that aim to increase physical activity levels for students in grades K-12 by increasing the quality and quantity of physical education (P.E.) provided by their schools at every grade level. We developed a spreadsheet-based model to predict potential changes in physical activity from three P.E. policy scenarios for middle and high school students in California:

1. Increase the percent time in moderate-to-vigorous physical activity (MVPA) during P.E. in secondary grades where PE is mandatory (i.e. grades 6-10);
2. Increase compliance with state P.E. requirements (i.e. 400 minutes every 10 school days in secondary grades);
3. Require P.E. in 11th and 12th grades (assumed $11^{th}$ and $12^{th}$ graders are currently exempt).

These scenarios were chosen because they are likely to directly impinge on students' short-term levels of physical activity and because they reflect the range of types of policy recommendations presented by State Superintendent Jack O'Connell in 2004 (California Department of Education, 2004). The represent a menu of options that could be implemented individually or in combination.

The aim of this comparative analysis was to inform both policy-makers and stakeholders of the relative benefits of the three different policy scenarios through objective quantification of a measurable outcome with important clinical consequences. We chose class time spent in

moderate-to-vigorous physical activity (MVPA) as the impact of interest because of its strong association with health outcomes, such as obesity, cardiovascular fitness, and mental health. The differential impact of policies on children by weight status (overweight versus normal weight) was subsequently addressed because overweight children have the most to gain in terms of health from increased physical activity and can potentially be targeted by specific P.E. policies. With some assumptions regarding the data and the mathematical model, the spreadsheet developed for this study resulted in expected increases in MVPA attributable to the three policy alternatives. This spreadsheet has high practical value in that inputs, assumptions, and level of analysis can be varied depending on the user, whether it is a school district interested in the potential changes in MVPA of the student body due to a policy change or a state lawmaker who has to decide between various P.E. policies.

## Potential benefits of expanded and enhanced P.E.

Physical activity and P.E. at school can provide significant opportunities for increasing total physical activity. Expanding the quantity and quality of school P.E. has become an important focus of comprehensive strategies that promote physical activity among youth (Centers for Disease Control and Prevention [CDC], 1997; Pate & Hohn, 1994; Sallis & McKenzie, 1991; U.S. Department of Health and Human Services, 2000). Based on a systematic review of evidence, the Guide to Community Preventive Services has strongly recommended school-based, activity-focused P.E. as an effective method of increasing physical activity and fitness (Kahn et al., 2002). Furthermore, Healthy People 2010 (U.S. Department of Health and Human Services, 2000) identified improving P.E. as a national health objective, aiming to increase the number of schools scheduling daily P.E., the proportion of students participating, and the number of students who are physically active for at least 50 percent of lesson time.

## Initiatives to improve the quality and quantity of physical education in California

Over the past two years a number of proposals have been put forth by the California State Legislature and the California Department of Education to improve the quality and quantity of P.E. in California. The Local School Wellness Policy (LSWP) Collaborative Group, including the California Department of Education and other state and local agencies, has drafted a number of recommendations for P.E. programs in compliance with the federal requirements under the Child Nutrition and WIC Reauthorization Act (Public Law 108-265). In October 2004 State Superintendent O'Connell's Task Force for Childhood Obesity, Type 2 Diabetes, and Cardiovascular Disease recommended a number of policy changes to increase the quality and quantity of instruction in P.E. Among the Task Force's recommendations are:

1. Including physical education as core curriculum;
2. Maintaining and enforcing the required 200 minutes of physical education each 10 school days in grades K-5 and 400 minutes each 10 school days in grades 6-12 (all exclusive of lunch and recess);
3. Recommending an additional 100 minutes of physical education each 10 school days in grades K-12;

4. Not granting exemptions to minimum requirements to any school or class;
5. Allowing exemptions to individual students for documented medical or hardship reasons, and for 11th and 12th graders only in lieu of participation in athletic programs that have daily physical activity for 40 or more minutes;
6. Ensuring that 50% of physical education time is spent doing moderate to vigorous physical activity (MVPA). (California Department of Education, 2004).

## Methodology

We developed a spreadsheet-based model to predict potential changes in physical activity from three P.E. policy scenarios for middle and high school students in California. Data from various sources were combined to estimate how each policy scenario would affect levels of moderate-to-vigorous physical activity (MVPA) among California's secondary school students. These effects were assessed over the entire target population as well as differentially weight status (overweight versus normal weight). Although not analyzed, differential impacts for other subgroups, for example boys versus girls, can be measured using our model.

While making changes to P.E. instruction in elementary grades is a recognized priority, policy options towards this aim were not analyzed as part of the quantitative model we developed due to (1) limited information on the statewide prevalence of obesity and fitness levels of young school age children; (2) lack of information on the amount and quality of PE instruction in the elementary grades in California; (3) significant obstacles to implementing widespread changes in elementary school P.E. programs given that P.E. is often taught by regular classroom teachers and often incorporated into other classroom activities.

Many of the data for this analysis came from the California Department of Education's database of student characteristics. From this source we obtained data on school enrollment, student demographic characteristics, and Fitnessgram results on 7th and 9th graders which we used to estimate body composition or overweight. The 2002-2004 California Behavioral Risk Factor Surveillance System (BRFSS) was used to estimate overweight among 18 year olds, the typical age of 12th graders. Estimates of time engaged in MVPA during P.E. and differential MVPA levels among normal weight versus overweight students were derived from preliminary results from two, as yet unpublished studies conducted by the UCLA School of Public Health and Samuels and Associates (California Endowment HEAC Evaluation study, and the "School Physical Activity/Physical Education" (PA/PE) study, summarized in UCLA Center to Eliminate Health Disparities and Samuels & Associates, 2007).

## Results

Given our model's baseline assumptions, increasing the percent of PE class time in MVPA, policy scenario 1, would be the most effective at increasing overall activity levels—adding approximately four minutes of daily MVPA for all secondary school students, compared to two minutes for scenario 2 (increased compliance) and three minutes for scenario 3 (require PE in 11th and 12th grade) (See Table A). For overweight students, the impact of scenario 1 is

especially large—averaging approximately five minutes of additional daily MVPA, compared to one to two minutes for scenarios 2 and 3.

**Table A: Estimated average daily minutes of MVPA in P.E. classes for secondary school students in California public schools (grades 7-12) for three policy scenarios**

| | All Students | | Normal Weight | | Overweight | |
|---|---|---|---|---|---|---|
| ***Policy scenario*** | Current | Post- | Current | Post- | Current | Post- |
| 1. 50% of PE period in MVPA | 5.4 | 9.2 | 6.6 | 9.4 | 3.1 | 8.7 |
| 2. Full compliance only (i.e. 200 minutes PE/week) | 5.4 | 7.2 | 6.6 | 8.8 | 3.1 | 4.2 |
| 3. require 11th/12th grade P.E. | 5.4 | 8.2 | 6.6 | 4.2 | 3.1 | 5.1 |

NB: Although policy scenario 3 does not target grades 10 and under, in order to facilitate comparison of policy options the base population used to calculate all averages for all scenarios is the same (i.e. all secondary students enrolled in California public schools)

## Discussion

*Policy options to encourage physical activity among students who need it most*

We project the aggregate increases in physical activity among secondary students to be greatest from implementation of a policy to require that students spend at least 50% of each P.E. period engaged in MVPA (Scenario 1). While this does not mean that the there is no value in implementing the other policy options, it does suggest that by themselves other policy options will have a smaller effect on increasing physical activity, especially among overweight students.

Increasing the amount of MVPA in P.E. is especially advantageous for increasing physical activity levels among students who are currently least active. Since data were not available on the prevalence and characteristics of students who are less active in P.E., these students are represented by proxy in our analysis by students classified as "overweight." If the goal of changes to P.E. requirements is to stem the rise in sedentary lifestyle and consequent obesity and health risks, then it is essential that these changes increase activity levels among the students who are less active. If activity levels increase only among those students who are already highly active, then the population health impact of these changes will be minimal.

*Dealing with data gaps*

Due to high levels of incomplete information about the current state of P.E. in California schools, including compliance rates of student exemptions and activity levels, the results of this analysis should not be taken as point estimate predictions of activity levels. Nonetheless, the results of this analysis can be used to understand the relative potential impact of different policy options on students' activity levels. If the goal of policies to reform P.E. in California schools is to combat the growing epidemic of obesity and sedentary lifestyle and the subsequent negative impacts on the well-being of Californians, then it is essential to consider which policy options are most effective at targeting these problems. Because school P.E. has a "captive audience" and because it is so ubiquitous, reaching across all geographic and demographic boundaries, it has a great potential to positively impact those children and youth who have most to benefit—those who are at greatest risk of inactivity and overweight. However, current P.E. programs are not effectively engaging all of California's students in significant levels of daily physical activity. To ameliorate this situation, policy-makers should consider ways to efficiently direct instructional resources

and efforts to encourage more activity among children at highest risk of inactivity and overweight. This analysis shows that simply doing more of the same, that is, requiring more minutes of P.E., is probably not the best approach to realizing this goal.

*Challenges of implementation*
Requiring that at least 50% of P.E. time be spent in MVPA necessitates commitment, in both securing resources that enable students to fall into line with the recommendation as well as monitoring of compliance by schools or districts. For example, increasing the time spent in MVPA is likely to be achieved through plans to ensure that P.E. classes are taught by specialists who have received training in MVPA instructional methods and providing indoor and outdoor facilities and proper equipment for high-intensity activities.

*Combined efforts necessary*
It is essential to keep in mind that even the most effective efforts to improve the quality and quantity of P.E. will by themselves be insufficient to stem the growing tide of physical inactivity and overweight and obesity. Efforts should address physical activity in all settings—in after-school programs, routine activity in the community and at home, and options for voluntary recreational physical activity in and out of school. And, of course, efforts to increase physical activity need to be coupled with efforts to encourage and enable healthier eating practices.

**Overview of the HIA**

Childhood overweight and obesity have become the focus of increased attention among public health practitioners, policy makers and the public spurred by a tripling in the prevalence of overweight since 1960. Approximately 15 percent of all U.S. children were classified as overweight in 2000 (National Health and Nutrition Examination Survey, 2004; Ogden et al., 2003). An obesogenic environment has largely been implicated in this rise in overweight. This type of environment is one in which calorically-dense foods are readily available and pervasively advertised and energy expenditure through physical activity is not integrated into daily living. For children, the obesogenic elements of their school environment can have a large impact on their eating and activity patterns. Poor eating and consumption patterns at school have received a great deal of attention and have prompted a number of successful measures to alter the nutrition environment of schools; for instance the California Childhood Obesity Prevention Act (SB 677) was instrumental in eliminating the sale of soda during school hours in elementary and middle schools.

There is now considerable interest in enacting policies in California schools that encourage physical activity. An intuitive starting point is to target physical education (P.E.) classes, not only because they are designed to provide children physical activity instruction and play time, but also because the quantity and quality of P.E. appears to have been eroded by resource constraints and educational priority shifts. A recent report by the California Center for Public Health Advocacy showed that more than half of California school districts fail to meet the mandated elementary school P.E. requirement of 200 minutes every ten days (California Center for Public Health Advocacy, 2006a). Anecdotal reports from teachers and others within the school system suggest that P.E. teachers and programs are being cut to meet tight school

budgets; and resources are focused on reading, mathematics and other subjects for which there are mandated standardized tests (California Center for Public Health Advocacy, 2006b; California Department of Education, 2005a; California State Assembley, 2006; National Association for Sport and Physical Education, 2006b; Nofsinger, 2005). Besides reducing the time students spend in P.E. classes, shifting school resources away from P.E. can also erode the quality of P.E. instruction, particularly as class sizes continue to increase and more P.E. classes are taught by teachers without P.E. credentials. As with P.E., recess in some elementary schools is also being reduced or eliminated in order to allow more class time to prepare students for standardized tests (Posnick-Goodwin, 2002).

As part of the California Endowment's Healthy Eating Active Communities Initiative, this Health Impact Assessment (HIA) examines state policies that aim to increase physical activity levels for students in grades K-12 by increasing the quality and quantity of P.E. provided by their schools at every grade level.

## Rationale for HIA

### *Obesity trends and health effects*

According to a report by the California Research Bureau, childhood obesity in the U.S. doubled between 1990 and 2000 (Cohen, 2000). Further, results from the 1999-2000 National Health and Nutrition Examination Survey (NHANES) show that 16 percent of children and adolescents (aged 6-19 years) are now obese, compared to only four percent among children and five percent among adolescents in the 1960's (NCHS 2004). This rise in obesity among youth has been associated with a dramatic increase in type-2 diabetes, a disease that was once called "adult-onset" diabetes in part because it was rarely observed among youth. Due to a rise in the

number of overweight children, there has been a ten-fold increase in the incidence of childhood type-2 diabetes between 1982 and 1994 (Hill et al., 2003). Freedman (1999) found that overweight school children (BMI>95$^{th}$ percentile) compared to normal weight children (BMI <85$^{th}$ percentile) were 2.4 times more likely to have elevated total cholesterol, 2.4 times more likely to have elevated diastolic blood pressure, 3.0 times more likely to have elevated low-density cholesterol; 3.4 times more likely to have high density cholesterol; 4.5 times more likely to have high systolic blood pressure; 7.1 times more likely to have high triglycerides, and 12.6 times more likely to have high fasting insulin levels.

Being overweight in childhood and adolescence also increases the likelihood of having a number of different chronic disease risk factors in adulthood. Overweight children and adolescent are between 8.5 to 10 times more likely to develop high blood pressure compared to their normal weight peers (Lauer & Clarke, 1984; Srinivasan et al., 1996). Overweight during adolescence (BMI >75$^{th}$ percentile) is associated with a 2.4-fold increase in the prevalence of total cholesterol greater than 240mg/dl, a 3 fold increase in LDL above 160 mg/dl, and an 8 fold increase in HDL levels greater than 35 mg/dl in adults aged 27-31 (Srinivasan et al., 1996). Childhood obesity has also been linked to diabetes, colon cancer, menstrual complications, gestational hypertension, gout, arthritis, hip fractures, difficulty with personal care and routine activities of daily living in adulthood, and overall mortality (Engeland, 2004; Must et al., 1992; Must & Strauss, 1999; Power et al., 1997), although at least one study (Must et al., 1992) did not find increased risk of mortality among women. It also appears that the effects of childhood obesity on morbidity and mortality in adulthood depend in part on the age of onset and persistence of obesity in adulthood (Engeland et al., 2004). In the Bogalusa Heart Study sample

over 90% of the new cases of non-insulin dependent (or Type II) diabetes mellitus were overweight (BMI >90$^{th}$ percentile) as children or adolescents (Srinivasan et al., 1996).

*Physical activity trends*

The surge in obesity rates is a product of both poor nutrition and decreased energy expenditure. America's population is becoming increasingly sedentary; only 15% of adults engage in the recommended 30 minutes or more of moderate exercise five times each week or 20 minutes of vigorous activity three or more time per week and nearly one-third are completely sedentary (U.S. Department of Health and Human Services, 2000). Based on the 2001 Youth Risk Behavior Surveillance System (YRBS), 24.2% of male students and 37.9% of female students in the U.S. were classified as inactive (Brownson et al., 2005). Accordingly, the percentage of students who attended P.E. class daily has decreased from 41.6% in 1991 to 32.2% in 2001 (Brownson et al., 2005). Nationally, only 8% of elementary schools, 6% of middle/junior and senior high schools provide daily P.E. or its equivalent for the entire school year (Burgeson et al., 2001).

There are also disparities in physical inactivity by gender and ethnicity and these differences become more pronounced as children age. Gender differences in the participation of youth in overall physical activity are well documented (McKenzie et al., 2004). Boys have been shown to be more physically active than girls outside of school (Sallis et al., 2000). In a recent study of objectively measured physical activity using accelerometers among 375 students in grades 1 through 12 (Trost et al., 2002), boys were consistently more active than girls, in particular for vigorous-intensity activities; however, participation in moderate physical activity was similar for boys and girls. In a study of physical activity at school, boys were significantly

more active than girls in 3rd grade P.E. classes during the free play segments (McKenzie et al., 1996). Similarly, a study of 5th graders showed that while girls and boys had similar rates of physical activity during physical education classes, the boys were significantly more active during recess (Sarkin et al., 1997). Another study showed that at the middle school level, boys engaged in significantly more moderate to vigorous physical activity and vigorous physical activity than girls during P.E., particularly during skill drills, game play, and free play contexts (McKenzie et al., 2000).

The relatively low levels of physical activity among adolescent girls has been attributed to a number of causes (Clemmens & Hayman, 2004), including feelings of self-consciousness (Leslie et al., 1999), lack of motivation, lack of friends to participate with, and feeling too tired (Robbins et al., 2003). The physical, psychosocial, cognitive, and emotional changes of adolescence also significantly influence participation in physical activity (Sallis et al., 2000). These differential levels and rates of age-related decline in physical activity suggest different strategies may need to be employed to reduce these disparities.

Additionally, minority adolescents are also generally less active than their non-minority counterparts (Sallis et al., 2000), which is particularly true for minority adolescent girls (Gordon-Larsen et al., 2002; Kimm et al., 2002). A longitudinal study following a cohort of 1,213 African-American girls and 1,166 Caucasian girls for ten years found a steady decline in leisure time physical activity in both African-American and Caucasian girls, however among African-American girls physical levels were lower at the beginning of the study and declined more sharply. Rates of decline in physical activity for both groups were associated with girls' BMI. By Year 8 of the study 56% of the African-American girls and 31% of the Caucasian girls reported no habitual activity. Results from Years 9-10 were not analyzed since by that time

median habitual activity scores for the African-American girls in the sample had dropped to zero (Kimm et al., 2002).

Gordon-Larsen and colleagues (2000) examined data from the 1996 National Longitudinal Study of Adolescent Health, a nationally representative survey of 17,766 U.S. students enrolled in middle and high schools, to identify factors associated with moderate-to-vigorous physical activity (MVPA[1]) and physical inactivity. Across ethnic groups, the proportion of girls scoring in the "high" category of weekly MVPA was 45% to 65% that of boys. Levels of MVPA were also lower among African-American and Hispanic girls compared to Caucasian and Asian girls. Although most sample participants (78.7%) were not enrolled in P.E. courses at the time of survey, having P.E. five days per week (14.6% of the sample) more than doubled the likelihood that an individual scored in the highest category of weekly MVPA (adjusted odds ratio: 2.21; confidence interval: 1.82-2.68). Individuals using a recreation center were also more likely to report the highest levels of weekly MVPA (adjusted odds ratio:1.75, confidence interval: 1.56-1.96).

*Interventions to increase physical activity among youth*

Based on general theories of physical activity, interventions have been classified into three types, each affecting different determinants of physical activity behavior: (1) Information-based determinants, (2) Environmental and policy determinants, and (3) Behavioral and social determinants (Kahn et al., 2002).

Interventions geared at information-based determinants seek to change knowledge and attitudes about the benefits of physical activity and provide information about opportunities for

[1] MVPA is often defined in survey questions as physical activity that is sufficiently vigorous to make you sweat (e.g. jogging, very brisk walk, playing competitive soccer).

physical activity within a community. This is primarily done through the use of educational instruction to offer information on physical activity, exercise and the resultant health benefits. This type of information is thought to improve knowledge regarding the benefits of physical activity; increase awareness of opportunities to increase participation in physical activity in the community, and to help overcome negative attitudes. An example of such an approach is classroom-based health instruction that provides information and skills involved in making decisions to exercise. Such programs have had mixed results. On the whole, there is little evidence to show that classroom-based health education actually increases levels of physical activity or improves fitness (Kahn et al., 2002). Outside of school a notable example of an informational approach to promoting physical activity is the *VERB* television ad campaign supported by the U.S. Centers for Disease Control. Featuring kids engaged in a variety of enjoyable activities, the campaign aims to foster a sense that physical activity is fun and to suggest that kids should engage in more of those activities that they find particularly appealing. Although the advertising campaign was recently terminated after Congress failed to renew its funding (Parker-Pope, 2006), preliminary cross-sectional survey results show that youth who report seeing *VERB* ads engaged in 34% more free-time physical activity than youth who did not see the ads (Huhman et al., 2005).

Environmental and policy interventions change the physical and organizational environments to improve the safety, attractiveness, and convenience of places for physical activity participation. This type of intervention is directed at whole communities or entire schools, and the goal is to increase physical activity through changing social networks, organizational norms, policies, and the physical environment. There are various examples of such interventions including creating walking or biking trails, providing access to school grounds

after hours, or allowing workers to take a longer lunch break if they use the time to exercise. Many of these programs, policies, or practices are supplemented with outreach activities and there is strong evidence of the effectiveness of this combination for increasing physical activity (Kahn et al., 2002).

Interventions based on behavioral and social determinants focus on giving people the skills needed to adopt and maintain behaviors that increase physical activity and create social environments that facilitate and increase behavioral change. School-based P.E. classes, designed to increase the amount of time students engage in moderate to vigorous activity, are an example of this type of intervention. Most physical education classes do not meet the Healthy People 2010 (HP 2010) guidelines of spending 50% of class time in moderate-to-vigorous physical activity (U.S. Department of Health and Human Services, 2000). However, students who are enrolled in enhanced physical education classes, such as the ones used in the Coordinated Approach to Child Health (CATCH) and the Sports, Play and Active Recreation for Kids (SPARK) interventions, have been found to spend significantly more time in moderate-to-vigorous physical activity and meet the HP 2010 goal (McKenzie et al.,. 2001; Sallis et al., 1997). P.E. classes can have a significant impact on physical activity in children if the length, number of classes, or amount of time spent engaging in moderate to vigorous activity (MVPA) during class is increased.

*Potential benefits of expanded and enhanced P.E.*

A majority of one's time during youth is spent in school. Thus, physical activity and P.E. at school can provide significant opportunities for increasing total physical activity. High quality P.E. programs have been shown to increase the time spent engaged in physical activity at school,

increase the amount of P.E. class time spent engaged in moderate to vigorous physical activity, increase daily energy expenditure, and improve aerobic capacity of students (Kahn et al., 2002). High quality P.E. may also promote knowledge of, and positive attitudes towards physical activity throughout an individual's lifespan (Sallis & McKenzie, 1991).

Consequently, expanding the quantity and quality of school P.E. has become an important focus of comprehensive strategies that promote physical activity among youth (Centers for Disease Control and Prevention [CDC], 1997; Pate & Hohn, 1994; Sallis & McKenzie, 1991; U.S. Department of Health and Human Services, 2000). Based on a systematic review of evidence, the Guide to Community Preventive Services has strongly recommended school-based, activity-focused P.E. as an effective method of increasing physical activity and fitness (Kahn et al., 2002). Furthermore, Healthy People 2010 (U.S. Department of Health and Human Services, 2000) identified improving P.E. as a national health objective, aiming to increase the number of schools scheduling daily P.E., the proportion of students participating, and the number of students who are physically active for at least 50% of lesson time.

*Research on improving the quality of P.E.*

Prior research has demonstrated that changes in the quality of P.E. courses can have significant effects on children's daily physical activity levels. The importance of quality P.E. was clearly demonstrated in the Child and Adolescent Trial for Cardiovascular Health (CATCH), which took place in 96 public schools in four states between 1991 and 1994 (McKenzie et al., 1996). The P.E. component of the intervention included a comprehensive curriculum and materials, teacher training, and on-site consultation to teachers. Results indicated a significant increase in the amount of MVPA during P.E. class time for the intervention schools compared to

the control schools. The Sports, Play and Active Recreation for Kids (SPARK) intervention, provided curricula and teacher training for promoting high levels of physical activity, movement skill instruction and enjoyment in P.E. classes. After one year of follow-up students in control schools averaged 13.9 minutes less minutes of weekly MVPA in P.E. than students in schools with SPARK-trained classroom teachers and 22.4 minutes less MVPA than students in schools with SPARK-trained P.E. specialists (Sallis et al., 1997). Evidence from a longitudinal study of young children has shown that one hour of P.E. participation in kindergarten is associated with less weight gain among overweight and at-risk-for-overweight girls one year later (Datar & Sturm, 2004).

Improved instruction and class management along with developmentally appropriate activity-based programs have been repeatedly shown to increase physical activity patterns within P.E. classes without requiring increases in class frequency or duration (McKenzie et al., 1996; McKenzie et al., 2004). Studies have shown that there is a high degree of sustainability of P.E. training and curriculum among youth for periods up to five years (Dowda et al., 2005; McKenzie et al., 2003; Lytle et al., 2003; Heath et al., 2002; Hoelscher et al., 2004). Lytle et al. (2003) found that the P.E. component of CATCH had the highest level of sustainability of all the program elements. In a study of predominantly low-income Latino 3rd-5th graders in schools along the Texas-Mexico border, the CATCH intervention resulted in fewer boys and girls who became overweight or at-risk-for-overweight two years later (Coleman et al., 2005). Sallis et al. (1997) demonstrated that regular classroom teachers and P.E. teachers can be trained to deliver high-quality physical education, improving fitness levels and standardized test scores in some participants.

*Current physical education policies in California*

In the middle of the twentieth century, California was a national leader in P.E. programs, and the first state to require daily P.E. in public elementary schools. However, during the past two decades, P.E. programs and staffing in California have suffered immensely. State-level data for California from the SHPPS indicates that California is falling behind other states and the nationwide objectives for many measures related to the states' P.E. policies and programs (Burgeson et al., 2001). In the 2005/2006 school year 25 percent of the students in grade five, 29 percent in grade seven, and 27 percent in grade nine achieved the fitness standards for all six areas of the Fitnessgram test. Forty percent of 5$^{th}$ and 7$^{th}$ graders and 52% of 9$^{th}$ graders did not meet the standard for aerobic fitness (assessed by a one-mile run/walk or a "PACER" shuttle-run) (California Department of Education, 2006).

In response to concern about the erosion of P.E. in this state and the growing body of research supporting the benefits of physical activity, the California Legislature amended Section 60800 of the *Education Code* (California Department of Education, 1999). The updated state requirements for P.E. in public schools require that elementary and secondary schools include P.E. courses and specify the minimum amount of P.E. minutes to be provided to students. For high school graduation, students are now required to have completed at least two years of P.E. years while in high school (California State Education Code, sections 51220, 51222 and 51241). For elementary grades 1-6, a minimum of 200 minutes each ten days is required, and for secondary grades 7-12, the provision requires a minimum of 400 minutes each ten days. For elementary school districts grades 1-8 there is a minimum of 200 minutes every ten days. An unknown, but possibly substantial proportion of students, do not receive the specified minutes of P.E. instruction due to numerous waiver options allowing students to opt out of P.E. Waivers are

given to individual students for medical and hardship reasons; for participation in after-school sports and driver education; and for work (California State Education Code, sections 51222, 51241, 51242). Besides the waivers granted to individual students, waivers may also be granted to middle and high school classes that are on certain alternate term schedules (California Department of Education, 1999).

With the objective to provide an easy way for P.E. teachers to report the results of physical fitness assessments, the "Fitnessgram" was developed in 1982 by The Cooper Institute in Dallas, Texas (The Cooper Institute, 2001). Since 1996, Education Code Section 60800 has required that each school district administer this physical performance test to all students in grades five through nine. More recently, in 1998, Senate Bill 896 began requiring the California Department of Education to compile all of the physical performance tests and report the results to the Governor and Legislator (California Department of Education, 2005b).

In 2005 the California Department of Education issued "Physical Education Model Content Standards for California Public Schools, Kindergarten Through Grade Twelve." These recommended standards are intended to guide districts and schools in their development of physical education programs and local requirements. These standards (California Department of Education, 2006b), do not include any requirements for minimum amounts of physical activity, As shown in the text analysis summarized in Table 1, they place a strong emphasis on developing students' knowledge and specific motor skills with less emphasis on participating in physical activities during P.E. classes. A similar emphasis is reflected in recommendations from the National Association for Sport and Physical Education (NASPE) that stress that "physical education should not be compared to or confused with other physical activity experiences such as recess, intramurals, or recreational endeavors" (National Association for Sport and Physical

Education, 2006a). Although these content standards are only recommendations, they do show that efforts to increase physical activity levels in P.E. may conflict with other educational objectives.

**Table 1: Frequency of key verbs describing learning objectives in the "Physical Education Model Standards for California Public Schools" (California Department of Education, 2006b)** (*rank order)*

| Verbs describing learning objectives | Category | Frequency |
|---|---|---|
| Explain | Cognitive | 102 |
| Identify | Cognitive | 97 |
| Demonstrate… | | |
| knowledge | Cognitive | 62 |
| specific skill | Physical activity | 58 |
| other | Cognitive or action | 11 |
| Analyze | Cognitive | 47 |
| Describe | Cognitive | 40 |
| Participate | Physical activity | 35 |
| Discuss | Cognitive | 6 |
| Recognize | Cognitive | 6 |
| Play | Physical activity | 0 |

*Physical education policies in other states*

There is no federal standard or education mandate for P.E.; state and local boards of education are free to decide on the breadth and intensity of the P.E. curriculum and standards in schools. As a result, there is great variation among state P.E. requirements across the country. Forty-eight states and Washington, D.C. require some form of P.E., but only one state, Illinois, requires daily P.E. in grades K-12 (Trust for America's Health, 2004). A national survey of state obesity control policies recently concluded that P.E. requirements are rarely enforced, insufficiently funded; viewed as expendable in comparison to core curriculum requirements such as math and reading, and are frequently waived through exemptions (Trust for America's Health, 2004). Nationwide data from the School Health Policies and Programs Study (SHPPS) (Burgeson et al., 2001) indicated that most states require elementary schools (78.4% of states), middle/junior high schools (85.7% of states), and senior high schools (82.4% of states) to teach

P.E. However, among those states, 20-60% of them allow students to be exempted from P.E. requirements, depending on the school level. Reasons for exemption include: cognitive disability, enrollment in other courses, high physical competency test score, participation in community service or sports activities, participation in school sports or vocational training, permanent physical disability and finally for religious reasons. Moreover, the percentage of schools that require P.E. decreases in each subsequent grade, from 50% in grades 1 through 5; to 25% in grade 8; and to only 5% in grade 12 (Burgeson et al., 2001).

Most schools (81.4%) follow national, state, or district P.E. standards or guidelines. Of these schools, about 82% of them follow guidelines based on the *National Standards for Physical Education*. This set of six standards strives to "develop physically educated individuals who have the knowledge, skills, and confidence to enjoy a lifetime of healthful physical activity" (National Association for Sport & Physical Education, 2005). Almost two-thirds of states have adopted P.E. goals, objectives, or expected outcomes in addition to the national standards. The specific outcomes addressed by the goals and objectives vary from the ability to perform a wide variety of movement forms at a basic level, to knowledge of the benefits of physical activity and regular participation in physical activity. About one-third of states and many districts have developed their own P.E. curricula. States and districts may provide schools with instructional materials for P.E., lesson plans or learning activities, a chart describing the scope of sequence of instruction for P.E., or plans for how to assess and evaluate students.

The CDC-funded SHPPS also demonstrated that only about one-fourth of states have a policy on the maximum allowable student-to-teacher ratio for P.E. Among those states with policies, the average maximum allowable rate ranged from 27:1 for elementary schools to 34:1 for high schools. Only 2.1% of the states prohibit schools from using physical activity to punish

students for bad behavior in P.E. class, and 8.3% of states prohibit schools from excluding students from all or part of P.E. class for bad behavior in another class. Approximately 25% of states and 40% of districts actually discourage this practice.

*Initiatives to change physical education policies in California*

In 2004 President Bush signed into law the Child Nutrition and WIC Reauthorization Act (Public Law 108-265) that required every U.S. school district participating in the National School Lunch and/or Breakfast Program develop and implement a "local wellness policy" by the beginning of school year 2006-2007. These wellness policies must set specific school-based nutrition and physical activity goals. In California, the Local School Wellness Policy (LSWP) Collaborative Group, including the California Department of Education and other state and local agencies, drafted a number of recommendations in compliance with the federal requirements. For the physical activity component of the wellness policies, the LSWP Collaborative Group recommended that at minimum:

1. Schools comply with current California requirements that students in grades 1-6 should receive a minimum of 200 minutes of P.E. for every 10 school days and students in grades 7-12 should receive a minimum of 400 minutes for every 10 school days;
2. Temporary exemptions from physical education be limited to students whose medical conditions do not allow for inclusion in the general, modified, or adapted physical education program;

3. High school students who are exempt from two years of physical education in grades 10, 11, or 12, per local district policy, be provided with the opportunity to participate in a variety of physical education elective courses;
4. High school physical education course content include effects of physical activity on dynamic health, mechanics of body movement, aquatics, gymnastics and tumbling, individual and dual sports, rhythm and dance, team sports, and combatives;
5. Physical education instruction be delivered by a teacher credentialed to teach physical education;
6. Class size be consistent with the requirements of good instruction and safety;
7. School districts administer a physical fitness test annually to all students in grades five, seven, and nine;
8. Students will receive their individual fitness test results upon completing the test;
9. Teachers and other school and community personnel cannot use physical activity or withhold opportunities for physical activity as punishment.

The LSWP collaborative group also issued a number of recommendations regarding: P.E. course credit, curriculum and instruction; facilities, assessment and goals of student learning; professional development, daily recess, integration of P.E. in the classroom, before- and after-school opportunities; safe routes to school, student safety, and physical activity for school staff. The curriculum and instruction recommendations are designed to enhance P.E. instruction; among the various recommendations in this category, two specifically seek to increase the level of MVPA during P.E. for all students. These recommendations are: (1) Full inclusion of all students in P.E., and (2) At least 50 percent of instructional time spent in moderate-to-vigorous

physical activity. With the goal of limiting the use of waivers out of P.E. and increasing participation in P.E., it is also recommended that student involvement in other activities involving physical activity for example, sports and marching band, not be substituted for meeting the P.E. requirement.

In October 2004 State Superintendent O'Connell's Task Force for Childhood Obesity, Type 2 Diabetes, and Cardiovascular Disease recommended a number of policy changes to increase the quality and quantity of instruction in P.E. Among the recommendations are:

1. Including physical education as core curriculum;
2. Maintaining and enforcing the required 200 minutes of physical education each 10 school days in grades K-5 and 400 minutes each 10 school days in grades 6-12 (all exclusive of lunch and recess);
3. Recommending an additional 100 minutes of physical education each 10 school days in grades K-12;
4. Not granting exemptions to minimum requirements to any school or class;
5. Allowing exemptions to individual students for documented medical or hardship reasons, and for 11$^{th}$ and 12$^{th}$ graders only in lieu of participation in athletic programs that have daily physical activity for 40 or more minutes;
6. Ensuring that 50% of physical education time is spent doing moderate to vigorous physical activity (MVPA). (California Department of Education, 2004).

Recently a number of California Bills have been introduced to the Senate; most notable is State Senator Torlakson's proposed Senate Bill (S.B.) 559 that would delete provisions to allow students in grades ten through twelve to be excused from P.E. class when they meet one of

several criteria for exemption. S.B. 559 would also redefine a P.E. class as one in which each student is required to actively participate, and includes a provision for expenditure for teacher training/professional development in physical activity intervention.

**HIA Logic framework**

Information on the putative linkages between the health outcomes stemming from increased physical activity from P.E. is represented graphically in the logic framework shown in Figure 1. Ostensibly, physical education may affect health through other pathways, such as establishing the skills and motivation to engage in physical activity in adulthood or even to discourage later physical activity among students who have negative experiences in physical education (Taylor et al., 1999). Certainly, physical education has other pedagogic goals: movement skills and knowledge; self-image and personal development, and social development (California Department of Education, 1994), but in terms of health outcomes we felt there was insufficient empirical evidence to model these impacts.

The causal pathways of the logic framework start with the three policy options we examined:

1. Increase the percent time in moderate-to-vigorous physical activity (MVPA) during P.E. in secondary grades where PE is mandatory (i.e. grades 6-10);

2. Increase compliance with state P.E. requirements (i.e. 400 minutes every 10 school days in secondary grades);

3. Require P.E. in 11th and 12th grades (assumed $11^{th}$ and $12^{th}$ graders are currently exempt).

These policy alternatives may or may not reflect actual legislative proposals, but they represent the range of types of policy options that were presented by State Superintendent O'Connell in 2004 (California Department of Education, 2004) and are likely to directly impinge on students' short-term levels of physical activity. After reviewing the research literature on the effects of increased physical activity among children we identified four intermediate outcomes which could mediate some effects on health outcomes and for which we believed sufficient evidence exists to include in the analysis:

1. Long-term increases in physical activity;
2. Exposure to air pollution;
3. Psychosocial factors, including social skills, attitudinal changes and social support;
4. Increased academic performance.

At the distal (right hand) side of the logic framework are potential health outcomes, such as musculoskeletal health (i.e. bone density), obesity and insulin sensitivity, that are linked directly to short-term increases in physical activity, as well as other health outcomes, such as asthma, mental health, and pregnancy whose effects are mediated through other intermediate factors.

Of all the various pathways in the logic framework, only one was determined to have sufficient data to model quantitatively—the direct pathway from P.E. programs to physical activity. Our quantitative model, shown in Figure 2, includes steps used in the quantification of physical activity. Given the lack of sufficient data for quantitative modeling, all other impacts were assessed qualitatively though a literature review.

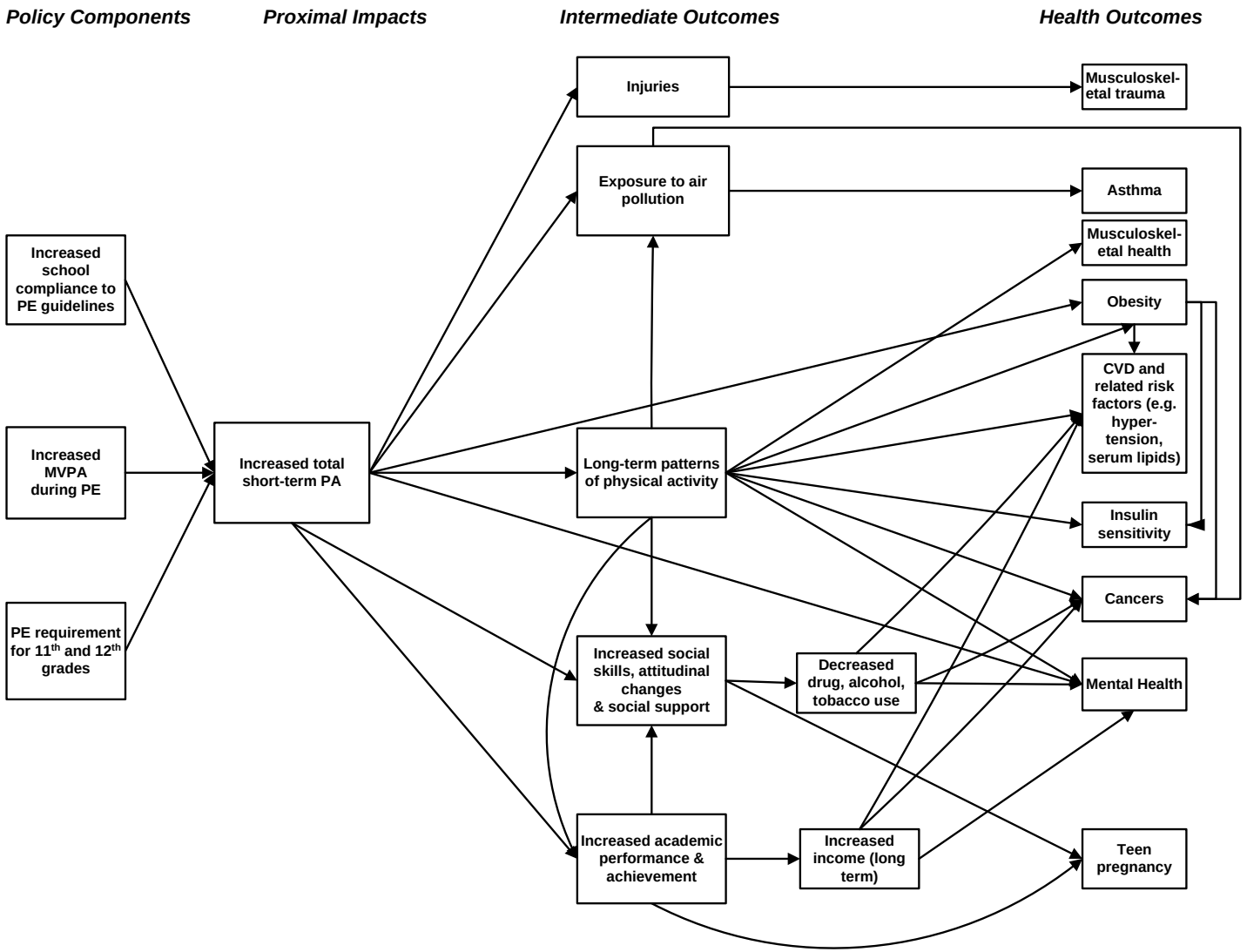


**Figure 1. General logic framework of P.E. policy impacts on health.**

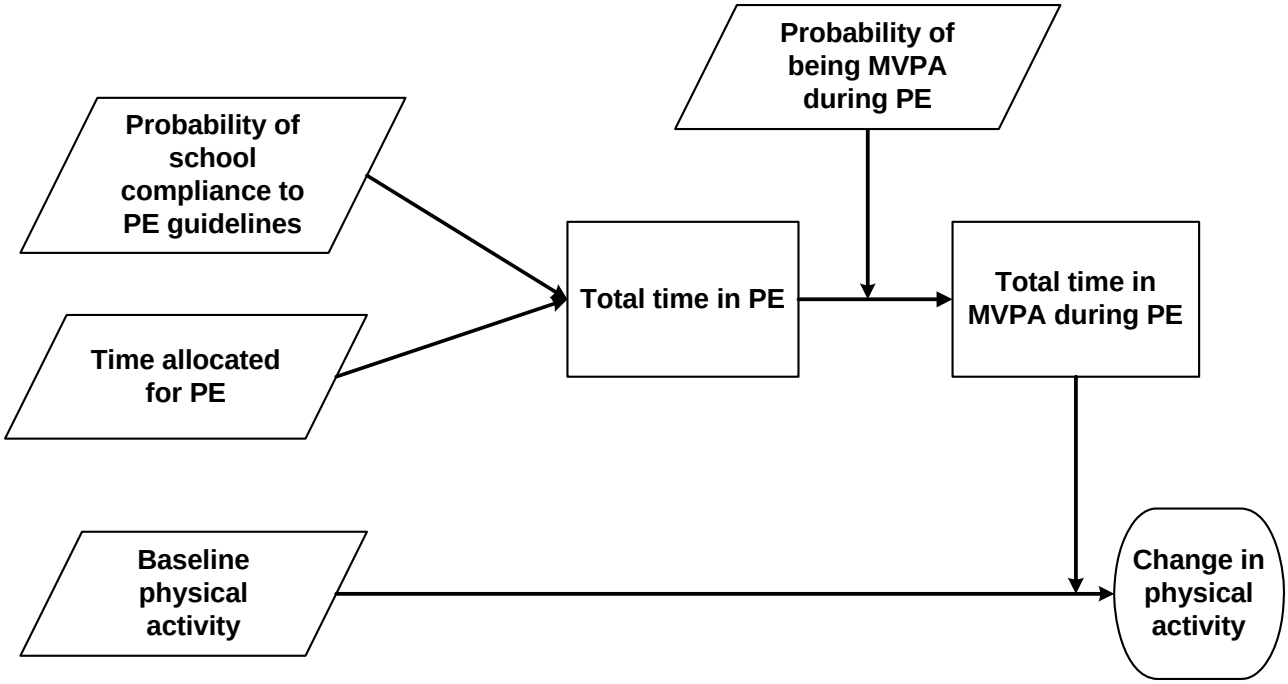


**Figure 2. Quantitative model for estimation of change in physical activity resulting from changes to state requirements for physical education in schools**

**Qualitative Assessment of Impacts**

*Overview of current evidence*

Physical activity in children has been hypothesized to improve physiological and psychological development in childhood, decrease chronic disease risks in adulthood, and contribute to patterns of physically active lifestyle over the lifespan (Blair et al., 1989). Accordingly, the Surgeon General's Healthy People 2010 objectives include increasing physical activity among youth—at least 30 minutes of moderate activity five or more days per week and at least 20 minutes of vigorous physical activity three or more days per week (U.S. Department of Health and Human Services, 2000). A recently convened expert panel reviewing research evidence on physical activity in youth has recommended that school age youth get at least 60 minutes of moderate to vigorous physical activity every day (Strong et al., 2005).

Despite a general sense that physical activity in youth benefits health, there remain a number of gaps in knowledge on these effects due to:

1. The relative infrequency of most chronic health conditions affected by physical activity among youth;
2. Long delays between the behavior of interest, (i.e. physical activity in youth), and the observation of most of the positive health outcomes affected by this behavior, such as reduced rates of heart disease in later adult years;
3. Maturational changes that make it difficult to separate the physiological effects of physical activity from changes due to normal growth and development, especially during puberty—changes which occur in different children at different ages.

Notwithstanding these gaps in knowledge, considerable evidence has accumulated on the diverse benefits of physical activity, including short- and long-term benefits, both independent effects and effects mediated by changes in body weight and body fat. The health impacts for which there is ample literature are briefly summarized below. Readers interested in comprehensive summaries of the health effects of children's physical activity should turn to recent reviews conducted by the Institute of Medicine's Committee on Prevention of Obesity in Children and Youth (Koplan, Liverman & Kraak, 2005) and the expert panel convened by the Centers for Disease Control and Prevention on "evidence-based physical activity for school-age youth" (Strong et al., 2005).

*Body fat*

A substantial body of evidence from intervention research and longitudinal studies demonstrates that physical activity can help achieve and maintain a healthy body weight in both normal weight and overweight children (Berkey et al., 2003; Budd & Volpe, 2006; Doak et al., 2006; Flynn et al., 2006; Gutin et al., 2002; Gutin et al., 1999; Kvaavik et al., 2003; LeMura & Maziekas, 2002; Moore et al., 2003). This finding has been corroborated by experimental evidence: interventions of 30 to 60 minutes of MVPA 3 to 7 days a week resulted in reductions in total body and visceral body fat in overweight children and adolescents in three different studies (Gutin et al., 2002; LeMura & Maziekas, 2002; Owens et al., 1999). In a meta-analysis of 30 intervention studies, a low-intensity longer duration of physical activity lead to some of the most favorable changes in body composition in children (LeMura & Maziekas, 2002). In a study of close to 10,000 students in the United States, the effect of an increase in physical

education instruction time between kindergarten and first grade, for the same child, on BMI was examined (Datar & Sturm, 2004). In a study of close to 10,000 students in the United States, the effect of an increase in physical education instruction time between kindergarten and first grade on BMI was examined (Datar & Sturm, 2004). Increasing physical education by one additional hour in first grade compared to kindergarten reduced BMI among girls who were overweight or at the risk for being overweight in kindergarten; there was no significant association, however, for boys who were overweight or at risk for being overweight and normal weight boys and girls.

*Near-term effects on blood lipids, triglycerides and insulin resistance*

There is lack of strong empirical evidence on the relationship between physical activity or fitness on the overall blood lipid profile in children (Armstrong & Simons-Morton, 1994; Webber et al., 1996; Boreham et al., 1997); there is some evidence, however, that high-density lipoprotein cholesterol (HDL) concentration insulin levels, triglycerides, total cholesterol/HDL, diastolic BP, and hypertension might be improved with physical activity (Rowland, 2001; Steinberger & Daniels, 2003). It also appears that the benefits of physical activity are the greatest for children who already have a health condition (e.g., hypertensive, overweight).

*Bone density*

Weight-bearing physical activities have been shown to be stimuli for bone structure and has the potential to increase bone mass in children as much as 7 to 8 percent (Vuori, 1996). However, low impact activities only have a weak effect on bone density

(Bailey & Martin, 1994; Bailey et al., 1996). Thus, it is unclear if walking to school would be sufficient to increase bone density; especially since the long-term impact of low intensity physical activity on bone growth is still unknown (Livingstone et al., 2003).

*Asthma*

The association between physical activity and asthma is not consistently positive or negative in cross-sectional studies (Chen et al., 2001; Weston et al., 1989; Kistansas et al., 2000; Nystad, 1997; Nystad et al., 2001; Counil, 2001). Particularly because some studies show that among asthmatic youth, higher levels of asthma-symptoms are associated with increased levels of physical activity (Strong et al., 2005). However, studies also show that increased levels of asthma-related symptoms are multi-factorial, and perhaps a decrease in physical activity may be a potential contributor to the increase in asthma prevention and severity. In addition, an overwhelmingly majority of studies support exercise conditioning for asthmatics as a way to improve cardiovascular fitness and quality of life (Lucas & Platts-Mills, 2005).

*Musculoskeletal Injuries*

There are limited data on the rate of injuries related to P.E. classes. Strong et al. (2005) suggest that the injury rate is close to zero for three 20 minute P.E. class sessions per week.

*Mental health*

Physical activity is not only beneficial to a child's physical heath, but there is also evidence that it benefits their mental health as well. Cross-sectional studies have consistently shown negative associations between physical activity and anxiety as well as depressive symptoms (Strong et al., 2005); these associations are strong in quasi-experimental studies (Strong et al., 2005).

In a number of studies, physical activity has been shown to have a positive effect on self-concept, physical self-concept, global self-concept, and self-esteem (Calfas & Taylor, 1994; Dishman et al., 2004; Gordon & Grant, 1997; Gruber, 1986; Steptoe & Butler, 1996). Additionally, meta-analyses performed on several studies have also shown a statistically significant increase in self-esteem and self-concept brought about with an increase of physical activity (Spence et al., 1997).

Increases in mental health outcomes may also be partially attributed to increased academic performance and achievement. Cross-sectional studies have consistently shown a positive association between physical activity and academic performance (Pate et al., 1996; Dwyer et al., 2001; Hanson & Austin, 2002; Kim et al., 2003; Field et al., 2001), concentration and memory, and classroom behavior. Positive gains, albeit small, were shown to be the result of the addition of physical education to curriculum in a three studies (Dwyer et al., 1983; Sallis et al., 1999; Shephard et al., 1984). Even when time allocated to other subjects is reduced, allocating more time to P.E. does not negatively affect academic achievement (Shephard, 1997). Nearly all studies examining the relationship between physical activity and classroom conduct have shown positive effects of physical activity on attitudes, discipline, behavior and creativity (Dwyer et al., 1983;

Keller, 1981; Martens & Grant, 1980; Scherman, 1989; Sinclair, 1983; Tuckman & Hinkle, 1986; Wearring, 1981).

*Teen pregnancy*

Studies have shown that physical activity can play a significant role in preventing teen pregnancy. For instance, female athletes are less likely to get pregnant than female non-athletes (5% and 11% respectively); more likely to report never having sexual intercourse; more likely to have their first intercourse at a later age; and more likely to use contraceptives (Women's Sports Foundation, 1998).

In addition, female athletes tend to have higher grades and standardized test scores than non-athletes. Consequently, improved school performance has also been associated with a decrease risk of teen pregnancy (McNeal, 1995).

**Quantitative Assessment of Impacts: Modeling Effects of P.E. on Physical Activity**

We developed a spreadsheet-based model to predict potential changes in physical activity from three P.E. policy scenarios for middle and high school students in California:

1. Increase the percent time in moderate-to-vigorous physical activity (MVPA) during P.E. in secondary grades where P.E. is mandatory (i.e. grades 6-10);

2. Increase compliance with state P.E. requirements (i.e. 400 minutes every 10 school days in secondary grades);

3. Require P.E. in 11th and 12th grades (assumed $11^{th}$ and $12^{th}$ graders are currently exempt).

These scenarios were chosen because they are likely to directly impinge on students' short-term levels of physical activity and because they reflect the range of types of policy recommendations presented by State Superintendent O'Connell in 2004 (California Department of Education, 2004). Eventual impacts on health outcomes of participating students were not estimated since these changes would likely to be too small to model accurately.

While increasing the quantity and quality of PE instruction in elementary grades is a recognized priority,[2] policy options towards this aim were not analyzed as part of this model due to:

1. Limited information on the statewide prevalence of obesity and fitness levels of young school age children. The youngest age for Fitnessgram is 5$^{th}$ grade. Most other sources of information on activity levels for this population are based on small samples from which extrapolation to the entire state is highly problematic;
2. Nearly non-existent information on the amount and quality of PE instruction in the elementary grades in California. Compliance is known to be a major problem but the extent is unknown. In UCLA/Samuels and Associates study reported hours of weekly PE were often not consistent with observed hours of PE. The problem is largest in schools without PE specialists. When PE is taught by ordinary classroom teachers there are no guarantees that PE activities will actually take place during time scheduled for PE. Furthermore, lack of teacher

[2] Growing concern among policy-makers about physical education at the elementary level is evidenced by (1) the report "Dropping the Ball" by the California Center for Public Health Advocacy that documented non-compliance with state P.E. requirements among elementary schools, (2) $40 million in the State's 2006/07 budget in grant support for PE instruction in grades K-8 (see http://www.ebudget.ca.gov/Enacted/BudgetSummary/K12/8877746.html), and (3) the proposed Assembly Bill 1779 (Karnette) (see California State Assembly, 2006) that would require at least 20 minutes of P.E. each school day for students in grades K-6.

training in PE methods and emphasis on academic subjects may act as incentives for teachers to use PE time for other purposes.

3. Without PE specialists and dedicated time set aside for PE, mechanisms to achieve and monitor compliance with PE mandates in elementary schools are quite different than they are in secondary schools. Implementation and monitoring efforts would incur substantial costs and high levels of non-compliance would likely persist.

Our goal was to make estimates of effect of increasing MVPA, averaged over the entire target population as well as differential impacts for important subgroups for the three different policies. For our analysis we chose to assess the differential impact on children by weight status (overweight versus normal weight) not only because overweight children have the most to gain in terms of health from increased physical activity but they can potentially be targeted by specific P.E. policies. Differential impact by other subgroups, for example boys versus girls, can be modeled using our methodology.

The quantitative model in Figure 2 illustrates the data elements (or inputs) required to calculate the change in physical activity stemming from P.E. In order the calculate the average total time in P.E. for California children the following inputs were required: (1) Percent of students who do not take P.E. due to exemptions or the lack of a P.E. requirement, and (2) the total time allotted for P.E. each day. To calculate the average time spent actually engaged in MVPA during P.E., we needed to know the probability of being MVPA during P.E. Overweight students are less likely to be engaged in MVPA during P.E. than normal weight students; hence, the level of difference

was added as an input in the model in order to assess the differential impact of P.E. on PA by weight status.

*Data sources*

Data from the California Department of Education included enrollment data for school size and student demographic characteristics (California Department of Education, 2004). The California Department of Education's 2004 Fitnessgram data were used to estimate the percent of $5^{th}$ – $9^{th}$ grade students with unhealthy body composition; using this value and the assumption that 95% of student with unhealthy body composition are overweight, we estimated the percent students who are overweight and normal weight. The 2002-2004 California Behavioral Risk Factor Surveillance System (BRFSS) was used to estimate overweight among 18 year olds, the typical age of $12^{th}$ graders.

In order to estimate the average time engaged in MVPA during P.E., we used preliminary results of the California Endowment's HEAC Evaluation study as inputs (see Box 1). Based on this study, approximately 30% of total time in P.E. is spent engaging in MVPA. In comparing the probability of MVPA during P.E. for overweight to normal weight students, results showed that for normal weight children 35% of P.E. time is spent engaged in MVPA, compared to overweight children who spend only 18%.

**Box 1: The UCLA/Samuels and Associates School PA/PE study**

A number of the values for key inputs for the quantitative model in this HIA come from the UCLA School of Public Health and Samuels and Associates study of "Disparities in School Physical Activity and Physical Education in California." Conducted from Fall 2005 through Spring 2006, this study compared physical activity and physical education at schools in 10 school districts in Northern, Central, and Southern California.

Five school districts in different parts of the state with physical fitness test scores (2002/03 aerobic portion of the "Fitnessgram" - Cooper Institute) in the bottom tertile of Fitnessgram scores statewide were matched with 5 districts from the same regions and with similar percentages of their student populations eligible for free-/reduced price lunches (socioeconomic status (SES)) but whose Fitnessgram scores were in the top tertile of scores statewide. Both high and low SES districts were included. Data were collected on programs, facilities, equipment, policies, and observed physical activity both in and outside of P.E. through principal surveys, stakeholder interviews and site visits (29 schools) with direct observation.

While as yet unpublished, preliminary results of this study became available during the writing of this HIA. Some of the findings of the PA/PE study utilized by this HIA analysis include:

- Environmental audits found that the mean amount of P.E. class-time in moderate-to-vigorous physical activity (MVPA) was 26.4% (std. dev.=15.8)
- Percentage of class-time in MVPA was influenced by class size and student SES
- Principals report that students with PE waivers at their schools are about 3% at elementary schools, 1% at middle schools, 10% in 9$^{th}$ grade, 26% in 10$^{th}$ grade, 55% in 11$^{th}$ grade and 66% in 12$^{th}$ grade
- High year-to-year variability in Fitnessgram scores in many schools
- Schools' Fitnessgram scores are positively associated with scores on standardized state tests of academic performance (i.e. California Academic Performance Index (API)), although part of this association is explained by the effect of student SES on both physical fitness and academic performance
- The amount of MVPA in a school's PE classes is associated with higher average Fitnessgram scores, however this effect is attenuated by SES (i.e. effect is larger in high income schools)

*Targeted and Affected Populations*

There are two populations for which the impacts of physical education intervention are relevant. The first is the actual population targeted by the intervention, either middle school or 11$^{th}$ and 12$^{th}$ graders depending on the policy scenario, and the second is all the students in the affected population, which includes all students in 7$^{th}$ to

12th grades. For example, the policy scenarios to increase percent time in MVPA during PE and increase compliance with PE guidelines targets all middle school students. This population includes all enrolled middle school students in California, which is estimated to be about 1,000,000, according to the California Department of Education. Similarly, the policy scenario requiring 11th and 12th grade PE targets only 11th and 12th graders, also estimated to be about 900,000 students. The affected population includes all secondary school (7th-12th) students in California, estimated to be about 3,000,000. Applying estimates of effect, minutes of MVPA/day during P.E. due to intervention, to this affected population allows for comparison of effect across scenarios and is politically relevant as this is the population that bears the effects of the interventions due to policy.

*Assumptions*

The assumptions required for this analysis are many; however, the spreadsheet model allows for flexibility in these assumptions as values can be changed according to the population and policy scenario of interest. Table 2 details the assumed values and data sources used in the spreadsheet model.

Table 2: Assumed values for key variables in the impact model of physical education policy

| Variable | Value | Data Source |
|---|---|---|
| Percent Overweight | 23%-40% depending on gender and grade level | California Department of Education Fitnessgram 2004-2005, 5th, 7th, 9th grade[1]<br><br>Behavioral Risk Surveillance Survey, 18 year olds |
| Gender Distribution | 50% Male, 50% Female | Assumed value |
| Percent of students w/ individual PE exemptions | 3% - Elementary,<br>1% - Middle School,<br>18% - 9th to 10th Grade,<br><br>100%[2] - 11th to 12th Grade | UCLA/Samuels and Associates School PA/PE Study – Principal's Survey<br>Assumed graduation requirements for P.E. are met in grades 9 & 10; hence no P.E. obligations in 11th and 12th. |
| PE sessions/week | 3 days/week | Assumed value |
| Time per PE session | 50 minutes | Assumed value |
| Percent of time in MVPA during PE | 35% - normal weight<br>18% - overweight | UCLA/Samuels and Associates School PA/PE Study |
| Relative % time in MVPA for overweight children compared to normal weight children | 0.5 | Assumed based on non-formal observation of observers in the UCLA/Samuels and Associates PA/PE study |

[1] Fitnessgram estimates % of students in Healthy Fitness Zone (HFZ), we assume 95% of students not in HFZ are overweight; estimates from Fitnessgram for 5th graders are used for K-3 grade due to lack of population data on overweight for this age group. [2] CA graduation requirements include only 2 yrs of P.E. which is generally met by students in grades 9 and 10; we assume that no P.E. is taken by 11th and 12 graders.

*Results of the quantitative model*

According to our model, introducing P.E. requirements in grades 11 and 12 ("Scenario 3") has the greatest impact averaged for all secondary ($7^{th}$ -$12^{th}$ grade) students in terms of additional minutes of MVPA/day (2.8 minute increase in MVPA/day as compared to 2 and 0.9 minute increases for the two other Scenarios). When the results are not averaged over the entire Secondary student population, there is an 8.6 minute increase in MVPA for $11^{th}$ and $12^{th}$ graders, who make up about 9,000,000 students in California (see Table 3). The 8.6 minute increase is an average for both overweight and normal weight students; when this value is stratified by weight status, it is apparent that normal weight students have far larger increases in MVPA (10.5 minutes) as compared to overweight students (5.4 minutes).

Although Scenario 3 has a greater increase in minutes of MVPA/day for all students compared to the other two scenarios, increasing the percent time in MVPA ("Scenario 1") has the greatest impact for overweight students. In Scenario 1, the percent time in MVPA is increased to 50% for all students; this translates into a large increase in minutes of MVPA/day for overweight students who have low levels of MVPA during PE at baseline or pre-policy intervention (18% according to UCLA/Samuels and Associates School PA/PE Study). Increasing the percent time in MVPA to 50% translates into a daily MVPA increase of about 10 minutes for over 300,000 overweight middle school students, whereas the increase in MVPA/day is only about 2 minutes for overweight middle school students in Scenario 2 and about 5 minutes for overweight $11^{th}$ and $12^{th}$ graders in Scenario 3 (Table 3).

**Table 3.** Increase in minutes of MVPA per day from P.E. for students targeted by policy interventions and students in the affected population (7th- 12th grade)

| | Students Targeted by Intervention | | | | All Students in Affected Population (7th–12th grade) | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Pre-intervention min. MVPA/day from P.E. | Post-intervention min. MVPA/day from P.E. | Increase in min. MVPA/day from P.E. | N | Pre-intervention min. MVPA/day from P.E. | Post-intervention min. MVPA/day from P.E. | Increase in min. MVPA/day from P.E. |
| Scenario 1: Increase in percent time in MVPA during P.E. to 50% for grades 7-10 | | | | | | | | |
| Total | 1,000,000 | 8.8 | 13.5 | 4.7 | 3,100,000 | 5.4 | 9.2 | 3.7 |
| Normal wt. | 684,600 | 10.4 | 13.5 | 3.1 | 2,074,228 | 6.6 | 9.4 | 2.8 |
| Overweight | 315,400 | 5.3 | 13.5 | 8.2 | 1,025,773 | 3.1 | 8.7 | 5.6 |
| Scenario 2: Compliance[1] with P.E. guidelines of 200 min/week for grades 7-10 | | | | | | | | |
| Total | 1,000,000 | 8.8 | 10.7 | 1.9 | 3,100,000 | 5.4 | 7.2 | 1.8 |
| Normal wt. | 684,600 | 10.4 | 12.6 | 2.2 | 2,074,228 | 6.6 | 8.8 | 2.2 |
| Overweight | 315,400 | 5.3 | 6.5 | 1.1 | 1,025,773 | 3.1 | 4.2 | 1.0 |
| Scenario 3: Introduce P.E. requirement for 11th/12th graders[2] | | | | | | | | |
| Total | 1,000,000 | 0 | 8.6 | 8.6 | 3,100,000 | 5.4 | 8.2 | 2.8 |
| Normal wt. | 635,000 | 0 | 10.5 | 10.5 | 2,074,228 | 6.6 | 9.8 | 3.2 |
| Overweight | 365,000 | 0 | 5.4 | 5.4 | 1,025,773 | 3.1 | 5.1 | 1.9 |

[1] Compliance with 200 min/week P.E. guideline is assumed to be achieved by increasing number of days of P.E. sessions from 3 days/week to 4 days/week.
[2] Assumed that 100% of 11th and 12th graders do not take PE because 2 year P.E. graduation requirement is met in 9th & 10th grades; and, introducing a requirement would reduce this number to 0% ("best case scenario").

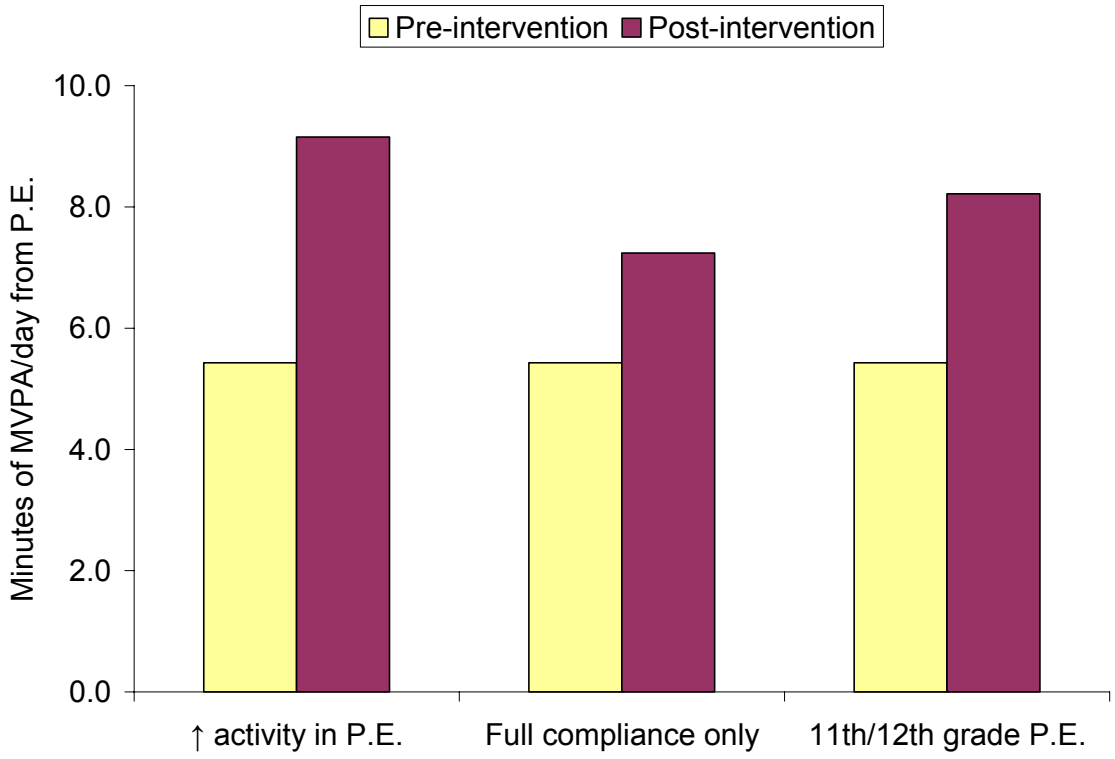


Figure 3. Post-intervention minutes of MVPA/day from P.E. for 3 Scenarios for **all students**

Figure 3 depicts an increase in the minutes of MVPA/day averaged over **all students** in the affected population ($7^{th}$ -$12^{th}$ grade). As illustrated in this figure, introducing a P.E. requirement for $11^{th}$ and $12^{th}$ graders (Scenario 3) shows the greatest increase in total minutes of MVPA for all students.

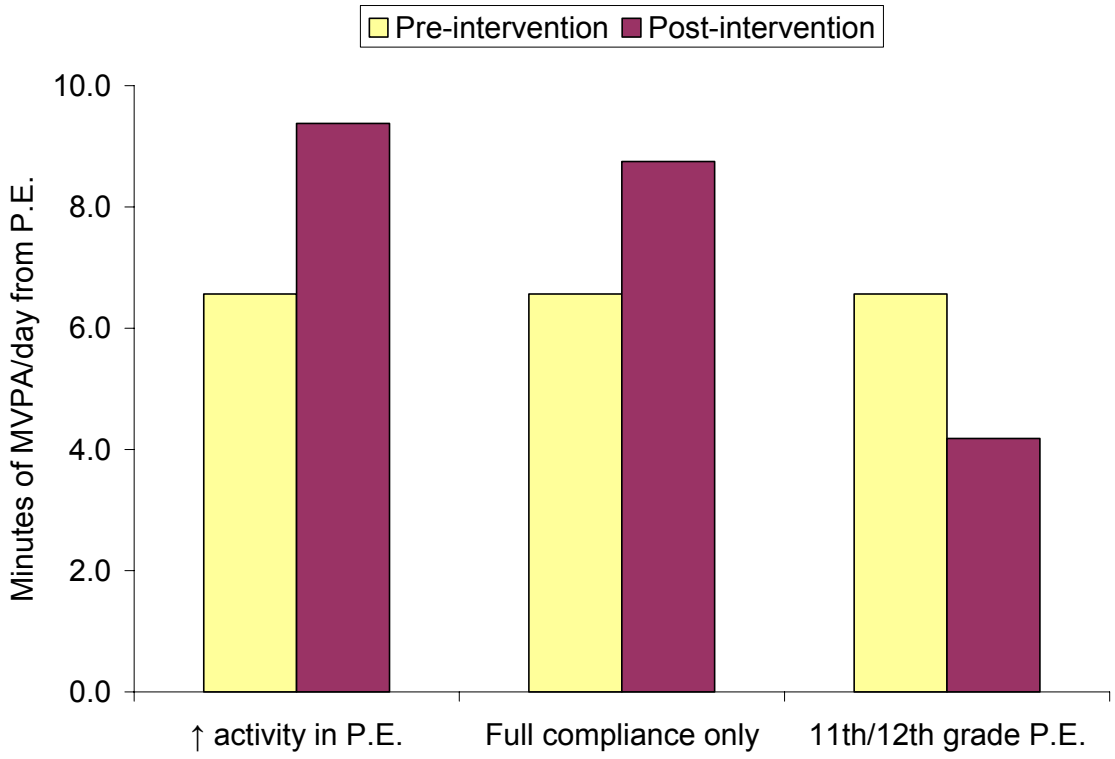


Figure 4. Post-intervention minutes of MVPA/day from P.E. for 3 Scenarios for **normal weight students**

Figure 4 depicts an increase in the minutes of MVPA/day averaged over all **normal weight students** in the affected population ($7^{th}$ -$12^{th}$ grade). As illustrated in this figure, introducing a P.E. requirement for $11^{th}$ and $12^{th}$ graders (Scenario 3) shows the greatest increase in total minutes of MVPA for all students.

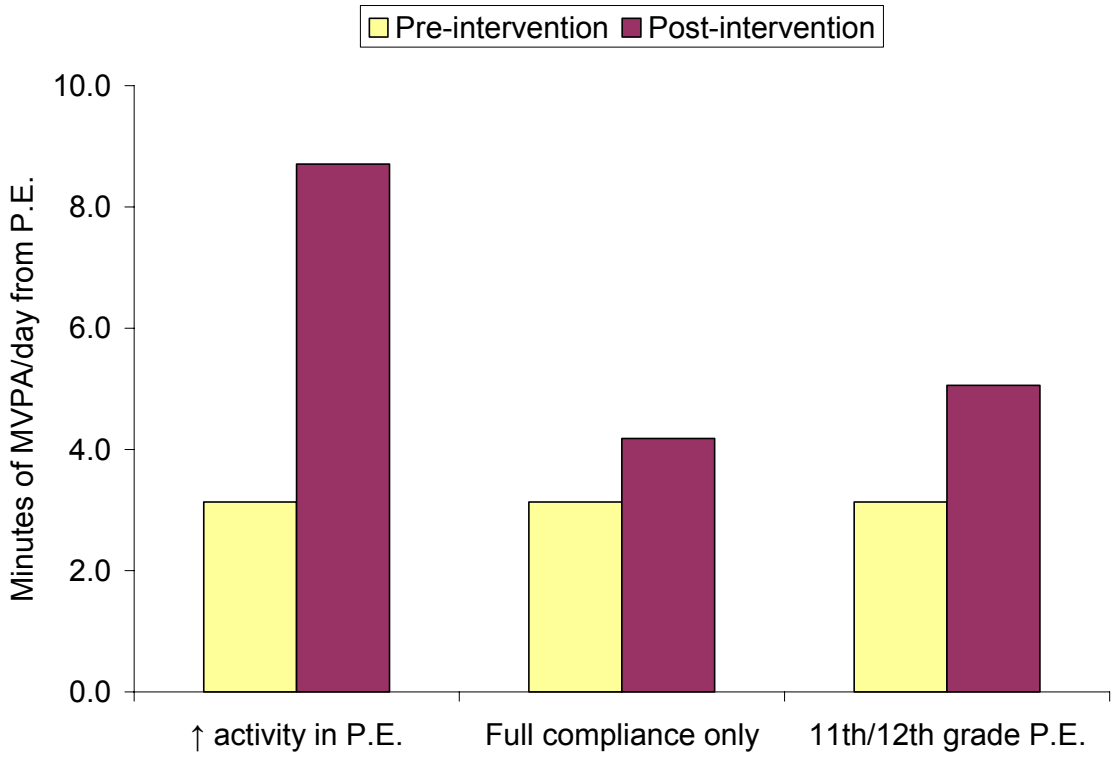


Figure 5. Post-intervention minutes of MVPA/day from P.E. for 3 Scenarios for **overweight students**

Figure 5 depicts an increase in the minutes of MVPA/day averaged over all **overweight students** in the affected population ($7^{th}$ -$12^{th}$ grade). In this figure, increasing activity in P.E (Scenario 1) is shown to have the greatest affect on overweight students. The percent time in MVPA is increased by 50% for all overweight students.

**Discussion and Recommendations**

Utilizing the best data available and our "best-guess" assumptions for missing data, we project the aggregate increases in physical activity among secondary students to be greatest from implementation of a policy to require that students spend at least 50% of each P.E. period engaged in moderate-to-vigorous physical activity (MVPA) (Scenario 1). Increasing the amount of MVPA in P.E. is especially advantageous for increasing physical activity levels among students who are currently least active and thus most likely to benefit, represented in our analysis by students classified as "overweight." Our analysis examines only P.E. in the secondary grades—issues affecting physical activity in P.E. classes in elementary schools are quite different and would likely yield different results.

Whatever policies are adopted, we believe it is essential that policy-makers consider their impact on more sedentary students. If the goal of changes to P.E. requirements is to stem the rise in sedentary lifestyle and consequent obesity and health risks, then it is essential that these changes increase activity levels among students who are less active. If activity levels increase only among those students who are already highly active, then the population health impact of these changes will be minimal.

The results from our quantitative estimation model are contingent on assumptions and extrapolations from existing research. For instance, all policy scenarios assume perfect compliance. And, we must assume that the data used as inputs in the spreadsheet adequately represent true values for all secondary school children in California. However, the strength of the model is in its flexibility; users can examine the impacts of all types of different scenarios with different assumptions. Furthermore, this model could

be scaled down to the district level or scaled up to the national level to examine district and national policy options.

The estimated average aggregate increase in daily MVPA of 3.7 minutes represents only 6% of the recommended 60 minutes of daily physical activity. By itself this does not appear to be a large amount of physical activity. The average change in minutes of MVPA is small in part because it is spread over the whole population of 7th to 12th grade students. The reason for including the whole population of students was to be able to make comparisons across the different scenarios. When estimated for the target population, 7th to 10th graders, the average increase from Scenario 1 is close to 5 minutes per day for all students. For overweight students the increase in MVPA is a little over 8 minutes per day, which could translate into an increase of 40 minutes of MVPA per week if P.E. is offered daily. This is not a trivial increase.

Based on the comparative analysis of the three scenarios, it appears that targeting the percent time spent in MVPA during P.E. has the greatest potential for increasing health-inducing physical activity levels among secondary school students, particularly overweight children. Further analyses might take into account the costs of each policy scenario to be able to make statements regarding their relative cost-effectiveness.

Requiring that at least 50% of P.E. time be spent in MVPA necessitates commitment in securing resources that enable students to fall into line with the recommendation as well as monitoring of compliance by schools. According McKenzie et al. (2000) there are a number of characteristics of P.E. classes that are associated with time spent in MVPA and targetable for change. For example, large class size is associated with more time spent in management and less time in MVPA. Certain

activities and sports, such as soccer, provide more MVPA than others such as softball. Smaller spaces and lack of available equipment for P.E. also reduce time in MVPA. Furthermore, time spent in MVPA can probably be achieved through plans to ensure that P.E. classes are taught by specialists who have received training in MVPA instructional methods.

Clearly, improving the quality and quantity of physical education in schools can lead to increases in the total time spent in MVPA. However, because the increases are fairly modest they are not likely to cause drastic improvements in the percent of children meeting the recommended daily activity level. Hence, P.E. policies by themselves are unlikely to lead to significant reductions in morbidity and mortality related to sedentary lifestyle and obesity. Activity achieved during P.E., however, an essential component of efforts to combat these conditions (Pate et al., 2006), in part because young people spend so much of their waking hours in school and because increasing physical activity in P.E. has the potential to reach the students who are at greatest risk.

## References


Armstrong N, Simons-Morton B. (1994). Physical activity and blood lipids in adolescents. Pediatric Exercise Science;6:330-347.

Bailey DA, Faulkner RA, McKay HA. (1996). Growth, physical activity and bone mineral acquisition. Exercise and Sports Science Reviews;24:233–266.

Bailey DA, Martin AD. (1994). Physical activity and skeletal health in adolescents. Pediatric Exercise Science;6:330–347.

Berkey CS, Rockett HRH, Gilman MW, Colditz GA. (2003). One-year changes in activity and in inactivity among 10 to 15 year old boys and girls: relationship to change in Body Mass Index. Pediatrics;111:836-843.

Blair SN, Clark DG, Cureton KJ, Powell KE. (1989). Exercise and fitness in childhood: implications for a lifetime of health. In Perspectives in Exercise Science and Sports Medicine. C.V. Gisolfi and D.R. Lamb (eds). New York: McGraw-Hill 1989; 401–430.

Boreham CA, Twisk J, Savage MJ, Cran GW, Strain JJ. (1997). Physical activity, sports participation, and risk factors in adolescents. Medicine and Science in Sports and Exercise;29:788–793.

Brownson RC, Boehmer TK, Luke DA. (2005). Declining rates of physical activity in the United States: what are the contributors? Annual Review of Public Health;26: 421-43.

Budd GM, Volpe SL. (2006). School-Based Obesity Prevention: Research, Challenges, and Recommendations. J Sch Health:76:485-495.

Burgeson CR, Wechsler H, Brener ND, Young JC, Spain CG. (2001). Physical education and activity: Results for the School Health Policies and Programs Study 2000. Journal of School Health;71(7):279-293.

Calfas KJ, Taylor WC. (1994). Effects of physical activity on psychological variables in adolescence. Pediatric Exercise Science;6:406-423.

California Association for Health, Physical Education, Recreation and Dance (CAHPERD). (2003). Final Key Bills for the 2003/2004 Legislative Session. Accessed on May 26, 2005 at http://www.cahperd.org/legislation/FinalKeyBills.html.

California Center for Public Health Advocacy. (2006a). Dropping the Ball…California Schools Fail to Meet Physical Education Mandates. Accessed on June 15, 2006 at http://www.publichealthadvocacy.org/droppingtheball.html.

California Center for Public Health Advocacy. (2006b). Sample quotes from multiple subject student teachers regarding physical education at their placement schools. Supplement to Dropping the Ball…California Schools Fail to Meet Physical Education Mandates. Accessed on November 27, 2006 at http://www.publichealthadvocacy.org/droppingtheball.html.

California Department of Education. (1999). Physical Education Requirements. Education Code Section 33050 et seq.

California Department of Education. (2004). Task Force Recommendations. Accessed on June 8, 2005 at http://www.cde.ca.gov/ls/he/cd/recommendations.asp.

California Department of Education (2005a). Final Minutes, Wednesday, September 7, 2005, Item W-12: Request by San Jose Unified School District for a waiver of the elementary Physical Education statute.

California Department of Education. (2005). Fact Book 2005: Handbook of Education Information. Accessed on July 22, 2005 at http://www.cde.ca.gov/re/pn/fb/yr05testing.asp.

California Department of Eduation. (2005). Physical Fitness Testing (PFT). Accessed on Novmber 28, 2006 at http://www.cde.ca.gov/ta/tg/pf/index.asp.

California State Assembly, Appropriations Committee. (2006). AB 1779 (Karnette): Bill Analysis, Purpose. Hearing Date May 10, 2006. Accessed November 30, 2006 at http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_1751-1800/ab_1779_cfa_20060509_163023_asm_comm.html.

Centers for Disease Control and Prevention (CDC). (1997). Guidelines for school and community programs to promote lifelong physical activity among young people. Mortality and Morbidity Weekly Report, 46 (No. RR-6):1-36.

Centers for Disease Control and Prevention (CDC). (2004). Participation in high school physical education – United States 1991-2003. Mortality and Morbidity Weekly Report; 53(36):844-847.

Chen Y, Dales R, Krewski D. (2001). Leisure-time energy expenditure in asthmatics and non-asthmatics. Respir Med;95:13-8.

Clemmens D, Hayman LL. (2004). Increasing activity to reduce obesity in adolescent girls: a research review. J Obstet Gynecol Neonatal Nurs;33(6):801-8.

Cohen J. (2000). Overweight Kids: Why Should We Care? CRB 00-008, December 2000. Sacramento, CA: California Research Bureau.

Coleman KJ, Tiller CL, Sanchez J, Heath EM, Sy O, Milliken G, Dzewaltowski DA. (2005). Prevention of the epidemic increase in child risk of overweight in low-income schools: the El Paso coordinated approach to child health. Arch Pediatr Adolesc Med;159(3):217-24.

Counil FP, Karila C, Varray A, Guillaumont S, Voisin M, Prefaut C. (2001). Anaerobic fitness in children with asthma: adaptation to maximal intermittent short exercise. Pediatr Pulmonol;31:198-204.

Datar A, Sturm R. (2004) Physical education in elementary school and body mass index: evidence from the early childhood longitudinal study. Am J Public Health;94(9):1501-6.

Dishman RK, Motl RW, Saunders R, Felton G, Ward DS, Dowda M, Pate RR. (2004). Self-efficacy partially mediates the effect of a school-based physical-activity intervention among adolescent girls. Preventive Medicine;38:628-36.

Doak CM, Visscher TLS, Renders CM, Seidell JC. (2006). The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. Obesity Reviews:7:111–136

Dwyer T, Coonan W, Leitch D, Hetzel BS, Baghurst RA. (1983). An investigation of the effects of daily physical activity on the health of primary school students in South Australia. International Journal of Epidemiology;12(3):308-13.

Dwyer T, Coonan WE, Leitch DR, Hetzel BS, Baghurst RA. (1983). An investigation of the effects of daily physical activity on the health of primary school students in South Australia. Int J Epidemiol;12:308-13.

Dwyer T, Sallis JF, Blizzard L, Lazarus R, Dean K. (2001). Relationship of academic performance to physical activity and fitness in children. Pediatr Exerc Sci;13:225-37.

Engeland A, Bjorge T, Tverdal A, Sogaard AJ. (2004). Obesity in adolescence and adulthood and the risk of adult mortality. Epidemiology: 15(1):79-85.

Field T, Diego M, Sanders CE. (2001). Exercise is positively related to adolescents' relationships and academics. Adolescence;36:105-10.

Flynn MAT, McNeil DA, Maloff B, Mutasingwa D, Wu M, Ford C, Tough SC. (2006). Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations. Obesity Reviews:7(Suppl. 1):7–66.

Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. Pediatrics;103:1175-1182.

Gordon J, Grant G. (1997). How We Feel. London: Jessica Kingsley Publishers.
Gordon-Larsen P, Adair LS, Popkin BM. (2002) Ethnic differences in physical activity and inactivity patterns and overweight status. Obesity Research;10(3):141-9.

Gordon-Larsen P, McMurray RG, Popkin BM. (2000) Determinants of adolescent physical activity and inactivity patterns. Pediatrics;105(6):E83.

Gruber JJ. (1986). Physical activity and self-esteem development in children: a meta-analysis. In Effects of Physical Activity on Children. G. Stull and H. Eckert (eds). Champaign, IL: Human Kinetics: 330–348.

Gutin B, Barbeau P, Owens S, Lemmon CR, Bauman M, Allison J, Kang HS, Litaker MS. (2002). Effects of exercise intensity on cardiovascular fitness, total body composition, and visceral adiposity of obese adolescents. American Journal of Clinical Nutrition ;75:818-26.

Gutin B, Owens S, Okuyama T, Riggs S, Ferguson M, Litaker M. (1999). Effect of Physical Training and Its Cessation on Percent Fat and Bone Density of Children with Obesity. Obesity Research;7:208-214.

Hanson TL, Austin G. (2002). Student health risks, resilience and academic performance in California: year 2 report, longitudinal analyses. Los Alamitos, Calif: WestEd.

Hill JO, Wyatt HR, Reed GW, Peters JC. (2003). Obesity and the environment: where do we go from here? Science;299;853-5.

Huhman M, Potter LD, Wong FL et al. (2005). Effects of a Mass Media Campaign to Increase Physical Activity Among Children: Year-1 Results of the VERB Campaign. Pediatrics:116;277-284.

Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, et al. (2002). The effectiveness of interventions to increase physical activity: A systematic review. American Journal of Preventive Medicine;22(4S):73-107.

Keller S. (1982). An historical review. Journal of Physical Education, Recreation and Dance;53(9):26-28.

Kim HY, Frongillo EA, Han SS, Oh SY, Kim WK, Jang YA, et al. (2003). Academic performance of Korean children is associated with dietary behaviours and physical status. Asia Pac J Clin Nutr;12:186-92.

Kimm SY, Glynn NW, Kriska AM, Barton BA, Kronsberg SS, Daniels SR, Crawford PB, Sabry ZI, Liu K. (2002) Decline in physical activity in black girls and white girls during adolescence. New England Journal of Medicine;347(10):709-15.

Kimm SY, Glynn NW, Kriska AM, Fitzgerald SL, Aaron DJ, Similo SL, McMahon RP, Barton BA. (2000) Longitudinal changes in physical activity in a biracial cohort during adolescence. Medical Science Sports Exercise;32(8):1445-54.

Kitsantas A, Zimmerman BJ. (2000). Self-efficacy, activity participation, and physical fitness of asthmatic and nonasthmatic adolescent girls. J Asthma;37:163-74.

Koplan JP, Liverman CT, Kraak VI, eds. 2005. Preventing Childhood Obesity: health in the balance. Washington, D.C.: National Academies Press.

Kvaavik E, Tell GS, Kleep KI. (2003). Predictors and tracking of body mass index from adolescence into adulthood: follow-up of 18 to 20 years in the Oslo Youth Study. Archives of Pediatrics and Adolescent Medicine;157:1212-1218.

Lauer RM, Clarke WR. (1984). Childhood risk factors for high adult blood pressure: The Muscatine study. Pediatrics;84:633-641.

LeMura LM, Maziekas MT. (2002). Factors that alter body fat, body mass, and fat-free mass in pediatric obesity. Medicine and Science in Sports and Exercise;34:487-496.

Leslie E, Owen N, Salmon J, Bauman A, Sallis JF, Lo SK. (1999). Insufficiently active Australian college students: perceived personal, social, and environmental influences. Prev Med;28(1):20-7.

Livingstone MB, Robson PJ, Wallace JM, McKinley MC. (2003). How active are we? Levels of routine physical activity in children and adults. The Proceedings of the Nutrition Society;62:681-701.

Lucas SR, Platts-Mills TA. (2005). Physical activity and exercise in asthma: relevance to etiology and treatment. J Allergy Clin Immunol;115(5):928-34.

Lytle LA, Ward J, Nader PR, Pedersen S, Williston BJ. (2003). Maintenance of a health promotion program in elementary schools: results from the CATCH-ON study key informant interviews. Health Educ Behav;30(4):503-18.

Martens F, Grant B. (1980). A survey of daily physical education in Canada. Canadian Association of Health, Physical Education and Recreation Journal;may-june:30-38.

McKenzie TL, Marshall SJ, Sallis JF, Conway TL. (2000). Student activity levels, lesson context, and teacher behavior during middle school physical education. Research Quarterly for Exercise and Sport; 71(3):249-259.

McKenzie TL, Nader PR, Strikmiller PK, Yang M, Stone EJ, Perry CL, Taylor WC, Epping JN, Feldman HA, Luepker RV, Kelder SH. (1996). School physical education: Effect of the child and adolescent trial for cardiovascular health. Journal of Preventative Medicine; 25:423-431.

McKenzie TL, Sallis JF, Prochaska JJ, Conway TL, Marshall SJ, Rosengard P. (2004). Evaluation of a two-year middle-school physical education intervention: M-SPAN. Epidemiology;36(8):1382-1388.

McKenzie TL, Stone EJ, Feldman HA, Epping JN, Yang M, Strikmiller PK, Lytle LA, Parcel GS. (2001). Effects of the CATCH physical education intervention: teacher type and lesson location. Am J Prev Med;21(2):101-9.

McNeal RB. (1995). Extracurricular activities and high school dropouts. Sociology of Education;68:62-81.

Moore LM, Gao D, Bradlee L, Cupples LA, Sundarajan-Ramamurti A, Proctor MH, Hood MY, Singer MR, Ellison RC. (2003). Does early physical activity predict body fat changes thought childhood? Preventive Medicine;37:10-17.

Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. (1992). Long-term morbidity and mortality of overweight adolescents: A follow-up of the Harvard Growth Study of 1992 to 1935. New England Journal of Medicine;327:1350-1355.

Must A, Strauss RS. (1999). Risks and consequences of childhood and adolescent obesity. International Journal of Obesity Related Metabolic Disorders;23:2-11.

National Association for Sport & Physical Education (NASPE). (2005). What constitutes a quality physical education program? Accessed on June 6, 2005 at http://www.aahperd.org/naspe/template.cfm?template=qualityPePrograms.html.

National Association for Sport and Physical Education (NASPE). (2006a). Understanding the difference: Is it physical education or physical activity? NASPE website. Accessed November 28, 2006 at http://www.aahperd.org/naspe/template.cfm?template=difference.html

National Association for Sport and Physical Education (NASPE). (2006b). Shape of the Nation: Executive Summary. Accessed on November 28, 2006 at http://www.aahperd.org/naspe/ShapeOfTheNation

National Center for Health Statistics (NCHS). (2004). Prevalence of overweight and obesity among adults: Unites States 1999-2000. Accessed on September 30, 2005 from http://www.cdc.gov/nchs/products/pubs/pubd/hestats/obese/obse99.htm.

National Health and Nutrition Examination Survey (NHANES). (2004). NHANES, 1999-2000. Accessed on September 30, 2004 from http://www.cdc.gov/nchs/about/major/nhanes/nhanes99_00.htm.

Nofsinger J. Phys Ed cuts may leave children's health behind. Fox News. November 20, 2005. Accessed November 27, 2006 from http://www.foxnews.com.

Nystad W, Nafstad P, Harris JR. (2001). Physical activity affects the prevalence of reported wheeze. Eur J Epidemiol;17:209-12.

Nystad W. (1997). The physical activity level in children with asthma based on a survey among 7-16 year old school children. Scand J Med Sci Sports;7:331-5.

Ogden CL, Carroll MD, Flegal KM. (2003) Epidemiologic trends in overweight and obesity. Endocrinol Metab Clin North Am;32(4):741-60.

Owens S, Gutin B, Allison J, Riggs S, Ferguson M, Litaker M, et al. (1999). Effect of physical training on total and visceral fat in obese children. Med Sci Sports Exer;31:143-8.

Parker-Pope T. (2006). Passing the ball: Hip government exercise campaign looks for its next move. The Wall Street Journal, September 5, 2006:D1.

Pate RR, Davis MG, Robinson TN et al. (2006). Promoting physical activity in children and youth: a leadership role for schools: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. Circulation:114:1214-24.

Pate RR, Baranowski T, Dowda M, Trost SG. (1996). Tracking of physical activity in young children. Med Sci Sports Exer;28:92-6.

Pate RR, Hohn RC. (Eds.). (1994). Health and fitness through physical education. Champaign, IL: Human Kinetics.

Posnick-Goodwin S. (2002). Fitness boosts brainpower. California Educator, 7(3). Accessed June 6, 2005 at http://www.cta.org/CaliforniaEducator/v7i3/feature_1.htm.

Power C, Lake JK, Cole TJ. (1997). Measurement and long-term health risks of child and adolescent fatness. International Journal of Obesity;21:507-526.

Robbins LB, Pender NJ, Kazanis AS. (2003). Barriers to physical activity perceived by adolescent girls. J Midwifery Womens Health;48(3):206-12.

Rowland TW. (2001). The role of physical activity and fitness in children in the prevention of adult cardiovascular disease. Progress in Pediatric Cardiology;12:199-203.

Sallis JF, Alcaraz JE, McKenzie TL, Hovell MF. (1999). Predictors of change in children's physical activity over 20 months: variations by gender and level of adiposity. Am J Prev Med;16:222-9.

Sallis JF, McKenzie TL. (1991). Physical education's role in public health. Research Quarterly for Exercise and Sport; 62:124-137.

Sallis JF, McKenzie TL, Alcaraz JE et al. (1997). The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. Am J Public Health: 87:1328-34.

Sallis JF, Prochaska JJ, Taylor WC. (2000). A review of correlates of physical activity of children and adolescents. Med Sci Sports Exerc;32(5):963-75.

Sarkin JA, McKenzie TL, Sallis JF. (1997). Gender differences in physical activity during fifth-grade physical education and recess periods. Journal of Teaching in Physical Education;17:99-106.

Scherman A. (1989). Physical fitness as a mode for intervention with children. The School Counselor;36:328-31.

Shephard RJ, Volle M, Lavallee H, LaBarre R, Jequier JC, Rajic M. (1984). Required physical activity and academic grades: a controlled study. In: Ilmarinen J, Valimaki I, eds. Children and sport. Berlin: Springer-Verlag:58-63.

Shephard RJ. (1997). Curricular physical activity and academic performance. Pediatr Exerc Sci;9:113-25.

Sinclair G. (1983). A daily physical education pilot project. Canadian Association of Health, Physical Education and Recreation Journal;(Suppl. 49):22-26.

Spence JC, Poon P, Dyck P. (1997). The effect of physical-activity participation on self-concept: A meta-analysis. Journal of Sport and Exercise Psychology;19:S109.

Srinivasan SR, Bao W, Wattigney WA, Berenson GS. (1996). Adolescent overweight is associated with adult overweight and related multiple cardiovascular risk factors: The Bogalusa Heart Study. Metabolism;45:235-240.

Steinberger J, Daniels SR. (2003). Obesity, insulin resistance, diabetes, and cardiovascular risk in children: an American Heart Association scientific statement from the Atherosclerosis, Hypertension, and Obesity in the Young Committee (Council on Cardiovascular Disease in the Young) and the Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism). Circulation;107(10):1448-53.

Steptoe A, Butler N. (1996). Sports participation and emotional well being in adolescents. Lancet;347:1789–1792.

Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM, Rowland T, Trost S, Trudeau F. (2005). Evidence based physical activity for school-age youth. J Pediatr.;146(6):732-7.

Taylor WC, Blair SN, Cummings SS, Wun CC, Malina RM. (1999). Childhood and adolescent physical activity patterns and adult physical activity. Med Sci Sports Exerc;31(1):118-23.

The Cooper Institute. (2001). Overview: FITNESSGRAM/ACTIVITYGRAM. Accessed on July 22, 2005 at http://www.cooperinst.org/ftgmain.asp.

Trost SG, Pate RR, Sallis JF, Freedson PS, Taylor WC, Dowda M, Sirard J. (2002). Age and gender differences in objectively measured physical activity in youth. Med Sci Sports Exerc;34(2):350-5.

Trust for America's Health. (2004). F as in Fat: How obesity policies are failing in America (Issue Report). Washington, DC: Trust for America's Health, 2004. Accessed on July 22, 2005 at http://www.healthyamericans.org.

Tuckman B, Hinkle S. (1986). An experimental study of the physical and psychological effects of aerobic exercise on schoolchildren. Health Psychology;5:197-207.

U.S. Department of Health and Human Services (USDHHS). (1996). Physical activity and health: a report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

U.S. Department of Health and Human Services (USDHHS). (2000). Healthy People 2010. Washington, DC: U.S. Department of Health and Human Services, U.S. Government Printing Office. Accessed on July 22, 2005 at http://web.health.gov/ healthypeople/Document/tableofcontents.htm.

U.S. Department of Health and Human Services (USDHHS). (2001) The Surgeon General's call to action to prevent and decrease overweight and obesity. Washington, DC: U.S. Government Printing Office.

UCLA Center to Eliminate Health Disparities and Samuels & Associates. 2007. Failing Fitness: Physical Activity and Physical Education in Schools. Funded by the California Endowment. Accessed on June 10, 2007 at http://www.calendow.org.

Wearring G. (1981). Daily physical education: necessary but not sufficient. Canadian Association of Health, Physical Education and Recreation Journal:31-36.

Webber LS, Osganian SK, Feldman HA, Wu M, McKenzie TL, Nichaman M, Lytle LA, Edmundson E, Cutler J, Nader PR, Luepker RV. (1996). Cardiovascular risk factors among children after a two and a half year intervention – The CATCH Study. Preventive Medicine;25:432–441.

Weston AR, Macfarlane DJ, Hopkins WG. (1989). Physical activity of asthmatic and nonasthmatic children. J Asthma;26:279-86.

Women's Sports Foundation. (1998). The Women's Sport Foundation Report: Sport and Teen Pregnancy, May 1998. NY: The Women's Sport Foundation. Accessed on March 20, 2006 at http://www.womenssportsfoundation.org/cgi-bin/iowa/issues/body/article.html?record=883.