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Top 10 Lessons Learned from Project Healthy Schools

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ABSTRACT

Childhood obesity is increasing in the United States; obese children are more likely to become obese adults with obesity-associated health issues. Effective programs designed to reduce the prevalence of childhood overweight and obesity are needed. We sought to review one such program, Project Healthy Schools (PHS), for key findings. Project Healthy Schools is a health curriculum that includes educational lessons, school environment changes, and health measurement. Data have shown improvement in numerous metrics after the program, including positive changes in physiologic measures and healthier lifestyle behaviors. The school's socioeconomic status has been shown to correlate with baseline and follow-up measures, and gender differences exist. Additionally, school environmental changes support improved health behaviors. The collaborative effort and support of various stakeholders have led to the success of this health education program, resulting in numerous physiologic and behavioral benefits in middle school students throughout Michigan, and providing a replicable, real-world approach to combating childhood obesity.
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The prevalence of childhood obesity (body mass index [BMI] ≥95th percentile) in the United States has drastically increased over the past 30 years.[1] Childhood obesity has immediate and long-term effects on a child's health. Obese children are more likely than non-obese children to have risk factors for cardiovascular disease,[2,3] the leading cause of death in the United States for men and women.[4] Obese children are more likely to become obese adults; obese adults are also more likely to have cardiovascular disease risk factors and other health complications.[2,5] There are numerous long-term health issues associated with obesity (eg, diabetes, hypertension, sleep apnea, osteoarthritis, cancer).[2,6] Project Healthy Schools (PHS) was established to address childhood obesity and its associated cardiovascular risk factors.

Project Healthy Schools is a middle school–based program, created from a partnership between the University of Michigan Health System, middle schools in Michigan, community organizations, and donors to educate and encourage children to lead healthier lifestyles. Project Healthy Schools began as a pilot program in 1 Ann Arbor middle school during the 2004-2005 school year. Since 2004, PHS has been implemented in more than 80 schools across Michigan; more than 50,000 students have participated in the program. The program utilizes school-based environmental changes and health education focused on sixth grade students.

The educational component consists of 10 sessions (**Table 1**) taught by a PHS health educator: a trained PHS staff member or teacher from the school. The interactive sessions focus on targeted health topics and last from 20 to 45 minutes, resulting in a minimum total of 3 hours and 20 minutes of health education. The sessions are designed to be hands-on and fun for students, while

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emphasizing the 5 goals of PHS: 1) eat more fruits and vegetables; 2) choose less sugary food and beverages; 3) eat less fast and fatty foods; 4) be active every day; and 5) spend less time in front of a screen. Environmental changes consist of a variety of tactics to encourage healthier behaviors in the students, including making healthier food and beverage choices available in the school (Table 2). The frequency and type of environmental changes vary by school and are determined by school administrators. The sessions and environmental changes continually evolve, on the basis of feedback from students and staff.

Two tools are used to assess the program's effectiveness: a health behavior questionnaire and an optional health screening. The health behavior questionnaire is a modified version of the School Physical Activity and Nutrition questionnaire, which is a validated survey developed by the University of Texas Health Science Center, in collaboration with the US Centers for Disease Control and Prevention and the US Department of Agriculture, as a means of monitoring the dietary, physical activity, and sedentary habits of children.[7,8] Questions address dietary choices, physical activity levels, sports team enrollment, screen time, and other health-related topics. Data from the baseline and follow-up health behavior questionnaires allow for a comparison of students' health habits before and after the PHS program.

Physiologic data, including blood pressure, resting and recovery heart rate, height, weight, nonfasting glucose, and nonfasting lipids (Table 3), are collected through optional health screenings after acquiring informed consent from both parents and students. Nonfasting measurements are collected because it was felt by school administrators and PHS staff that it would be unwise to have students fast before screenings, recognizing the time of the lipid assessment varies between schools. Additionally, some studies have shown that a failure to fast before lipid profiling does not significantly alter lipid levels; fasting may be unnecessary.[9,10] All physiologic measurements are obtained using standard protocols by trained study staff. Recovery heart rate is measured after the students complete a step test, which consists of stepping up and down on a bench following a 96 beats per minute cadence for 3 minutes under staff supervision. The research component of PHS was approved by the University of Michigan institutional review board.

The findings from both the behavioral and physiologic measures have shown significant improvements in students' health and lifestyles and have been detailed in 16 published articles and 51 abstracts presented at national conferences. A summary of the findings will be reviewed in this article.

CLINICAL SIGNIFICANCE

- The Project Healthy Schools (PHS) school-based wellness program has proven effective in improving physiologic parameters and health behaviors in middle-school students.
- Socioeconomic status plays a large role in middle-school students' physiologic and behavioral risk factors; however, PHS has proven effective in students regardless of socioeconomic status.
- The collaboration of multiple, committed, stakeholders is essential for the implementation of a successful school-based wellness program.

LESSON 1: MORE THAN 35% OF STUDENTS PARTICIPATING IN PHS ARE EITHER OVERWEIGHT OR OBESE

A 2013 study of the PHS population discovered that 17.4% of students participating in the program were overweight (BMI >85th-95th percentile, adjusted for age and gender), and 18.6% were obese (BMI ≥95th percentile, adjusted for age and gender).[11] This obesity rate is higher than the 2011 Michigan data on children aged 10-17 years (14.8%).[12] In a separate study, obese students were found to have more cardiovascular risk factors than non-obese students, including higher total cholesterol ($P < .001$), low-density lipoprotein (LDL) cholesterol ($P = .004$), triglycerides ($P < .001$), blood pressure ($P < .001$), resting heart rate ($P < .001$), and recovery heart rate ($P < .001$).[13] They were also more likely to drink regular soda ($P = .029$), eat school lunch ($P = .001$), and engage in screen time ($P < .001$) and less likely to participate in physical activity ($P = .03$). The high prevalence of obesity in this population and the increased cardiovascular risk highlight the importance of interventions designed to improve dietary habits and increase physical activity.

LESSON 2: PARTICIPATION IN PHS IMPROVES PHYSIOLOGIC MEASURES

Participation in the PHS program has resulted in significant improvements in students' physiologic measures.[11,14] In a study of 287 PHS students from 3 participating schools, comparison of baseline and follow-up data showed significant reductions in students' total cholesterol (169 to 154 mg/dL; $P < .0001$), LDL cholesterol (86 to 84 mg/dL; $P = .01$), random glucose (96 to 93 mm/dL; $P = .01$), and diastolic blood pressure (63.6 to 62.3 mm Hg; $P = .01$).[14] These findings were supported by a later study of 4021 PHS students.[11] Reductions in triglycerides (113 to 101 mg/dL; $P < .001$) and systolic blood pressure (109.47 to 107.76 mm Hg; $P < .001$) were also noted.

LESSON 3: PARTICIPATION IN PHS IMPROVES HEALTHY BEHAVIORS

The PHS program has also shown improvement in health behaviors.[11] After PHS, students reported eating significantly more fruits per day than reported at baseline (1.31 to

Table 1 Description of the Educational Topics in Project Healthy Schools (PHS)

Educational Lessons	Description
Lessons 1: Healthy Habits	Students learn the objectives of PHS. This lessons aims to give students a personal connection to health by linking the benefits of health to daily adolescent life.
Lesson 2: I Am From	Students explore how cultural ideologies, demographics, and geography affect food choices. They make inferences about why these differences might exist between cultures.
Lesson 3: My Plate My Choice	Students learn that all foods provide different nutrients for the body depending on the food offered in schools.
Lesson 4: Sugar Shock	Students discuss why it is important to limit sugar intake, learn how to read nutrition labels, and identify added sugars.
Lesson 5: Get the Beat	Students learn the anatomy of the heart and why it needs to be conditioned for good health. They learn how to measure heart rate to evaluate the effectiveness of physical activity on heart health.
Lesson 6: Rainbow of Color	Students learn why a variety of fruits and vegetables is important for their bodies and make a nutrient-dense meal with fruits and vegetables.
Lesson 7: Jump Start Your Day	This lesson outlines the importance of eating breakfast. Students use their prior knowledge to collaboratively analyze and modify healthy breakfast options.
Lesson 8: Assessing Advertising	This lesson encourages students to develop critical thinking skills by asking them to evaluate food and beverage advertisements.
Lesson 9: Facts on Fats	Students explore ways that dietary fat affects overall health, and they learn the difference between saturated fat, unsaturated fat, and trans fat.
Lesson 10: PHS Finale	Students participate in a review activity in which they demonstrate what they have learned throughout the program.

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1.40 servings; $P < .001$). Students also participated more frequently in moderate (3.16 to 3.54 sessions per week; $P < .001$) and vigorous exercise (4.13 to 4.52 sessions per week; $P < .001$) and attended more physical education classes per week (2.59 to 2.62; $P < .001$). Additionally, students reduced their daily television (2.27 to 2.08 h/d; $P < .001$) and video game screen time (1.32 to 1.22 h/d; $P = .043$). Similar improvements in physical activity were seen in another study, with vigorous (4.61 to 4.95 sessions per week; $P < .001$) and moderate (3.49 to 3.94 sessions per week; $P < .001$) exercise increasing significantly after the program.[15]

LESSON 4: PHYSIOLOGIC RESULTS ARE SUSTAINABLE

Equally important to showing that the program yields successful results[11,14] is showing that the results are

Table 2 Description of the Environmental Changes in Project Healthy Schools (PHS)

Environmental Changes	Description
Kick-Off Event	Organization of a large school activity involving community members, teachers, parents, and children to raise awareness of the program's start and 5 healthy goals.
Healthy Class Challenge	To stimulate healthy behaviors learned in class (educational lessons), students and classes compete to see who can achieve the healthiest habits. The habits that are tracked include physical activity and the consumption of fruits, vegetables, and healthy beverages. The winning class earns a PHS trophy and a fruit smoothie party.
Bulletin Boards	Ongoing communication to promote PHS goals and inform students of physical activity events (eg, yoga, basketball, running, and other events) and healthy eating (promoting the salad bar and healthy snack items).
Physical Activity Events	Events to improve vigorous- and moderate-intensity physical activity in students. Organized events may include Field Days, Running/Walking events (Turkey Trot), Open Gym Nights, Volleyball and Sports Tournaments, Exercise Challenges, or Walking Clubs.
Healthy School Cafeteria	Improved availability and accessibility of healthy foods in the school environment through salad bars in the school cafeteria, healthy snack items, and replacement of unhealthy foods/beverages with healthier options. Healthy snack items include carrots, celery with peanut butter, and the replacement of fried chips with lower-fat baked chips. Throughout the school, sugary beverages are replaced with bottled water and other non-soft drink selections in both the vending machines and the cafeteria. Local and regional partnerships are initiated to develop a farm-to-school program.

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Table 3 Physiologic Data (Non-Fasting) Collected by Project Healthy Schools

Blood pressure
Resting heart rate
Recovery heart rate (after 3-min step test)
Height
Weight
Random glucose
Total cholesterol
HDL cholesterol
LDL cholesterol
Triglycerides

HDL = high-density lipoprotein; LDL= low-density lipoprotein.

sustainable.[15] Follow-up data were collected annually for 4 years after the PHS program for middle school students in one high- and one low-income district in Michigan. Students completed baseline and follow-up health behavior questionnaires and health screenings in sixth grade. Three additional follow-up health behavior questionnaires and health screenings were conducted annually through ninth grade. Within the high-income district, improvements in total cholesterol, LDL cholesterol, and triglycerides were sustained 4 years after the PHS program. Among the low-income district, there were significant improvements in total cholesterol, LDL cholesterol, and triglycerides after the first year. At the 4-year follow-up, total cholesterol and LDL cholesterol improvements were sustained. Both high- and low-income district students had reduced resting heart rates at the 4-year follow-up.[15]

LESSON 5: BASELINE HEALTH STATUS IN STUDENTS FROM LOW-INCOME COMMUNITIES IS WORSE THAN IN STUDENTS FROM HIGH-INCOME COMMUNITIES, BUT BOTH COMMUNITIES SHOWED SIGNIFICANT IMPROVEMENTS IN BEHAVIORAL AND PHYSIOLOGIC MEASURES AFTER PHS

Project Healthy Schools has been implemented in many schools throughout Michigan, and data have been gathered from students representing a wide range of socioeconomic strata. A study comparing health behaviors and physiologic measurements of students from 2 neighboring communities of differing resources (median household income of US $28,610 vs US $46,299) before PHS found that a higher percentage of students from the community with fewer resources were obese (22.2% vs 12.6%; $P = .01$).[16] Moreover, a higher percentage reported elevated consumption of fast and fatty foods and sugary beverages, less involvement in physical education classes and sports teams, and higher levels of sedentary behaviors compared with students from the community with more resources. A separate study reported that as the community average household income decreased, the frequency of fried food consumption and television/video time increased, whereas the frequency of vegetable consumption and moderate/vigorous exercise decreased.[17]

In addition to these baseline differences, students in schools of lower community income responded differently to PHS than students of higher community income. After PHS, 29.5% of low-income students improved their participation in physical education classes per week, compared with 8.9% of high-income students ($P < .001$). Similar trends were seen in sedentary and dietary habits, with higher percentages of low-income students reducing screen time and unhealthy dietary behaviors.[18]

Low-income students also showed greater improvement in recovery heart rate (−4.73 vs 1.25 mean change in beats per minute; $P < .001$), whereas high-income students showed greater improvement in systolic blood pressure (−5.14 vs −0.26 mean change in mm Hg; $P < .001$), diastolic blood pressure (−3.81 vs 0.15 mean change in mm Hg; $P < .001$), and total cholesterol (−7.71 vs −3.05 mean change in mg/dL; $P < .001$).

LESSON 6: (A) HIGH MOBILE DEVICE USE LEADS TO INCREASED OVERALL SCREEN TIME AND LESS PHYSICAL ACTIVITY, AND (B) PASSIVE SCREEN TIME (TELEVISION) IS ASSOCIATED WITH LESS HEALTHY BEHAVIORS THAN ACTIVE SCREEN TIME (COMPUTER/VIDEO GAMES)

The dangers of physical inactivity include higher risk for heart disease, hypertension, and dyslipidemia, as well as a lower average lifespan.[19] Screen time increases the risk of childhood obesity, and current guidelines suggest limiting screen time to less than 2 hours per day.[20]

A PHS study on mobile device use among 2566 students divided them into 2 groups: high mobile device users (>2 h/d) and low mobile device users (≤2 h/d).[21] High users spent more time per day watching television (2.3 vs 1.7 hours; $P < .001$), on a computer (1.39 vs 0.88 hours; $P < .001$), and playing video games (1.47 vs 1.01 hours; $P < .001$) than the low users. Low users participated in more strengthening exercises and more sports teams.

Project Healthy Schools data also suggest that passive screen time (television) results in more unhealthy behaviors than active screen time (computer and video games).[22] A total of 1003 students were split into 3 cohorts based on their baseline (pre-PHS) screen time habits: passive screen time (2-6 h/d spent watching television), active screen time (2-6 h/d spent on the computer or playing video games), and low screen time (<0.5 h/d of total screen time). Both high screen time groups (active and passive) demonstrated increased unhealthy snack consumption compared with the low screen time group. However, the passive screen time group had higher systolic blood pressure (108.4 vs 104.2 mm Hg; $P < .001$), diastolic blood pressure (63.9 vs 60.9 mm Hg; $P < .001$), and BMI (21.5 vs 19.5 kg/m^2; $P < .001$) than the active screen time group. No differences in blood pressure or BMI were seen between the active screen time

group and the low screen time group. These findings suggest that increased television time, which is less interactive, exposes children to unhealthy food advertisements, frees up hands for mindless snacking, is more harmful to children than other forms of screen time.

LESSON 7: ENVIRONMENTAL CHANGES IN THE SCHOOL SUPPORT IMPROVED HEALTH BEHAVIORS

Although the PHS program supports environmental changes (Table 2) in schools, not all schools supplement the educational sessions. Students from schools that implemented environmental changes reported healthier behaviors than those who received the educational sessions only.[23] When compared with students from schools without environmental changes, students at schools with environmental changes reported increased daily fruit intake (9% increase from reported consumption at baseline vs 2% decrease; $P = .046$), fewer servings of sugary or fatty foods per day (11% decrease vs 4% increase; $P = .002$), and more sessions of moderate physical activity per week (50% increase vs 11% increase; $P = .009$) after the PHS program.

LESSON 8: POOR PHYSIOLOGIC MEASURES AND HEALTH BEHAVIORS ARE OFTEN ASSOCIATED WITH ADDITIONAL POOR PHYSIOLOGIC HEALTH MEASURES

In adults, a higher heart rate after physical activity (ie, recovery heart rate) has been associated with increased cardiovascular disease risk.[24,25] Project Healthy Schools students in the upper quartile for recovery heart rate (ie, the least fit) had higher triglycerides ($P < .001$), total cholesterol ($P = .02$), LDL cholesterol ($P = .02$), systolic blood pressure ($P < .001$), and diastolic blood pressure ($P = .001$) and lower high-density lipoprotein (HDL) cholesterol ($P < .001$) than students in the other quartiles.[26] Additionally, obese children had a higher mean recovery heart rate than children in the normal BMI range (116.6 vs 100.3 beats per minute; $P < .001$).

In another study, students with low HDL cholesterol (≤40 mg/dL) had increased systolic blood pressure (110.88 vs 107.98 mm Hg; $P = .002$), diastolic blood pressure (66.01 vs 63.67 mm Hg; $P = .001$), resting heart rate (84.34 vs 80.22 bpm; $P = .001$), recovery heart rate (110.72 vs 103.39 bpm; $P = .001$), triglycerides (175.01 vs 111.88 mg/dL; $P = .001$), and LDL cholesterol (93.53 vs 87.90 mg/dL; $P = .009$), compared with students with high HDL cholesterol (>40 mg/dL).[27] These results are consistent with the notion that risk factors cluster in children who are overweight/obese and sedentary, much as we see in adults with metabolic syndrome.

In addition to these physiologic predictors, unhealthy behaviors are also associated with increased cardiovascular risk. A recent study separated 2667 PHS students into 2 groups based on the number of unhealthy behaviors the students reported (Table 4).[28] Compared with students in the "Healthier Behavior" group, students in the "Unhealthy Behavior" group were positively associated with overweight/obesity (odds ratio [OR] 1.41; 95% confidence interval [CI], 1.19-1.67), negatively associated with HDL cholesterol (OR 0.79; 95% CI, 0.6-0.99), and demonstrated a trend toward increased LDL cholesterol (OR 1.51; 95% CI, 0.83-2.77).

Table 4 Criteria for Unhealthy and Healthier Behavior Groups

Unhealthy Behavior = 4 or More of the Following Behaviors Healthier Behavior = No More Than 1 of the Following Behaviors
• <1 d/wk vigorous (20 min) or moderate (30 min) physical activity
• <1 d/wk physical education classes
• <1 team sport participation per year
• >2 h/d TV time, computer time, or video games
• <1 time per day fruit or vegetables
• No daily breakfast consumption
• >1 time/day sugary foods and beverages

LESSON 9: GENDER DIFFERENCES EXIST IN OVERWEIGHT/OBESITY PHYSIOLOGIC AND BEHAVIORAL RISK FACTORS

Obesity in both boys and girls was associated with 2 independent behaviors: regularly eating school lunches (boys OR 1.29; 95% CI, 1.01-1.64; $P = .04$) (girls OR 1.27; 95% CI, 1.00-1.62; $P = .05$), and watching ≥2 hours of television per day (boys OR 1.19; 95% CI, 1.07-1.32; $P < .01$) (girls OR 1.19; 95% CI, 1.06-1.34; $P < .01$).[29] Compared with non-obese boys, obese boys were more likely to have higher total cholesterol, LDL cholesterol, and triglycerides, as well as lower HDL cholesterol. Compared with non-obese girls, obese girls showed lower HDL cholesterol, as well as higher triglycerides and random glucose. The obese groups from both genders showed higher blood pressures (systolic and diastolic), as well as higher resting and

Table 5 Top 10 Lessons Learned from Project Healthy Schools (PHS)

1	More than 35% of students participating in PHS are either overweight or obese.
2	Participation in PHS improves physiologic measures of health.
3	Participation in PHS improves healthy behaviors.
4	Improved physiological results are sustainable.
5	Socioeconomic status matters.
6	High screen time is associated with less physical activity.
7	Environmental changes support improved behaviors.
8	One poor measure of health is often associated with additional poor measures.
9	Gender differences exist in physiological and behavioral risk factors.
10	Collaboration is key to success.

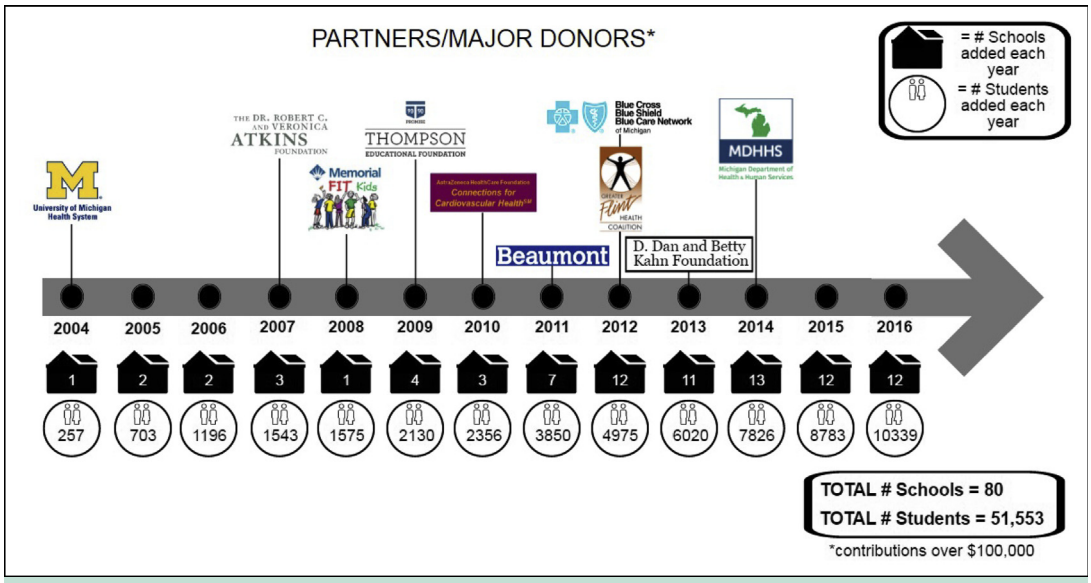

Figure Timeline of Project Healthy Schools. This figure shows the growth of Project Healthy Schools since 2004. Above the timeline, major partners and donors to the program are displayed. Below the timeline, the number of schools and students participating in the program each year is displayed.

recovery heart rates. For boys, vigorous physical activity and school sports participation seemed to be protective against obesity (OR 0.90; 95% CI, 0.82-0.98; $P = .01$; and OR 0.77; 95% CI, 0.64-0.94; $P = .01$, respectively). For girls, milk consumption seemed to be protective (OR 0.81; 95% CI, 0.67-0.98; $P = .03$).

LESSON 10: COLLABORATION IS KEY

Although PHS began with a single person determined to combat the pressing tide of a childhood obesity epidemic, the sustained help of Ann Arbor Public Schools, the local YMCA and Hands On Museum, the Washtenaw County Health Department, and many schools, health systems, and university departments was essential to the success of the program. Through this collaborative effort, PHS was able to design and implement an effective and feasible program that could be duplicated in diverse communities. Project Healthy Schools has since grown into a state-wide partnership between multiple health systems, communities, and stakeholders; it continues to expand each year (**Figure**). Project Healthy Schools now spans the state of Michigan, and several international initiatives are being explored.

The success of PHS comes from its inclusive, highly collaborative nature. Combining the unique skills from each member or organization involved in PHS has created a diverse and efficient team for implementing change on a grand scale. Strong leadership, teamwork, and collaboration make up the framework of the PHS partnership and have allowed PHS to impact thousands in Michigan.

CONCLUSIONS

Project Healthy Schools, a middle school intervention program that promotes healthy lifestyles, has been implemented in more than 80 schools in Michigan, reaching more than 50,000 students. Significant behavioral and physiologic changes have resulted, including improvement in lipids, activity levels, and consumption of healthier foods. Educational sessions are continually improved to stay contemporary, while remaining fun and engaging for students. These sessions incorporate important health education into straightforward lesson plans, making the PHS model easy to implement and highly transportable. By partnering with health systems, community organizations, and philanthropists, PHS has been able to facilitate sustainable improvements in child health on a wide scale. The program has consistently been well received by students and teachers and continues to expand. The program results presented in this article (**Table 5**) are encouraging and should provide hope to other school-based health interventions.

Project Healthy Schools is not a randomized, controlled trial and certainly has limitations; however, the program has demonstrated the powerful and promising influence that a well-structured, school-wide program can have on children's health.

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