

Healthier Students Are Better Learners: A Missing Link in School Reforms to Close the Achievement Gap

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to Close the Achievement Gap**

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This essay is dedicated to the urban minority youth of America.

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EXECUTIVE SUMMARY

No matter how well teachers are prepared to teach, no matter what accountability measures are put in place, no matter what governing structures are established for schools, educational progress will be profoundly limited if students are not *motivated and able to learn*. Health-related problems play a major role in limiting the motivation and ability to learn of urban minority youth, and interventions to address those problems can improve educational as well as health outcomes. Healthier students are better learners. Recent research in fields ranging from neurosciences and child development to epidemiology and public health provide compelling evidence for the causal role that *educationally relevant health disparities* play in the educational achievement gap that plagues urban minority youth. This is why reducing these health disparities must be a fundamental part of school reform.

School leaders must prioritize how to use scarce resources to address the critical health problems affecting youth. In this essay, three criteria were used for establishing priorities: prevalence and extent of health disparities negatively affecting urban minority youth; evidence of causal effects on educational outcomes; and feasibility of implementing proven or promising school-based programs and policies to address the health problem. Based on these criteria, seven educationally relevant health disparities were selected as strategic priorities: (1) *vision*, (2) *asthma*, (3) *teen pregnancy*, (4) *aggression and violence*, (5) *physical activity*, (6) *breakfast*, and (7) *inattention and hyperactivity*. Many other health problems affecting youth are also important, and the particular health problems deemed most important in a given school or school district will vary.

The health factors specified in this essay affect a large proportion of American youth. Visual problems have been estimated to affect 20% of youth. Asthma affects an estimated 14% or 9.9 million youth under 18 years old. An

estimated 8.4% of school-aged youth, 4.6 million, have received a diagnosis of attention-deficit/hyperactivity disorder (ADHD), with millions more exhibiting symptoms that are below established diagnostic criteria but nonetheless adversely affect teaching and learning. One in three American female adolescents is expected to become pregnant. Aggression and violence are a pervasive part of daily life for American youth, including at school. The majority of school-aged youth do not meet recommended levels of daily physical activity. Millions of youth do not eat breakfast on any given day. Urban minority youth from low-income families are disproportionately affected by all of these problems. If these factors are not addressed, the benefits of other educational innovations will be jeopardized.

Educationally relevant health disparities impede motivation and ability to learn through at least five causal pathways: *sensory perceptions*; *cognition*; *connectedness and engagement with school*; *absenteeism*; and *dropping out*. The causal pathways themselves are interrelated: for example, the student who is struggling cognitively is likely to feel less connected and less inclined to attend, which will further undermine educational progress. The causal connections between *multiple* health factors and motivation and ability to learn will be greater than the effects of individual factors. This is based on the expectation that at least some variance would be additive. However, it is reasonable to believe that the functional effects of reducing multiple impediments to motivation and ability to learn would be not only additive but also synergistic; therefore, school health programs must focus on multiple educationally relevant health disparities to maximize the educational yield from investments.

Schools cannot address all of the conditions that cause educational or health disparities, but proven and promising approaches exist and must

be applied to help close the achievement gap. Children should receive corrective care to enable them to see well enough to acquire basic academic skills. Children with poorly controlled asthma deserve in-school monitoring to help ensure that they receive high quality health care; a school that identifies and ameliorates allergens, irritants, and pollutants that trigger symptoms; and multiple opportunities for daily physical activity. Children need to learn and practice communication and social skills, such as resisting social pressures and negotiating to minimize interpersonal conflict and maximize cooperation, which can reduce risk for various health-compromising outcomes, including unintended pregnancy. For youth who are sexually active, contraceptive services should be available. For youth who become pregnant, targeted health and social services are essential if there is to be any hope of interrupting the intergenerational transmission of poverty.

Children have the right to attend a school that is safe. Progress in achieving this goal will be greatly influenced by the school climate and school connectedness. Measures of school climate and school connectedness should become a norm within measures of accountability—if the school climate is poor, connectedness and engagement in school will be less likely, which in turn will adversely affect educational as well as health outcomes. Youth who exhibit disruptive or aggressive behavior need attention during the early stages of development of these behaviors. Youth have the right to multiple daily opportunities for physical activity and to daily breakfast. Youth with attention and hyperactivity problems need help in learning ways to improve their mental and behavioral performance and, when parents and pediatricians agree, pharmacological treatment.

Most schools are already devoting some attention and resources to addressing important health barriers to learning, but these efforts are too often poor quality, not strategically planned to influence educational outcomes, and not effectively

coordinated to maximize linkages between different school health components. Despite compelling evidence linking health and academic achievement, there is no U.S. Department of Education initiative to reduce educationally relevant health disparities as part of a national strategy to close the achievement gap. For the nation's schools to address educationally relevant health disparities in a strategic and coordinated way, there must be fundamental change in the goals of schools, the way schools are financed, the personnel and services available, and the amount of time devoted to help youth learn social-emotional skills. Such change will not occur without leadership from the U.S. Department of Education. Now is an opportune time for such leadership.

National, state, and local strategies for helping schools implement high quality, strategically planned, and effectively coordinated school health programs are presented. These include policy development; guidance, technical assistance, and professional development; accountability supported by data and software systems; and priorities for a national research agenda. Even if health factors had no effect on educational outcomes, they clearly influence the quality of life for youth and their ability to contribute and live productively in a democratic society. Improving the health of youth is a worthy goal for elementary and secondary education. Indeed, pursuing this goal is a moral imperative.

INTRODUCTION

Low levels of academic achievement and educational attainment among low-income and minority youth, particularly in urban areas, undermine the quality of individual, family, and community life, threatening the very integrity of American society. Educationally relevant health disparities exert a powerful, but generally overlooked, influence on the achievement gap. Disparities in this context are health problems that disproportionately affect low-income urban minority youth as measured by incidence, prevalence and educationally relevant consequences. Health factors have direct and indirect effects on educational outcomes, including standardized test scores. To date, school reform efforts to close the achievement gap have not targeted reduction of educationally relevant health disparities.

To great extent, the educational achievement gap and health disparities affect the same population subgroups of American youth and are caused by a common set of social-environmental factors; it is increasingly clear that both education and health can also exert strong, reciprocal effects. The familial, social, physical, and economic environment in which youth live (Evans, 2004) is strongly associated with academic achievement and educational attainment (Evans & Schamberg, 2009; Murname, 2007; Rouse & Barrow, 2006), with childhood and adolescent health (Chen, Martin, & Matthews, 2007; Evans, 2006; Evans, Gonnella, Marcynszyn, Gentile, & Salpekar, 2005; Evans & Kim, 2007; Geronimus, 2000; Link, Phelan, Miech, & Westin, 2008; Lynch, Kaplan, & Shema, 1997; Marmot, 2002; Melchior, Moffitt, Milne, Poulton, & Caspi, 2007; Poulton et al., 2002), and with social mobility (Case, Fertig, & Paxson, 2005; Case & Paxson, 2006; Geronimus, 2000; Hass, 2006). The strong association between social class and health persists throughout the lifespan (Case & Paxson, 2006; Koivusilta, Arja, & Andres, 2003; Link & Phelan, 1995; Melchior et al., 2007; Palloni, 2006; Poulton et al., 2002).

An important emerging literature implicates children's health factors as causal mechanisms through which low socioeconomic status influences academic achievement and educational attainment (Case & Paxson, 2006; Crosnoe, 2006; Hass, 2006; Hass & Fosse, 2008; Heckman, 2008; Koivusilta et al., 2003; Palloni, 2006). The direction of causality, effect sizes, and hypothesized causal mechanisms mediating relationships among social-environmental factors (e.g., poverty), education, and health has been explored from multiple perspectives. It seems likely that these three factors—(1) familial, social, physical, and economic environment, (2) academic achievement and educational attainment, and (3) health—are causally related in reciprocal ways. The focus of this essay is the influence of selected health factors on educational outcomes.

The Role of Schools

It is neither reasonable nor realistic to expect that, on their own, schools can close the gaps in education or eliminate health disparities among the nation's youth. Schools should not be solely responsible for addressing these complex and recalcitrant problems. There are essential roles to be played by families, communities, health care systems, legislators, media, and by economic policy. All of these (and other) social institutions should, and must, contribute to solving these problems. There are no simple solutions.

However, with more than 50 million students spending a significant portion of their daily lives in school, this social context is surely one of the most powerful social institutions shaping the next generation of youth. By systematically addressing educationally relevant health disparities, schools can reduce both educational and health disparities. But this will not occur efficiently with the current strategy of investment in school health programs.

School health programs have a long history in the

United States (Mann, 1891) but have never been fully embraced. To date, reducing health disparities as a strategy to help close the achievement gap has lacked financial investment, has not had a prominent role in school reform movements, and has not occupied a central place within the educational mission of American schools. Consequently, high quality, strategically planned, and effectively coordinated school health programs and policies have not been widely implemented, and leaders and educators in urban public schools, serving minority youth from low-income families who are disproportionately affected by both educational and health disparities, face particular challenges contexts for developing, implementing and sustaining such school health programs.

Recently, the important role of schools in addressing health issues has been recognized by leading educational professional organizations, policy making, and interstitial groups. For example, policies or guidelines have been identified or proposed by the National Association of State Boards of Education (n.d.), National School Boards Association (n.d.), Council of Chief State School Officers (2008), Association for Supervision and Curriculum Development (n.d.) and their “New Compact to Educate the Whole Child,” American Academy of Pediatrics and National Association of School Nurses (n.d.), and A Broader, Bolder Approach to Education (n.d.), and by leading governmental agencies such as the Centers for Disease Control and Prevention (n.d.a, b, c).

An Opportune Time for Change

In the past, the U.S. Department of Education has provided resources to assist schools in addressing some health topics such as safety and drug use prevention, but it has not provided leadership for integrating school health into the fundamental mission of schools and supporting the widespread development and implementation of high quality, strategically planned, and effectively coordinated approaches that address a variety of health-related barriers to teaching and learning. Now is an opportune time for change.

Many schools in the United States provide some health programs or services; however, the quality of school health programs and services vary greatly. Most schools implement some programs or policies that address health (Kann, Telljohann, & Wooley, 2007) through activities such as physical education, breakfast and lunch meals, health services to provide acute care and administration of medications, health-related counseling, and curricula addressing tobacco, alcohol and drugs, nutrition, teen pregnancy and sexually transmitted disease (including HIV/AIDS), and violence. In addition, most schools offer some health care services, and some schools offer more extensive on-site health care services provided by nurses and school-based clinics. Some also offer a variety of health-related after-school programs. Community and full service schools offer in-school programs and services, including health and mental health programs and services to support youth before and after school and during the summer as well as during the typical school day (Coalition for Community Schools, 2008). While published data do not as yet exist, school health programs and services are likely inequitably distributed as are most other school resources—that is, there are both fewer and lower quality resources available in schools that serve low-income minority youth.

Despite the widespread and substantial investment in school health programs and services, current investments are likely to yield only limited educational benefits to students for several reasons. First, current financial investments are not sufficient to address the magnitude and severity of health problems affecting urban minority youth. Second, in too many cases the programs being implemented are not high quality. Third, existing efforts are not strategically planned to influence educational outcomes. Fourth, existing efforts are not effectively coordinated to capitalize on potential linkages between efforts. Though rhetorical support is increasing, school health is currently not a central part of the fundamental mission of schools in America nor has it been well integrated into the broader national strategy to reduce the gaps in educational opportunity and outcomes.

For public schools serving urban minority youth, a strategic approach is essential. Schools facing the greatest and most urgent challenges also have the least human and other resources, even before they attempt to deal with health factors. To make best use of scarce resources, priorities for dealing with health factors must be established. A public-health oriented strategic plan would focus on key health risk behaviors (those linked to leading causes of death in childhood and adolescence and those that are established in youth and contribute to the leading causes of death in adulthood), including unintentional injuries and violence, alcohol and drug use, sexual risk behavior, tobacco use, physical inactivity, and poor eating habits (Kolbe, Kann, & Collins, 1993).

Strategic Priorities

The current analysis establishes strategic priorities based on their relevance to educational outcomes and to closing the achievement gap. Three criteria were considered: (1) prevalence and extent of health disparities, (2) evidence of causal effects on educational outcomes, and (3) feasibility of implementing proven or promising school-based programs and policies. Prevalence and extent of health disparities was used based on the premise that, if a health problem is the cause of an educational disparity, the health problem must affect a large proportion of youth and be more prevalent or have more deleterious effects on urban minority youth. Disparities are described in terms of descriptive epidemiology indices (e.g., prevalence estimates) using data describing nationally representative samples, when available. Local data were used to highlight geographical variation.

If a health problem is the cause of an educational disparity, the health problem must be statistically and temporally associated with the unfavorable educational outcomes. Beyond a temporal statistical association, the case for causation is strengthened by a plausible explanation for why a particular health problem would cause a negative educational outcome: “What are the causal pathways?” Prioritizing health factors in terms

of causal links to educational outcomes may enhance their perceived importance and acceptability to policy makers, school leaders and teachers, and other educational stakeholders. The specific health factors selected by a given school or school system are less important than the fact that multiple educationally relevant health factors are prioritized and addressed collectively through a single set of high quality, strategically planned, and effectively coordinated programs and policies.

The third criterion used in the current analysis was feasibility of implementing proven or promising school health approaches. This criterion focuses on two issues, feasibility and effectiveness. Feasibility is based, in part, on the observation that some health programs and services are already being implemented in many schools and that guidelines and recommendations summarizing what schools can do to address the respective health problems are already available from credible sources. Effectiveness is based the availability of proven or promising approaches from a large body of evaluative research demonstrating that particular approaches can influence the acquisition and practice of various health-related behaviors.¹

Based on these criteria, the following educationally relevant health disparities were selected as priorities: (1) vision, (2) asthma, (3) teen pregnancy, (4) aggression and violence, (5) physical activity, (6) breakfast, and (7) inattention and hyperactivity. The omission of other

¹ There are different degrees of evidence concerning the likelihood of influencing particular health behaviors and health status indices. The overwhelming majority of evaluative research on disease prevention and health promotion for children and adolescents has not, however, measured educational outcomes. Another weakness in our current knowledge is that evaluative research has focused on the effects of interventions on individual health problems rather than efforts to address multiple health problems. Several national databases describing school health approaches with proven or promising results are available but apparently not used by many schools in their decision making about which school health programs to adopt and implement.

health topics should not be taken to suggest that they are unimportant. Tobacco, alcohol and drug use, dental problems, ear infections, obesity, accidental injuries, among others, are pervasive problems affecting youth and depending on the local context also warrant consideration. Indeed, all of these problems are rightly priorities of the U.S. Public Health Service. The seven specified priorities are intended to illustrate the effect that addressing particular health disparities can have on educational opportunity and the achievement gap. They illustrate a reasonable set of “starting points” through which school policies and programs might influence the achievement gap among urban minority youth. Schools in different social and economic contexts will have lesser or greater propensity to include various health factors as a priority; this is not problematic as long as problems are addressed with proven or promising approaches, are selected strategically, and are addressed through an effectively coordinated effort.

Causal Pathways

One or more of five causal pathways—the mechanisms by which health factors influence motivation and ability to learn—are identified and described for each health factor: (1) sensory perceptions, (2) cognition, (3) school connectedness and engagement, (4) absenteeism, and (5) temporary or permanent dropping out. It is axiomatic that sensory perception (e.g., seeing and hearing well) and cognition (executive functioning, memory, maintaining attention) have powerful effects on learning opportunities; that student absenteeism adversely affects opportunities to learn academically and to grow socially; and that dropping out adversely affects life course trajectories.

Until recently, what has been less clear, or at least less well documented empirically, is the importance of connectedness and engagement with school. Connectedness is essentially about interpersonal relationships, both with peers and school staff. It is the extent to which students perceive that adults and peers in the school community care about them as students and as individuals. A compelling body

of research demonstrates that connectedness and engagement with school is a key determinant of academic achievement and educational attainment (Battlin-Pearson et al., 2000; Bond et al., 2007; Fleming, Haggerty, Catalano, Harachi, Mazza, & Gruman, 2005; Ladd, Birch, & Buhs, 1999; Klem & Connell, 2004; Nelson, 2004; Rosenfeld, Richman, & Bowen, 1998;) as well as child and adolescent health (e.g., reduced risk of substance use, teen pregnancy, aggressive behaviors, and mental/emotional health problems) (Bond et al. 2007; Bonny, Britto, Klostermann, Hornung, & Slap, 2000; Eccles, Early, Fraser, Belansky, & McCarthy, 1997; Manlove, 1998; Mansour et al., 2003; McNeely & Falci, 2004; Resnick et al., 1997; Resnick, Harris, & Blum, 1993; Shochet, Dadds, Ham, & Montague, 2006). There is general consensus that connectedness and engagement in learning are important for success in school (Klem & Connell, 2004).

Because educational outcomes are influenced by many forces differentially across various contexts, each health factor, addressed separately, should not be expected to have large or consistent effects on educational outcomes. For example, the effects of diet on the brain are integrated with effects of other factors such as exercise and sleep (Gomez-Pinilla, 2008). The child who is well nourished, physically active, and well rested is likely to have advantages regarding cognition compared with the child with deficits in any of these areas. The child who has difficulty seeing, difficulty paying attention, or is bullied at school will struggle to succeed academically and will feel less connected and engaged with school. In turn, the child who is less connected and engaged with school will be less motivated to attend. Thus, beyond their individual effects, educationally relevant health disparities, collectively, can have an influential role in shaping the educational and social lives of the nation’s urban minority youth. Further, there are synergistic effects of acquiring skills at earlier stages in life whereby capabilities beget capabilities and influence long-term health (Heckman, 2007).

A Coordinated Approach

A coordinated approach is characterized by programs and services involving different groups of people, playing different roles, but forming a team and working toward a common set of priority goals, namely improving students' motivation and ability to learn. Once school health priorities are established, limited resources are used to support integrated efforts to achieve them. This helps to optimize the value of existing resources.

Linkages between teachers and health service personnel are essential in helping to ensure that identified problems (for example, with vision, asthma, or ADHD) receive indicated follow-up care. Linkages between categorical health curricula (for example, dealing with violence and teen pregnancy prevention) can optimize the use of curricular time by recognizing that reducing susceptibility to these different problems requires learning and practicing the same set of mental and social-emotional skills (e.g., self-regulation, dealing with social pressures, communicating assertively but not aggressively). Effective coordination requires a school health coordinator who is cognizant of the different programs, services, and policies and how they can be linked together to use limited resources effectively and efficiently.

Selection of program components can, at least in part, be based on the ability of distinct program or service components to influence the same set of priority outcomes. Thus coordination applies to planning as well as implementing school health efforts. Programs intended to ensure that youth eat breakfast, have daily physical activity, and arrive at school well rested would be addressed through different school health efforts, but could collectively affect cognition to a greater extent than any of the individual efforts.

Delimitations and Overall Intent

Several delimitations narrow the scope of this essay. First, the emphasis is on urban minority youth. Urban minority youth represent a large and growing

segment of the U.S. population. The percentage of students comprising all public school students enrolled in kindergarten through 12th grade who were white declined from 77.8% in 1972 to 56.9% in 2006 (Planty et al., 2008). Improved health status for all children is a worthy goal, but need is particularly urgent among urban minority youth who, as with adults, have great intergenerational educational and health disparities. There are, of course, other subpopulations (e.g., Native American and poor rural youth) facing extremely challenging educational and health contexts, which can and should be addressed. Second, though health may influence educational outcomes across the lifespan, attention is limited to health factors that influence school-aged youth. Again, this is in no way intended to minimize the important causal role of intrauterine, neonatal, infant and toddler health on motivation and ability to learn. Indeed, programs aimed at reducing health disparities among infants, toddlers, and children under five should be a top priority. A third delimitation is that health factors were selected based, in part, on feasibility of implementing proven or promising school-based programs and services. Clearly, the achievement gap cannot be closed without extensive involvement from other social institutions, but, at the same time, school health efforts that are high quality, strategically planned, and effectively coordinated are one of the best investments for influencing the health, as well as the minds, of the nation's youth.

This essay fills a significant gap in the current literature. In the following sections, each of the educationally relevant health disparities is described with respect to nature and scope of the problem, prevalence and disparities affecting urban minority youth, causal pathways by which the respective health disparity adversely affects motivation or ability to learn, ways that school programs and policies can address the problem, and evidence supporting proven or promising approaches.

The overall intent of this essay is to make the case for high quality, strategically planned, and effectively coordinated school health initiatives as part of a

national strategy to close the achievement gap by presenting the evidence regarding four main points: (1) urban minority youth are disproportionately affected by both educational and health disparities, (2) healthier students are better learners, (3) school programs and policies can favorably influence educationally relevant health disparities affecting youth, and (4) now is an opportune time for change. Initiatives to move this agenda forward at the national, state, and local levels are proposed.

Physical Activity

Overview and Disparities

Physical activity has dramatic effects on individuals' physical and mental health and on population-wide health status. Unacceptably low levels of physical fitness and physical activity have contributed to increasing prevalence, in the past decades, of overweight and obesity among youth (Gordon-Larsen, Adair, Nelson, & Popkin, 2004; Kimm et al., 2001, 2002; Ogden, Carroll, & Flegal, 2008; Ogden et al., 2006; Ogden, Flegal, Carroll, & Johnson, 2002). Prevalence of overweight and obesity is highest among minority female children and adolescents (Kimm et al., 2001, 2002; Ogden et al., 2002) and among Mexican-American boys (Flegal, Ogden, & Carroll, 2004; Freedman, Khan, Serdula, Ogden, & Dietz, 2007; Hedley et al., 2004; Ogden et al., 2006, 2008). While levels of physical activity are unacceptably low for most adolescents, they are particularly low for black and Hispanic females. The beneficial effects of physical activity and physical fitness on physical health are very well established, and there is increasing evidence of effects on mental health. An emerging literature documents the ways in which physical activity, fitness, and school-based physical activity programs, such as physical education, favorably affect educational outcomes.

Physical activity and resulting fitness affect physical health via the cardiovascular, musculoskeletal, endocrine, and neurological body systems. In adults, physical activity or physical fitness has been associated with reduced risk of cardiovascular disease (Brown, Burton, & Rowan, 2007; Mora et al., 2003; Myers et al., 2002; Stamatakis, Hamer, & Primatesta, 2008), cerebrovascular disease (Bassuk & Manson, 2005; Oczkowski, 2005; Wendel-Vos et al., 2004), various cancers (Brown et al., 2007; Chang et al., 2006; Dallal et al., 2007; Mai et al., 2007; Sprague et al., 2007; Wolin et al., 2007), diabetes (Bassuk & Manson, 2005; Brown et al., 2007; LaMonte et al., 2005), depression and anxiety (Brown, Ford, Burton, Marshall, & Dobson, 2005; Teychenne,

Ball, & Salmon, 2008; Wise, Adams-Campbell, Palmer, & Rosenberg, 2006), all-cause mortality and survival (Blair et al., 1989; Landi et al., 2008; Manini et al., 2006; Mora et al., 2003), and with enhanced cognitive functioning (Angevaren, Aufdemkampe, Verhaar, Aleman, & Vanhees, 2008; Bixby et al., 2007; Hillman et al., 2006). The causal effects of physical activity and fitness on health status are most apparent in adults since, in adults, they have the opportunity to accrue over decades.

Physical activity and fitness are also powerful markers of child and adolescent health (Ortega, Ruiz, Castillo, & Sjostrom, 2008). Physical activity and/or aerobic fitness has been associated with reduced fatness (Denckner et al., 2008; Eisenmann, Barteel, Schmidt, Welk, & Fu, 2008; Gutin et al., 1990; Katzmarzyk et al., 2008; Lohman et al., 2008; Ness et al., 2007; Ortega et al., 2007; Pate, Wang, Dowda, Farrell, & O'Neill, 2006; Treuth et al., 2007) and blood pressure (Gidding et al., 2006; Gutin et al., 1990; Leary et al., 2008), and improved bone health (Janz et al., 2007; Sardinha, Baptista, & Ekelund, 2008; Tobias, Steer, Mattocks, Riddoch, & Ness, 2007). Relatively strong (observational) evidence indicates the positive effects of physical activity and fitness on mental and emotional health of youth (Bonhauser et al., 2005; Dishman et al., 2006; Larun, Nordheim, Ekeland, Hagen, & Heian, 2006; Nelson & Gordon-Larsen, 2006; Ortega et al., 2008; Schmalz, Deane, Birch, & Davidson, 2007; Strauss, Rodzilsky, Burack, & Colin, 2001).

Physical fitness and aerobic fitness decline as youth transition from childhood and middle school to adolescence and high school (Duncan, Duncan, Strycker, & Chaumeton, 2007; Eaton et al., 2008; Kahn et al., 2008; McMurray, Harrell, Creighton, Wang, & Bangdiwala, 2008); and this may be especially true for females, in general (Hardy, Bass, & Booth 2007; Nader, Bradley, Houts, McRichie, & O'Brien, 2008; Nelson, Neumark-Stzainer, Hannan, Sirad, & Story, 2006; Pate, Dowda, O'Neill, & Ward, 2007; Pfeiffer, Dowda,

Dishman, Sirard, & Pate, 2007; Sirard, Pfeiffer, Dowda, & Pate, 2008), females who mature early (Baker, Birch, Trost, & Davison, 2007; Davidson, Werder, Trost, Baker, & Birch, 2007) and youth who are overweight (McMurray et al., 2008; Trueth et al., 2007). Males have higher levels of typical physical activity than females; for both, activity tends to decline over the progression from elementary and middle school through grade 12 (Eaton et al., 2008). Estimates of population-wide levels of physical activity indicate that black and Hispanic youth are less physically active than white youth, with disparities particularly evident for females (Eaton et al., 2008).

Almost two-thirds of the nation's high school students do not meet one recommended level of participation in physical activity: being physically active enough to raise heart rate and breathe hard some of the time at least 60 minutes per day on five days of the prior week. About 20% more of white high school students met this criterion than black or Hispanic high school students (37.0% versus 31.1% and 30.0%, respectively). About 25% more of white female high school students met the criterion than black or Hispanic females (27.9% versus 21.0% and 21.9%). The rates among high school males were 46.1% for whites, 41.3% for blacks and 38.6% for Hispanics.

Another criterion is *not* being physically active for at least 60 minutes on any of the prior seven days. By this measure, prevalence among Hispanic females was approximately twice as high and, prevalence among black females more than 150% as high, as prevalence among white females (35.2% and 42.1% versus 16.7%). In summary, a large proportion of youth is insufficiently physically active or inactive. This is especially true for females and immigrant children and adolescents (Singh, Yu, Siahpush, & Kogan, 2008). Due to the magnitude of the problem, this behavior confers a large population-attributable risk with respect to a variety of health and educationally relevant outcomes.

Those population segments of youth experiencing disparities in level of physical activity and fitness also

have disparities in access to school-based physical activity opportunities and resources. Opportunities for physical activity have been associated with access to school sports facilities and equipment storage space (Barnett, O'Loughlin, Gauvin, Paradis, & Hanley, 2006). Subjective and objective measures of recreational opportunities have been associated with physical activity levels among youth, including adolescent girls (Motl, Dishman, Saunders, Dowda, & Pate, 2007; Pate et al., 2008; Tucker et al., 2009). Recreational facilities are not equally distributed. Poor urban minority youth have less access to safe recreational facilities (Gordon-Larsen, Nelson, Page, & Popkin, 2006; Moore, Diez Roux, Evenson, McGinn, & Brines, 2008). The low level of physical activity among black and Hispanic adolescent girls is largely attributable to the nature of the schools they attend (Richmond, Hayward, Gahagan, Field, & Heisler, 2006). Not surprisingly, there is an inverse relationship between school's median household income and average body mass index (Richmond & Subramanian, 2008). Adequate investment of financial and human resources is associated with greater opportunities for physical activity (Barnett, O'Loughlin, Gauvin, Paradis, & Hanley, 2006).

Causal Pathways Affecting Educational Outcomes

Recent advances in molecular biology detailing the causal mechanisms through which physical activity influences brain chemistry and cognitive function have explained what the Greeks knew, intuitively, thousands of years ago--a strong mind and body are intimately related. **Physical activity affects metabolism and all major body systems, exerting powerful positive influences on the brain and spinal cord and, consequently, on emotional stability, physical health, and ability to learn.** This section reviews causal pathways by which physical activity and fitness may affect educational outcomes. **The strongest evidence supports direct effects of physical activity on cognition.** Other plausible, albeit speculative, pathways mentioned are connectedness with school, absenteeism, and dropping out.

Cognition

An emerging body of knowledge documents beneficial cognitive effects of physical activity among animals (Ding, Vayman, Akhavan, & Gomez-Pinilla, 2006) and among human adults of different ages (Angevaren et al., 2008; Bixby et al., 2007; Coles & Tomporowski, 2008; Deary, Whalley, Batty, & Starr, 2006; Kramer, Erickson, & Colcombe, 2006; Sibley & Beilock, 2007; Tomporowski, 2003). Exercise may favorably affect learning and memory ability associated with aging (Aufdemkampe et al., 2008; Bixby et al., 2007; Deary et al., 2006; Kramer & Erickson, 2007; Vaynman & Gomez-Pinilla, 2005), and recovery from brain or spinal cord injury (Vaynman & Gomez-Pinilla, 2005); it also may help to minimize adverse effects from chronic neurodegenerative disease (White & Castellano, 2008a,b). **The greatest cognitive benefits of physical activity may be for those with the lowest cognitive ability (Mahar et al., 2006; Sibley & Beilock, 2007).** Studies conceptualize and define physical activity and fitness and cognition in different ways, complicating the task of delineating which specific aspects of physical activity or fitness (e.g., cardio-respiratory, strength, flexibility, balance, speed agility) are causally related to which specific aspects of cognition (e.g., executive function, verbal, auditory and visual memory, inhibition, attention, response speed). **Nevertheless, current knowledge strongly indicates that physical activity can benefit aspects of cognition, thereby favorably affecting educational outcomes. Recent literature reviews on physical activity or physical fitness and cognition (Angevaren et al., 2008; Etnier, Nowell, Landers, & Sibley, 2006; Hillman, Erickson, & Kramer, 2008; Kramer & Erickson, 2007; Kramer, Erickson, & Colcombe, 2006; Vaynman & Gomez-Pinilla, 2006) have all reached the same conclusion: physical activity (or aspects of physical fitness) favorably affects cognitive functioning.**

Ploughman (2008) provides a concise summary of how exercise may affect executive functioning: (1) increasing oxygen saturation and angiogenesis, (2) increasing brain neurotransmitters (e.g., increasing serotonin), and (3) increasing brain-derived neurotrophins

that support neuronal differentiation and survival in the developing brain. Diverse research on exercise and energy metabolism, exercise and molecular causal pathways affecting the brain, and exercise and memory and learning (e.g., brain derived neurotrophin factors and resultant increased neuronal plasticity) provides a compelling rationale for ascribing a role in cognition to physical activity. It is likely that the effects of physical activity on cognition would be particularly important in the highly plastic developing brains of youth (Ploughman, 2008).

Among children, physical activity, physical fitness, and cognition have been investigated, from a variety of educationally relevant perspectives beyond the cellular level. Interpretation of this literature is complicated by several factors, most notably, variations in educational outcome measures. Some intervention studies analyzed on-task behavior during instruction (Mahar et al., 2006) or concentration (Caterino & Polak, 1999); others used standardized achievement tests (Ahamed et al., 2007; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Sallis et al., 1999). Some observational studies used standardized test scores (Carlson et al., 2008; Castelli, Hillman, Buck, & Erwin, 2007); others used grades (Nelson & Gordon-Larsen, 2006) or other measures of cognitive function (e.g., neuroelectrical indices of memory, attention and response speed) (Hillman, Castelli, & Buck, 2005), or interference control (a component of executive control) (Buck, Hillman, & Castelli, 2008). Some consider physical activity (Carlson et al., 2008; Nelson & Gordon-Larsen, 2006), others consider physical fitness (Castelli et al., 2007; Hillman et al., 2005; Buck et al., 2008). **Three recent literature reviews conclude that school-based physical activity programs may result in short-term cognitive benefits (Taras, 2005), improve cognitive functioning among children (Sibley & Etnier, 2003), and do not hinder academic achievement (Trudeau & Shepard, 2008). These different kinds of evidence support the case for favorable effects of physical activity or physical fitness on cognitive functioning of youth.**

Connectedness

No studies have specifically evaluated the relation between school-based physical activity programs and connectedness, but such programs would seem a natural context in which youth might engage and cooperate with peers, learn teamwork, and excel physically. These behaviors would be expected to foster engagement in school. Connectedness might also be enhanced via decreased overweight and obesity.

The transition from childhood to adolescence is a time when mental and emotional problems increase (Ge, Conger, & Elder, 2001; Kessler, Avenevoli, & Ries Merikangas, 2001; Patton et al., 2007; Patton & Viner, 2007). Problems such as anxiety and depression, among others, and resultant internalizing and externalizing behaviors, can have powerful adverse effects on school success, both academic and social. Physical activity favorably affecting indices of mental and emotional health can promote improved overall well-being, and, indirectly, connectedness with peers and teachers at school (Bond et al., 2007; Rice, Kang, Weaver, & Howell, 2008; Shochet, Dadds, Ham, & Montague, 2006).

Absenteeism

School-based physical activity programs may improve attendance by reducing obesity, which has been associated with absenteeism (Geier et al., 2007; Shore et al., 2008), by increasing connectedness, and by favorably affecting the health status of children with asthma. A consistent finding is that physical activity can improve cardiopulmonary fitness among youth with asthma (Fitch, Morton, & Blanksby, 1976; Matsumoto et al., 1999; Ram, Robinson, Black, & Picot, 2005; Welsh, Kemp, & Roberts, 2005). Physical activity has also been reported to have favorable effects on physiological indices other than fitness (Bonsignore et al., 2008; Fanelli, Cabral, Neder, Martins, & Cavalho, 2007) and to improve quality of life (Basaran, Guler-Uysal, Ergen, Seydaoglu, Bingol-Karakoç, & Ufuk Altintas, 2006; Fanelli et al., 2007). Exercise induced asthma should be addressed, not by avoiding exercise, but by increasing physical fitness (Williams, Powell, Hoskins, & Neville,

2008). School-based physical activity programs can help youth with asthma to learn and maintain healthy physical activity habits.

Dropping Out

One study investigated the relation between participation in school-based physical activity programs and drop-out. Findings were based on repeated measures collected as part of the National Educational Longitudinal Study. Drop-out rates were lower for youth who consistently participated in interscholastic sports (Yin & Moore, 2004). This is not meant to imply that school-based physical activity programs are a panacea for the drop-out problem. However, to the extent such programs are enjoyable for youth and foster teamwork, cooperation, and physical fitness, youth who participate may be more connected with and engaged in school, and more likely to attend and remain in school.

What Can Schools Do to Increase Levels of Physical Activity and Fitness?

School administrators, trying to raise standardized test scores, may mistakenly believe that physical education curricular time should be sacrificed and reallocated to reading, mathematics, and science. There is currently no evidence indicating that this strategy is, in fact, effective in increasing standardized test scores; in fact, a growing body of evidence shows that increased time for physical education and other school-based physical activity programs is associated with either a neutral or positive impact on academic outcomes. A variety of consensus recommendations are available to guide the conceptualization of school-based physical activity/education programs (Centers for Disease Control and Prevention, 1997; National Association for Sport and Physical Education, 2004; Pate et al., 2006; Pate & O'Neill, 2008; Strong et al., 2005).

Increased student physical activity and physical fitness can best be achieved through a comprehensive approach (Centers for Disease Control and Prevention,

(1997) that includes physical education, wise use of recess and after school times, co-curricular physical activity opportunities, and bicycling or walking to and from school. The nature and scope of school-based physical activity/education programs will vary with the resources available (e.g., human, physical, and social environmental) and with the level of commitment by school administrators. Community linkages can ease access to community recreational facilities. Cooperation of the local police can help ensure safety as students walk to and from school. In some localities, schools may represent the main recreational resources within the community.

The cornerstone of school-based physical activity programs should be a high quality physical education program based on national standards. Such programs are strongly recommended by the Task Force on Community Preventive Services as a way to increase physical activity and physical fitness among youth (Centers for Disease Control and Prevention, 2001). National Standards for Physical Education published by the *National Association for Sport and Physical Education* (2004) posit that a physically educated person:

- Demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities
- Demonstrates understanding of movement concepts, principles, strategies, and tactics as they apply to the learning and performance of physical activities
- Participates regularly in physical activity
- Achieves and maintains a health-enhancing level of physical fitness
- Exhibits responsible personal and social behavior that respects self and others in physical activity settings
- Values physical activity for health, enjoyment, challenge, self-expression, and/or interaction

Physical education class is an important opportunity for youth to be active and to learn self-awareness, self-

regulation, and other social-emotional skills, such as teamwork and cooperation. As with any school subject, quality is greatly influenced by teacher preparedness and enthusiasm. Opportunities for professional development can facilitate both. Another critical factor is the use of a sound physical education curriculum, consistent with the national physical education standards and the evidence-based characteristics of effective curricula. The CDC's "Physical Education Curriculum Analysis Tool" can help school districts select or develop such a curriculum.

Increasing participation by students least inclined to be active may require a new approach to physical education. Many youth really enjoy school physical activity/education programs. This can be true for many more. Opportunities for enjoyable play at school can dramatically affect youth development (Ginsburg, American Academy of Pediatrics Committee on Communications, & American Academy of Pediatrics Committee on Psychosocial Aspects of Child and Family Health, 2007) and foster school connectedness and engagement. Identifying and implementing physical activities that youth enjoy, particularly those who are less inclined to participate, is a key strategy in conceptualizing an effective physical education program. Research (Barr-Anderson et al., 2007, 2008; Dishman et al., 2005), as well as common sense, dictates that if students enjoy physical education, they will be more inclined to participate actively and to be engaged.

A school environment that motivates and enables youth to be physically active can serve to promote physical activity. Such an environment is determined in great part by the availability of space, equipment, and supplies. A safe environment is essential. Safety is achieved through design and maintenance of facilities, use of appropriate protective equipment, and adequate supervision. There is a well-documented inverse relationship between environmental safety and physical activity (Gordon-Larsen, McMurray, & Popkin, 2000; Molnar, Gortmaker, Bull, & Buka, 2004; Richmond, Field, & Rich, 2007; Ries et al., 2008).

The psychological environment is also important. If recreational time is characterized by negative social interactions, benefits will be limited. Some youth (e.g., overweight girls) may choose to avoid physical activities altogether. A psychological environment characterized by encouragement to be active and minimization of teasing and other aggressive behaviors will have benefits beyond physical activity, and is considered a national standard for physical education (National Association for Sport and Physical Education, 2004). Social support has been positively associated with level of physical activity among adolescent girls (Motl et al., 2007).

While emphasizing increased physical activity and fitness, schools can also help youth to learn, value and practice respectful and cooperative behaviors, and provide attentive social support for development of physical self-efficacy (Dishman, Saunders, Motl, Dowda, & Pate, 2009). The interpersonal interactions characteristic of many physical activities and learned in the context of a physical activity program can have important spillover effects on school climate. Like all school programs, physical activity programs require insight and leadership (Barnett, O'Loughlin, Gauvin, Paradis, & Hanley, 2006).

Extracurricular activities, before and after school and in the summer, can greatly contribute to the acquisition of regular physical activity habits. For many youth, participation in sports teams is an important context for physical activity and a powerful element of connectedness with school. As a matter of course, competitive sports tend to limit themselves to those with the greatest athletic abilities. Sports teams are not the answer for all students. Encouragement to be physically active needs to be intentionally directed toward those who need it most: the overweight and those with the least athletic abilities. Alternatives to competitive sports include dance, martial arts, walking, and physical activity games.

Recess, a time for play, may be an appropriate time

to promote physical activity. Some data suggest that school-day recess playtime can contribute significantly to children's overall levels of moderate to vigorous physical activity (Ridgers, Stratton, & Fairclough, 2006). Students, however are not all equally likely to be physically active during recess (Stratton, Ridgers, Fairclough, & Richardson, 2007). For some, free time for relaxation may be advantageous.

Children who walk or bike to school have higher levels of physical fitness and physical activity than those who do not (Davidson, Werder, & Lawson, 2008). Walking to and from school may be an option for some students, particularly in urban areas, but the majority of children in the United States do not walk to school (Centers for Disease Control and Prevention, 2002, 2005; Ham, Martin, & Kohl, 2008; McDonald, 2007) and the percentage of children who do has declined sharply over the past decades (Ham et al., 2008; McDonald, 2007). Longer distances and safety concerns have been identified as barriers to walking to school (Centers for Disease Control and Prevention, 2002, 2005). Active transportation to school has been identified as a potentially important strategy to increase physical activity among low-income minority youth (McDonald, 2008). The Centers for Disease Control and Prevention (2007) and the National Center for Safe Routes to Schools (n.d.) have developed programs and resources to encourage walking and biking to school.

Academic classroom time can be beneficially relieved with brief breaks for stretching or other activity associated with physical well-being. A classroom physical activity program integrating academic and physical activity curriculum—"TAKE 10!"—was found to increase levels of moderate physical activity among elementary level students (Stewart, Dennison, Kohl, & Doyle, 2004). Another intervention, comprising two ten minute lessons per day taught by classroom teachers, was found to yield increased levels of energy expenditure (Honas, Washburn, Smith, Greene, & Donnelly, 2008). Both interventions achieved beneficial physical activity goals without undermining academic goals.

Proven or Promising Approaches

Most evaluation studies focus on the extent to which school based physical activity/education programs increase physical activity and physical fitness. An ample number of studies document that well-conceived programs, implemented by skilled staff, can increase levels of both physical activity and physical fitness among youth (Pate, Saunders, et al., 2007; Pate, Ward, et al., 2007; Pate et al., 2005; Pfeiffer et al., 2006; Saunders, Ward, Felton, Dowda, & Pate, 2006; Ward et al., 2006). Based on synthesis of the scientific literature on evaluations of school based physical education programs, the Task Force on Community Preventive Services (2008) strongly recommends longer physical education classes and increased time engaged in moderate to vigorous activity as a strategy for increasing physical fitness.

An emerging body of evidence suggests that school based physical activity programs, such as physical education, have either a neutral or a positive impact on educational outcomes; there appears to be no evidence to support the notion that reducing time for physical education is a sound strategy for increasing academic achievement (Taras, 2005; Sibley & Etnier, 2003; Trudeau & Shepard, 2008). In the most recent and comprehensive review, Trudeau and Shepard (2008) concluded, based on a review of seven quasi-experimental and nine cross-sectional studies, that allocating more curricular time to physical activity programs, and less time to other academic subjects, does not affect the academic performance of elementary school students negatively and that an additional curricular emphasis on physical education may result in small absolute gains in academic achievement. A recent cross-sectional study not included in the Shepard review examined the association between time spent in physical education and academic achievement among a nationally representative sample of more than 5,000 students in the U.S. Department of Education's Early Childhood Longitudinal Study, Kindergarten Class of 1998 to 1999. Carlson and colleagues (2008) found a small but significant benefit for academic achievement

in mathematics and reading for girls enrolled in higher amounts of physical education, while higher amounts of physical education were not positively or negatively associated with academic achievement among boys.

Useful standards for implementing high quality, school-based physical activity programs are available from credible sources (National Association for Sport and Physical Education, 2004). The nation's public schools are well-positioned in their communities to have a dramatic influence on the physical activity and social behavior of youth. Students who have the greatest need to increase physical activity, namely urban minority children and adolescents, have the scantest resources and supports to do so (Barnett et al., 2006; Gordon-Larsen et al., 2006; Moore et al., 2008; Richmond et al., 2006).

Summary

Strong evidence supports the ability of school-based physical education programs to improve population-wide rates of physical activity and fitness. Benefits of such programs include facilitating physical activity and physical fitness, and favorably affecting weight control and overall health. It seems likely that mental and emotional health may benefit as well. Because physical activity affects the brain and cognition, there are likely to be favorable effects on ability to learn. Further, school-based physical activity programs provide an opportune time to help youth learn and practice social behaviors associated with teamwork, cooperation and respect for others, which in turn can favorably influence school climate, connectedness with school, and educational outcomes.