

# Preventive Cardiovascular Health in Schools: Current Status

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## Abstract

**Purpose of Review** This report presents a critical review and synthesis of selected school-based research that has been instrumental in demonstrating the feasibility and potential of schools as a population-based venue for preventive cardiovascular care and recent data on the status of school-based cardiovascular disease prevention initiatives.

**Recent Findings** Results underscore the importance of evidence-based approaches for promoting healthy behaviors and heart health in the school environment, indicate the need for policies that enhance the food and physical environments of schools, and provide data indicating substantial (state, school district, and school level) variability in implementation of policies designed to promote heart health in schools.

**Summary** Multilevel, evidence-based policies and dedicated resources are central and essential to promote heart health in school environments. Research is needed to evaluate the process and outcomes of school-based programs and policies and optimize schools as a delivery channel for preventive cardiovascular care.

**Keywords** Cardiovascular health promotion in schools · Prevention of risk for cardiovascular disease · Health behaviors · School nutrition and physical activity policies

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## Introduction

Despite substantial declines in cardiovascular disease (CVD) deaths in the past 50 years, CVD remains a major cause of mortality in women and men in the USA [1]. Attributed in part to improved primary and secondary prevention efforts and recognized as one of the greatest biomedical and public health achievements of the twentieth century, age-adjusted death rate for CVD in 2015 (168.5 per 100,000) represents nearly 70% reduction compared with rates 50 years earlier (542.5 per 100,000) [2]. Important to emphasize, however, is that burden of CVD mortality and morbidity in the USA is not equally distributed. Recent data highlight geographical differences in CVD mortality, underscore the importance of the social determinants of health including social status and networks, education, income, neighborhood and community environment, and access to quality health care [3]. Lifestyle behaviors (patterns of dietary intake, physical activity, smoking behaviors) are central to cardiovascular health across the life course and are influenced by the social determinants [4].

Adding to the risk and burden of CVD, the epidemic of obesity has called attention to factors that operate beyond the level of the individual and to the contexts that influence development, maintenance, and/or change of lifestyle behaviors [5]. Such contexts include family, school, workplace, community, system and source of health care, and the multilevel policies that impact those contexts. Paralleling the emphasis placed on such contexts, the American Heart Association (AHA) and other like-minded organizations offered explicit recommendations regarding primordial prevention and cardiovascular health [6]. By definition and design and as originally coined by Strasser, primordial prevention focuses on “prevention of the development of the risk factor in the first place” and population-based, public health approaches to

promoting optimal cardiovascular health beginning early in life and extending across the life course [7].

### Cardiovascular Health in Schools: Research Highlights and Lessons Learned

Schools are recognized as venues for population-based health promotion as well as chronic disease prevention. School health programs initiated in preschool and extending through high school have potential to influence the cardiovascular health of the majority of children and adolescents residing in the USA. Since the late 1970s, numerous school-based health promotion interventions have been developed and tested; some exclusively addressed heart health while others targeted risk factors for CVD through a more comprehensive approach [8]. Often referred to as the second generation of school-based research, studies conducted in the 1980s focused on theoretically derived behavioral interventions central to promoting heart health and incorporated measurement of physiologic risk factors for CVD as primary outcomes [8]. The collective results of these studies demonstrated the feasibility and potential of school-based interventions for improving the CVD risk status of children and adolescents and guided and informed the next (third) generation of school-based research focused on promoting cardiovascular health. Such third-generation interventions extended beyond the classroom and included efforts targeting the food and physical activity environments, as well as school policies that affect health-related behaviors [8].

The Child and Adolescent Trial for Cardiovascular Health (CATCH), the largest randomized controlled field trial designed to evaluate the effects of theoretically derived multi-component (individual, school- and family-based) interventions on risk factors for CVD in elementary school children, exemplifies the third generation of school-based research [9]. At the individual level, primary outcome of this 3-year intervention was change in serum cholesterol.

Detailed elsewhere, the multicomponent intervention did not result in between-group differences in serum cholesterol or other physiological indicators of CVD risk including blood pressure and body-mass index (BMI) [9]. Important to note, however, is that changes in total fat content of school lunches decreased significantly more in the intervention schools ( $n = 56$ ) from 38.7 to 31.9% than the control schools ( $n = 40$ ) from 38.9 to 36.2%. Similarly, the CATCH physical education (PE) intervention resulted in a significant increase in the percentage of moderate-vigorous physical activity (MVPA) during PE class—from 37 to 52%; intervention school students demonstrated greater energy expenditure than their control school counterparts [9]. A follow-up of 73% ( $n = 3714$ ) of the CATCH cohort was conducted 3 years later (eighth grade) to assess maintenance of between-group differences in health behaviors (physical activity, diet) and

physiological measures [10]. Self-reported MVPA remained higher in students in the intervention schools; however, between-group differences declined from 13.6 min in fifth grade to 8.8 min in eighth grade; the between-group differential in self-reported daily energy intake from fat was maintained [10]. Consistent with 3-year outcomes, no significant between-group differences were observed in any of the physiological indicators of CVD risk [9, 10].

Lessons learned from CATCH demonstrate the feasibility and short-term efficacy of theory-based behavioral interventions implemented in the school environment, highlight the importance of multicomponent interventions indicating the need to target interventions beyond the individual level, and include the food and physical activity environments of the school and point to the need for additional research on dose, duration, and intensity of school-based interventions required to change physiological indicators of risk for CVD. Importantly, CATCH results combined with those of other third-generation studies prompted advocacy for policy initiatives designed to improve the food and physical activity environments of schools and preschools.

As evidence began to accumulate regarding the early life origins of atherosclerosis and the importance of preventing the development of risk factors and adverse health behaviors early in life, preschool-based research and heart health education initiatives emerged. The ultimate goal of such preschool programs that paralleled third-generation school-based programs was to enable young children to make healthy lifestyle choices and develop good health behaviors in the first place, rather than learn “bad habits” that need to be undone later [11]. Building on lessons learned in CATCH and other school-based studies, research, and demonstration projects targeting preschoolers also focused on environmental factors central to development of heart health behaviors. Exemplifying this approach and initiated in the mid-1990s, Healthy Start was conducted in nine Head Start centers in upstate New York and was designed to reduce the total and saturated fat content of preschool meals and snacks, increase nutrition knowledge, and reduce serum total cholesterol [12]. Food service modification and teacher-training workshops lead by health education and nutrition specialists were key components of intervention preschools. Results supported lessons learned in school-based studies reaffirming the need for efforts to focus on the child and the preschool environment. Specifically, saturated fat content of preschool menus decreased from 12.5 to 8.0% energy intake (EI) in intervention schools [12]. Children in the intervention preschools as compared with those in the control schools experienced greater improvement in nutrition and overall health knowledge scores, and a significant decrease in total serum cholesterol ( $-6.0$  mg/dl) compared with controls ( $-0.4$  mg/dL) [12].

Taken together, lessons learned from second- and third-generation studies underscored the promise and potential of

schools and preschools as venues for population-based efforts designed to promote children's heart health, guided and informed subsequent research, and pointed to the need for multiple levels of intervention that go beyond targeting changes in behaviors of individuals and school environments. As suggested in comprehensive, systematic reviews of these second- and third-generation studies and reaffirmed by the AHA, broader public health interventions with school and community linkages combined with multilevel policy changes are central to optimizing schools as a delivery channel for cardiovascular health promotion for all children and adolescents [13–15].

Guided in part by lessons learned in second- and third-generation studies and fueled by the epidemic of obesity, the fourth (and current) generation of school-based research relevant to cardiovascular health has focused on combined, multicomponent physical activity and dietary interventions with goal of reducing body weight. Of note, the primary outcome in the majority of these studies has been a surrogate measure of adiposity, BMI *z*-score. An oft-cited systematic review identified 20 randomized controlled trials (RCTs) that included multicomponent (diet and physical) interventions of at least 12 weeks duration and were conducted in kindergarten, middle, and high schools [16]. Approximately half (9 of 20) demonstrated improvements in BMI *z*-score, the primary outcome. One of the 9 studies included in this systematic review, Planet Health, was conducted in 10 schools in the USA, targeted 12-year-olds and focused on dietary modification plus reduction of sedentary behaviors, especially television viewing [17]. The intervention reduced prevalence of obesity (OR = 0.47; 95% CI, 0.24–0.93) and increased obesity remission (OR = 2.16; 95% CI, 1.07–4.35) over 2 years [17]. Similarly, a World Health Organization review of 55 intervention studies, primarily from North America and focused on school-aged children, reaffirmed the importance of school-based multicomponent interventions in improving physical activity and dietary intake [18]. Key elements of effective multicomponent interventions, also recommended by AHA, include educational curricula taught by trained teachers, supportive school policies, a formal PE program, serving of healthy food and beverage options in school cafeterias and vending machines, and a parental or family component [18, 19]. The benefits of adding a family component to school-based interventions targeting obesity and behaviors central to energy balance have been reaffirmed in some, but not all, studies [18, 19].

Illustrating the importance of policies that affect the food and physical activity environments of schools is a study conducted by Foster and colleagues designed to examine the effects of a multicomponent School Nutrition Policy Initiative (SNPI) on the prevention of overweight and obesity among children in grades 4 through 6 from 10 schools in a Mid-Atlantic US city where 50% of students were eligible for free

or reduced-price meals [20]. Prior to randomization, schools were matched on size and type of food service. The SNPI included school self-assessment, nutrition education, nutrition policy, social marketing, and parent outreach. Primary outcomes were incidence of overweight (by age-, sex-specific BMI percentile) after 2 years; prevalence and remission of overweight and obesity, BMI *z*-score, total energy and fat intake, fruit and vegetable consumption, body dissatisfaction, and hours of activity and inactivity were secondary outcomes [20]. Importantly, the intervention resulted in a 50% reduction in incidence of overweight with significantly fewer children in the intervention schools (7.5%) than in the control schools (14.9%) becoming overweight after 2 years [20].

While progress has been made in developing selected evidence-based interventions designed to modify adverse health behaviors and promote cardiovascular health in the school environment, as discussed below, the current status of school-based cardiovascular health promotion varies substantially across the USA. While short-term efficacy of interventions to change adverse health behaviors and modify risk factors for CVD (BMI, serum cholesterol) has been demonstrated in some studies, moving from efficacy to effectiveness remains a challenge. Critically important to emphasize is the need for research including intervention studies with robust process evaluation protocols in addition to examining implementation and sustainability as well as the need to compare intervention effects across race, ethnic, culture, and socioeconomic groups. The extent to which school-based primordial preventive interventions focused on heart health behaviors are sustained over time and across contexts remains a fertile area for future inquiry.

### Cardiovascular Health in Schools: Current Status and Future Directions

The adoption and implementation of evidence-based recommendations for promoting heart health vary considerably across schools in the USA [21••]. Variation exists between and within states in both primordial prevention initiatives including implementation of policies to support healthy food and physical activity environments and primary prevention designed to reduce potentially modifiable risk factors and behaviors. For example, results from the 2012 School Health Policies and Practices Study (SHPPS), that collected data at the state and district levels only, highlight the need for improvement [21••]. Specifically, while states reported having standards for physical education and 90% of districts have adopted policies that require elementary, middle, and high schools to teach physical education, districts allow students to be exempted for a variety of reasons [21••]. Of note, the National Standards for Physical Education (NASPE) and the Centers for Disease Control and Prevention (CDC)

recommend that such waivers and exemptions not be used because they diminish the importance of PE as an integral component of a total education [22, 23]. A key indicator of quality PE is the teacher-to-student ratio in PE class; this type of policy can support PE teachers by reducing class sizes, enabling teachers to engage all students in activity during PE class. However, less than one-third of districts required a maximum teacher-to-student ratio for elementary, middle, and high schools [21••].

In addition to PE policies and practices, recess, regularly scheduled periods in the school day for physical activity and play that is monitored by trained staff or volunteers offers social, emotional, and cognitive as well as physical benefits. Of note, only 58.9% of districts required that elementary schools provide regularly scheduled recess for students and one in eight districts required schools at each grade level to provide physical activity breaks [21••]. *Let's Move!* Active School provides schools with support and resources to establish active environments and provide more physical activity opportunities for students [24]. While questions regarding the continuation of *Let's Move!* Active Schools beyond 2016 have been raised, the 2017–2019 strategic plan is in progress with emphasis on building a nationwide movement in support of PE and physical activity in schools [24]. Going forward, with the goal of realizing the recommended 60 min of physical activity a day as the norm for children and adolescents, partnerships with like-minded organizations and local community-based champions will be emphasized [24].

The 2014 SHPPS survey collected PE and physical activity data as well as information on the nutrition environment and food services at the school and classroom level only [25]. Results indicated that 3.6% of elementary schools, 3.4% of middle schools, and 4.0% of high schools required daily PE or its equivalent (150 min per week in elementary schools; 225 min per week in middle and high schools) [25]. Of note, 54.7% of schools offered intramural sports or physical activity clubs to students and 26.5% of elementary schools, 84.8% of middle schools, and 94.1% of high schools offered students opportunities to participate in interscholastic sports [25].

The school food environment is a central component of both primordial and primary prevention. In 2010, the Healthy, Hunger-Free Kids Act (HHFKA) was passed with the goal of revising the national school meal standards to be consistent with the 2010 Dietary Guidelines for Americans [26, 27]. The revised standards were implemented in academic year 2012–2013 in kindergarten through twelfth grade (K-12) in schools participating in the US Department of Agriculture (USDA) National School Lunch and School Breakfast Programs [26–28]. Guidelines include increasing the availability of whole grains, fruits, and vegetables, requiring children to select a fruit or vegetable and restricting serving sizes. Preliminary research suggests that the changes have resulted in increased fruit and vegetable intake at school [29].

Despite the potential public health benefit of HHFKA, there has been some pushback on the changes in the school lunch standards from various stakeholders including policymakers and school food service directors as well as teachers, parents, and students. In a recent policy brief, the Society of Behavioral Medicine (SBM) endorsed the HHFKA suggesting that the lunch standards be retained and nutrition education be promoted in schools along with creating cafeteria environments that facilitate healthful eating [30]. With consideration of the potential population health impact, the AHA also advocates for the promotion and implementation of robust nutrition standards for school meals and competitive foods [31••]. Clearly, additional research will be required to evaluate the implementation and longer-term impact of the 2010 revisions.

The 2014 SHPPS survey indicates some additional positive changes in the school food environment and some challenges that remain to be addressed [25]. Specifically, 88.3% of schools reported providing students with access to free drinking water in the cafeteria during mealtimes, and 74.1% of school permit students to have a drinking water bottle in all locations during the school day [25]. In addition, 22.3% of schools reported having a school food garden and 34.7% reported having a self-serve salad bar. Of note, however, 20.6% of elementary schools, 47.4% of middle schools, and 75.4% of high schools had either a vending machine, canteen, snack bar, or school store where students could purchase food or beverages. The most common foods sold were low-fat, salty snacks (25.7%), low-fat baked good (21.7%), and low-sodium snacks (20.8%). Nutrient-poor baked goods were commonly offered (in 52.7% of schools) for school fundraisers [25].

Guided and informed by evidence generated from school-based studies and fueled by the epidemic of childhood obesity, the AHA launched several primordial and primary prevention initiatives. Particularly noteworthy is Voices for Healthy Kids (VOICES), a collaborative campaign initiative with the Robert Wood Johnson Foundation designed to mobilize evidence-based legislation addressing childhood obesity [32]. Initiated in 2012, a major goal of VOICES is to build a culture of health for all children with emphasis on reducing health disparities [32]. A recent report on Voices for Healthy Kids-2016 suggests it is a promising model for changing policies that improve the nutrition and physical environment with schools as a key setting for such improvements [33]. Specifically, childhood obesity legislative activity occurred in all 50 states paralleling the first year of VOICES. Of note, in the year prior to VOICES (November 2012 to October 2013), 217 bills were identified and 304 bills at follow-up (November 2013 to October 2014) [33]. In states with active VOICES grantees, the bill enactment rate was 50% higher (increasing from 10% at baseline to 15% at follow-up) [33]. Recent 2016 success stories, detailed elsewhere, underscore the power and potential of collective multilevel collaborative

partnerships in promoting enactment of legislation essential to create healthy school and community environments for all children and families [34].

Taken together, available evidence and anecdotal observations suggest that progress has been made in the past decade in the implementation of initiatives designed to promote cardiovascular health in the school environment [21••, 25]. Recommendations for optimizing the potential of schools as population-based venues for both primordial and primary prevention efforts include incorporating and adapting the Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents and enabling schools to function as part of integrated systems of preventive cardiovascular care [35•]. Central to this recommendation is the availability of (and collaboration between) school-based health centers (SBHCs) and registered professional school nurses as suggested by the National Association of School Nurses [36]. Operating as medical clinics, SBHCs complement the work of school nurses by providing a readily accessible referral site for students without a source of health care. School nurses and SBHCs both function as health safety nets for children in need and working together could provide comprehensive health care to students [36, 37]. Applying this model of SBHC-school nurse collaboration to preventive cardiovascular care in schools would enhance primary prevention by enabling identification of children and adolescents at risk and providing a mechanism for referral and initial management.

Critically important to enabling such collaborations and advances designed to promote cardiovascular health in the school environment as well as maintenance of positive programmatic and environmental changes witnessed over the past several decades is the valuing of schools as a population-based venue for health promotion and CVD prevention. Primordial prevention delivered effectively and universally in schools has potential to reduce the unequal risk and burden of CVD. Clearly, the allocation of resources at federal, state, and local levels will be essential in realizing this vision.

## Conclusion

Evidence accumulated over the past several decades supports the promise and potential of schools as venues for population-based CVD prevention. Initiated in preschool and extending through high school, school health programs have the potential to influence the cardiovascular health of the majority of children and adolescents in the USA and reduce the disparities in risk and burden of CVD. School-based research has guided and informed evidence-based programs designed to promote adoption of heart health behaviors and enable school environments conducive to heart health. Central to prevention efforts delivered in the school environment are policies that promote the health as well as academic competencies of children and

adolescents and resources required for effective implementation of such health promoting policies. Future research to evaluate both process and outcomes of school-based heart health programs and multilevel policies will be required to optimize schools as venues for population-based preventive cardiovascular care.

## Compliance with Ethical Standards

**Conflict of Interest** Dr. Hayman have no conflicts of interests to declare.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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