eat right. American Dietetic Association

Healthier Options for Public Schoolchildren Program Improves Weight and Blood Pressure in 6- to 13-Year-Olds

DANIELLE HOLLAR, PhD, MS, MHA; SARAH E. MESSIAH, PhD, MPH; GABRIELA LOPEZ-MITNIK, MS, MPhil; T. LUCAS HOLLAR, PhD; MARIE ALMON, MS, RD; ARTHUR S. AGATSTON, MD

ABSTRACT

Childhood obesity and related health consequences continue to be major clinical and public health issues in the United States. Schools provide an opportunity to implement obesity prevention strategies to large and diverse pediatric audiences. Healthier Options for Public Schoolchildren was a quasiexperimental elementary school-based obesity prevention intervention targeting ethnically diverse 6- to 13-year-olds (kindergarten through sixth grade). Over 2 school years (August 2004 to June 2006), five elementary schools (four intervention, one control, N=2,494, 48% Hispanic) in Osceola County, FL, participated in the study. Intervention components included integrated and replicable nutrition, physical activity, and lifestyle educational curricula matched to state curricula standards; modified school meals, including nutrient-dense items, created by registered dietitians; and parent and staff educational components. Demographic, anthropometric, and blood pressure data were collected at baseline and at three time points over 2 years. Repeated measures analysis showed significantly decreased diastolic blood pressure in girls in the intervention group compared to controls ($P<0.05$). Systolic blood pressure decreased significantly for girls in the intervention group compared to controls during Year 1 (fall 2004 to fall 2005) ($P<0.05$); while not statistically significant the second year, the trend continued through Year 2. Overall weight z scores and body mass index z scores decreased significantly for girls in the intervention group compared to controls ($P<0.05$ and $P<0.01$, respectively). School-based prevention interventions, including nutrition and physical activity components, show promise in improving health, particularly among girls. If healthy weight and blood pressure can be maintained from an early age, cardiovascular disease in early adulthood may be prevented.

J Am Diet Assoc. 2010;110:261-267.

D. Hollar is a voluntary assistant professor of medicine, S. E. Messiah is a research assistant professor and a perinatal and pediatric epidemiologist, and G. Lopez-Mitnik is a biostatistician, University of Miami Miller School of Medicine, Miami, FL. T. L. Hollar is an assistant professor, Department of Government, Stephen F. Austin State University, Nacogdoches, TX. M. Almon is a clinical dietitian, South Beach Preventive Cardiology, Miami Beach, FL. A. S. Agatston is president, Agatston Research Foundation, Miami Beach, FL.

Address correspondence to: Danielle Hollar, PhD, MS, MHA, University of Miami Miller School of Medicine, 881 NE 72nd Terr, Miami, FL 33138. E-mail: daniellehollar@gmail.com

Manuscript accepted: September 4, 2009.

0002-8223/10/11002-0009$36.00/0

doi: 10.1016/j.jada.2009.10.029

The prevalence of obesity remains high among all age and racial groups in the United States, with a disproportionate rise among African Americans and Hispanic/Mexican Americans (1-3). Because obesity and related chronic disease risk factors are relatively stable characteristics that track from childhood into adulthood (4-10), the identification of children and adolescents with elevated risk factors is of great interest from both clinical and public health standpoints. Childhood weight gain, even among children considered in the normal weight category, is strongly associated with risk of future cardiovascular disease (11,12). In addition, childhood obesity can lead to neurologic, endocrine, cardiovascular, pulmonary, gastrointestinal, renal, and musculoskeletal complications (13), and children with overweight and obesity are more likely to have low self-esteem, higher rates of anxiety disorders, depression, and other psychopathology, which in turn may affect academic performance (14-17).

The etiology of the childhood obesity epidemic is evolving and multifaceted. Sedentary lifestyles, including television viewing and computer use, as well as advertisements aimed at children promoting energy-dense, lower-nutrient foods, socialize children into unhealthful lifestyle habits that follow into adulthood (18,19). Recommendations for daily physical activity at school and strong nutrition education curricula often are not followed because they are perceived to supplant time and resources allotted for core subjects (20,21). The Centers for Disease Control and Prevention reported that of high school students in Florida, 79% ate fewer than five servings of fruits and vegetables per day during a 7-day period; 88% drank fewer than three glasses of milk per day during a 7-day period; 39% participated in insufficient vigorous physical activity (vigorous physical activity for >20 minutes on at least 3 of 7 days); 78% participated in insufficient moderate physical activity (moderate physical activity for >30 minutes on at least 5 of 7 days); and 54% were not enrolled in physical education (22).

Schools can play a crucial role in improving the health of children. Because children generally attend school 5 days per week during 9 months of the school year, and schools in the United States are located in communities of every socioeconomic and racial/ethnic group, they provide ideal locales for interventions. Also, school-age children, particularly those from low-income backgrounds who participate in the US Department of Agriculture (USDA) National School Lunch Program (NSLP) and the School Breakfast Program, receive a substantial proportion of their daily nutrient requirements at school, often resulting in as much as 51% of daily energy intake (23).

Healthier Options for Public Schoolchildren (HOPS) was designed to pilot test a school-based obesity prevention intervention with nutrition and physical activity components, targeting a large, multiethnic population of 6- to 13-year-olds. The overall goal was to improve overall health status (body mass index [BMI] percentile and blood pressure) and academic achievement using strategies that can be replicated and integrated in other public school settings. The hypothesis was that the intervention would improve diastolic and systolic blood pressure and maintain healthy weight/BMI percentiles in intervention participants vs a control group.

METHODS

Study Design

The pilot quasi-experimental design study described here was implemented over 2 school years (2004-2005 and 2005-2006) and included 2,494 children (48% Hispanic) attending five elementary schools in Osceola County in central Florida. All schools had similar demographic and socioeconomic characteristics of the student body and were chosen from a sample of convenience. Schools were assigned to one of four intervention schools or one control school by district administration but were not randomized.

The Sterling Institutional Review Board, Atlanta, GA, approved the study. Letters were sent home to all parents at all schools. Parents signed their signature on review board–approved letters, on behalf of their minor children, if they did not want them to participate.

Intervention

HOPS included an integrated, replicable set of interventions: provision of nutritious ingredients and whole foods (acquired via existing public school food distribution networks implementing USDA NSLP) in breakfasts, lunches, and extended day snacks, which modeled nutrition education in the classrooms; the incorporation of a holistic curricula that taught children, parents, and school staff about good nutrition, healthful lifestyle management, and increased levels of physical activity; and the implementation of other school-based wellness activities such as fruit and vegetable gardens.

Dietary Component

The dietary intervention consisted of rigorous modifications to school-provided breakfasts, lunches, and extended-day snacks in all intervention schools. Menus were modified to include more high-fiber items, such as whole grains, fresh fruits, and vegetables; fewer items with high-glycemic effects, such as high-sugar cereals and processed flour bakery goods; and lower amounts of total, saturated, and *trans* fats, thus modeling the nutrition messages being shared in classrooms reflecting the core tenets of the Dietary Guidelines for Americans (24), and in compliance with USDA NSLP guidelines (25). Accordingly, the majority of changes to intervention menus resulted from the substitution of more healthful ingredients for less healthful ingredients, rather than an outright ban on "child-friendly" food items. For example, whole-grain flour–coated chicken patties were served instead of processed white-flour–coated patties; reduced-fat dairy products, including USDA Foods (also known as USDA Commodities), instead of whole-milk (higher fat) products. Menu modifications, created under the direction of a registered dietitian (RD), provided an especially important intervention whereby good eating practices being taught in the classrooms were modeled every day in school-provided meals. Study staff, including an RD, worked closely with the USDA Food and Nutrition Service, and school administration and cafeteria staff, to ensure intervention fidelity. Nutrition analyses of breakfast and lunch menus showed intervention menus, on average, contained approximately two times more fiber and 23% less fat than control menus (26-28).

Curricula Component

The curricula component consisted of a school-based holistic nutrition and healthful lifestyle management program for children and adults. The program included curricula and other school-based wellness projects to teach children, their parents, teachers, and staff about good nutrition and the benefits of daily physical activity. The primary goal was to improve the health and academic achievement of children in a replicable and sustainable manner. Replication and sustainability were assisted by incorporating USDA Team Nutrition materials, available to schools throughout the United States, as well as The OrganWise Guys (OWG) (29) materials that are used by many USDA County Extension Agents in the United States, many of whom are RDs who manage paraprofessionals conducting nutrition education in low-income schools every day.

The curricula included a thematic set of nutrition educational activities developed by HOPS staff (including an RD) in collaboration with elementary school education experts and USDA Food and Nutrition Service staff. Each month, a multimedia set of materials highlighting especially nutrient-dense foods and healthful lifestyle habits were sent to intervention schools, including Foods of the Month (FoM) posters, tips for FoM tastings, FoM parent newsletter inserts, FoM activity packets, healthful lifestyle handouts, school gardening instructions, and other materials aligned with special programming such as National Heart Health Month, National Nutrition Month, and National School Breakfast and Lunch Weeks. This curriculum now is disseminated by The OrganWise Guys, Inc (Duluth, GA).

In addition to the monthly educational programming just described, each intervention school received an OWG kit. The OWG curriculum brings together nutrition, physical activity, and other lifestyle behavior messages to help children understand the importance of making healthful lifestyle choices and motivate them to make these changes in their lives. In previous studies, OWG programming showed improvements in body mass index percentiles of OWG participants, as well as evidence that parents increasingly are engaged in their children's nutrition and healthful food choices (30). The OWG kit includes print (books and posters) and electronic media materials (videos and internet activities), as well as school assembly materials and a physical activity program (eg, OWG WISERCISE [29]).

Fruit and vegetable gardens at intervention schools provided a fun and creative component of the intervention. The goal of the garden component was to teach children how the nutritious fruits and vegetables served in their school cafeterias, their homes, and in restaurants are grown, cultivated, and harvested. Sustainability was assisted by USDA Master Gardeners, who are part of the Cooperative Extension in each county. Master Gardeners assist communities with gardening activities, including education about planting gardens, pest management, and general garden maintenance. Each Master Gardener must perform volunteer service hours to maintain Master Gardener Status, which provides an ongoing technical assistance resource for schools growing fruit and vegetable gardens.

Physical Activity Component

The physical activity component consisted of increased opportunities for physical activity during the school day in ways that were feasible within the constraints of testing mandates. In Florida, buy-in for allocating more time for physical activity was difficult until the governor mandated 150 minutes of physical activity, per week, for elementary schoolchildren, which was not passed until fall 2007. Thus, the amount and types of physical activity varied among intervention schools throughout the study. During Year 2, students were provided pedometers and OWG tracking books to track the number of steps they took each day. However, the pedometers broke easily, and students often lost them. Therefore, although a previous study showed the OWG pedometer program was useful in increasing daily physical activity of children participating in the program by approximately 1,000 more steps per day as compared to nonparticipants (31), the use of pedometers in the HOPS program was discontinued. Instead, schools were encouraged to implement daily physical activity in the classroom using a 10- to 15-minute deskside physical activity program (WISERCISE [29] and/or TAKE10! [32]) during regular teaching time. These deskside physical activities are matched with core academic areas such as spelling and math to encourage adoption of daily physical activity in addition to recess and physical education time. Schools also were asked to implement structured physical activity during recess time, as much as possible. Other physical activities, such as walking clubs, encouraged children and adults to walk before the start of each school day.

DATA ANALYSIS

Demographic information including date of birth, sex, grade, and race/ethnicity were collected by school study coordinators at baseline (fall 2004) and each fall and spring of the study years (2004-2006) for consistency and internal validity. Anthropometric data, collected at the same time as demographic data, included height (by stadiometer: Seca 214 Road Rod Portable Stadiometer, Seca North America East, Hanover, MD) and weight (by balance scale: LifeSource 321 Scale, A&D Medical, San Jose, CA), which were used to create an age and sex-specific BMI (calculated as kg/m^2) percentile. Participants removed their shoes, heavy outer clothing, and emptied their pockets before being measured by trained school study staff. BMI percentiles and weight measures were converted to z scores based on normative data for age and sex (33). Systolic blood pressure, diastolic blood pressure, and pulse were measured using Welch Allyn Spot Vital Signs (Welch Allyn Inc, Skaneateles, NY) automated measurement machines at the same time all other data were collected each fall and spring.

Procedures

Because the unit of analysis for this pilot study is a school, rather than individual-level data, cluster randomization was taken into account. With cluster randomization, the mean response under each experimental condition is subject to two sources of variation: cluster to cluster and across individuals within a cluster. Approaching the analytical plan from an individual-level only, rather than a cluster-level, would not take into account the between-cluster variation and can cause an inflation of type I errors where any intervention effect may become confounded with the natural cluster-to-cluster variability. Although this trial did not include a large number of schools to conduct a robust cluster analysis, a two-stage approach was incorporated as described below.

First Stage: Individual Level. In this first stage, all individual-level covariates to derive school-specific means that are adjusted for individual-level covariates were analyzed.

Second Stage: School Level. In the second stage, school-specific means and covariates adjusted for school site were analyzed to evaluate intervention effects. Univariate analysis consisted of simple frequency statistics for all demographic variables. We performed χ^2 analyses to test for associations between intervention condition and demographic characteristics. Repeated measures analysis tested for changes in trends over time (the 2-year study period or four points in time) in BMI percentile, weight, and blood pressure. P value was significant if <0.05. All tests were two-tailed. The Statistical Analysis Software (version 9.1.3, 2005, SAS Institute Inc, Cary, NC) and Statistical Package for the Social Sciences (version 15, 2006, SPSS Inc, Chicago, IL) were used in the analyses.

RESULTS

The study sample included 2,494 children. Almost one half (48%) of the study sample was Hispanic, 36% white, 8% African-American, and 8% other (multiethnic, Asian,

Table 1. Baseline ethnic distribution of Healthier Options for Public Schoolchildren study children by intervention condition (N=2,494)

Condition	White		African American		Hispanic		Other		Total No. of Children
	n	%	n	%	n	%	n	%	n
School 1 (Intervention)	79	25.82	19	6.21	181	59.15	27	8.82	306
School 2 (Intervention)	171	34.90	36	7.35	233	47.55	50	10.20	490
School 3 (Intervention)	250	40.92	31	5.07	298	48.77	32	5.24	611
School 4 (Intervention)	188	30.23	79	12.70	297	47.75	58	9.32	622
Totals for intervention schools	688	33.91	165	8.13	1009	49.73	167	8.23	2,029
School 5 (Control)	198	42.58	29	6.24	199	42.80	39	8.39	465
Totals	886	35.53	194	7.78	1208	48.44	206	8.26	2,494

American Indian). The average age was 8 years (range 6 to 13 years) and 51% were girls. Ethnicity by specific school site is described in Table 1. There were no significant differences by ethnicity or baseline BMI percentile between treatment arms.

Overall BMI z score and weight z score decreased significantly for girls in the intervention group compared to controls ($P<0.05$ and $P<0.01$, respectively) over the 2-year study period. Specifically, the girls in the intervention group decreased their mean BMI z score from 0.57 in fall 2004 to 0.54 in spring 2006, although there were no changes in girls in the control schools over the same time period (0.78 for both time points). With respect to weight z score, HOPS girls experienced statistically significant reductions. The mean weight z score for girls decreased from 0.56 in fall 2004 to 0.51 in spring 2006, whereas the mean weight z score for girls in the control schools decreased from 0.71 in fall 2004 to 0.68 over the same time period. No significant change was noted in BMI z scores among boys, but the mean BMI z score for boys in the intervention group decreased slightly over the 2-year study period from 0.73 to 0.72, whereas mean BMI z scores increased from 0.77 to 0.87 for the boys in the control schools over the same time period. This trend was also seen for weight z scores among boys (Table 2).

Among girls in the intervention schools, systolic blood pressure decreased from 100.07 mm Hg at baseline (fall 2004) to 98.3 mm Hg by fall 2005, and ended at 98.5 mm Hg in spring 2006 ($P=0.03$ for fall 2004 to fall 2005, not significant difference for overall difference). Girls in control schools saw a very slight rise in systolic blood pressure during the 2-year study period. There was a significant difference by treatment group in the change in systolic blood pressure for the first year of the study ($P<0.05$); the intervention group decreased whereas the control group increased systolic blood pressure (Table 2). There were no significant changes in systolic blood pressure noted for boys during the 2-year study period in the intervention vs control groups.

During the 2-year study period, repeated measures analysis showed a significant decrease in diastolic blood pressure in intervention group girls compared to those in the control group ($P<0.05$). Mean diastolic blood pressure decreased from 61.30 mm Hg to 59.55 mm Hg in intervention schools vs virtually no change in the control school (60.59 mm Hg and 60.63 mm Hg, respectively.) No significant changes in diastolic blood pressure by intervention or control schools were noted among boys (Table 2).

DISCUSSION

This longitudinal analysis of a school-based obesity prevention intervention among elementary school–aged children showed significant decreases in weight and blood pressure among girls during a 2-year study period among those in the intervention vs control schools. Although no significant differences were noted among boys, they trended in the same direction with improvements in weight and blood pressure in intervention vs control schools. This study shows that schools may be an effective environment in which to implement strategies to lower or modify weight and its associated health risks. This is particularly encouraging given that the majority of children in the United States attend school and, thus, intervention exposure can be maximized.

To date, evidence regarding efficacy of school-based obesity interventions for health promotion and weight control is limited (34). The Child and Adolescent Trial for Cardiovascular Health, a National Heart, Lung, and Blood Institute–sponsored multicenter, school-based intervention study promoting healthful eating, physical activity, and tobacco nonuse by elementary school students, is probably the most widely known school-based intervention program (1991-1994, with 3-year follow-up) (35). The primary physiologic goal was to reduce serum total cholesterol levels. Behavioral goals included reduction of dietary fat (total and saturated) and sodium intake, increased physical activity, and prevention of the onset of smoking. Overall, there were no statistically significant changes in body size/weight measures, blood pressure, or serum lipid levels in the intervention group compared with the control group (36,37), unlike our study that did find significant differences in blood pressure and weight. However, similar to other studies, different risk factor patterns for boys and girls were noted (36,37). Different results from previous studies in ethnic group differences were also noted. Specifically, the El Paso Child and Adolescent Trial for Cardiovascular Health study, which included four intervention and four control Title 1 (low-income) primarily Hispanic schools, reported slowing the increase in risk of overweight or overweight in intervention children compared to controls (38). But unlike our study, which also included schools with a predominant

Table 2. Change in blood pressure and weight by sex and intervention condition, Healthier Options for Public School Children study during fall 2004 through spring 2006

Measure	Sex	Intervention	Fall 2004	Spring 2005	Fall 2005	Spring 2006	*P* value Fall 04 vs spring 05	*P* value Fall 04 vs fall 05	*P* value Fall 04 vs spring 06	*P* value Fall 04 to spring 06
Body mass index (z score)	Boy	Intervention (4 schools)	0.73±1.20	0.65±1.22	0.78±1.09	0.72±1.13	0.09	0.87	0.88	0.86
		Control (1 school)	0.77±1.19	0.89±0.99	0.85±1.09	0.87±1.06				
	Girl	Intervention (4 schools)	0.57±1.19	0.51±1.17	0.63±1.10	0.54±1.12	0.0123*	0.0054*	0.0008*	0.0031*
		Control (1 school)	0.78±0.98	0.70±1.02	0.74±1.08	0.78±1.04				
Weight (z scores)	Boy	Intervention (4 schools)	0.74±1.14	0.72±1.13	0.68±1.14	0.68±1.13	0.88	0.52	0.57	0.59
		Control (1 school)	0.68±1.19	0.76±1.14	0.72±1.16	0.72±1.16				
	Girl	Intervention (4 schools)	0.56±1.13	0.55±1.11	0.53±1.11	0.51±1.10	0.07	0.0098*	0.0058*	0.011*
		Control (1 school)	0.71±1.03	0.68±1.11	0.65±1.13	0.68±1.12				
Systolic blood pressure	Boy	Intervention (4 schools)	101.20±9.76	100.85±10.00	100.51±10.50	100.27±10.89	0.55	0.67	0.38	0.3
		Control (1 school)	101.52±9.82	99.81±9.11	101.98±10.26	101.31±10.13				
	Girl	Intervention (4 schools)	100.07±10.42	99.22±10.57	98.26±10.06	98.47±10.49	0.46	0.0343*	0.14	0.15
		Control (1 school)	99.77±11.04	98.54±9.12	100.33±10.56	99.97±9.40				
Diastolic blood pressure	Boy	Intervention (4 schools)	60.99±6.55	59.78±6.24	60.33±6.53	60.00±6.95	0.32	0.76	0.31	0.79
		Control (1 school)	60.64±6.46	59.34±6.40	61.98±6.83	60.25±6.61				
	Girl	Intervention (4 schools)	61.30±6.58	59.76±6.40	59.96±6.54	59.55±6.51	0.21	0.0077*	0.25	0.0368*
		Control (1 school)	60.59±6.75	59.49±5.70	62.67±6.73	60.63±5.93				

*Significant difference at $P<0.05$.

Hispanic student body, the El Paso Child and Adolescent Trial for Cardiovascular Health study did not result in decreases in weight measures during the study period.

During a 2-year period, analyses of our study results showed significant decreases in both weight and diastolic blood pressure in girls in the intervention group vs controls. This may indicate that diastolic blood pressure is more correlated with weight than systolic blood pressure. Although similar trends in systolic blood pressure were noted, they were only significant for the first year among girls, and only modestly so. Conversely, previous research has shown a high correlation between systolic blood pressure and weight by measures of BMI and waist circumference (39-42).

Strengths

The strengths of this pilot study are the large sample size (~2,500 children), the diversity of the sample, the use of objective measures of health improvement (BMI z scores that appear to correlate well with blood pressure measurements), and multiple measures of the same group of children over an extended time period (2 years). Certainly, these pilot data argue for a large-scale, randomized, multicenter study similar to that presented here.

Limitations

Some limitations of this research are worth noting. First, HOPS was a school-based prevention intervention. As such, researchers could not control eating nor exercise outside of school. Similarly, there are concerns about lack of study control over eating and physical activity during extended periods of out-of-school time (holidays and summer vacation). Because children in this study appeared to increase their BMI z scores during summer break (43,44), consistent implementation of interventions was not possible. However, it is worth pointing out that despite these limitations regarding control of out-of-school eating and exercise, intervention children improved their overall weight and blood pressure measures during the 2-year intervention, particularly girls. Second, despite the use of simple-to-use blood pressure measurement equipment and training on measurement technique before each data collection period, the measurements were taken by study coordinators in nonclinical settings; thus, measurement may be susceptible to some errors. In addition, despite standardized approaches to measuring blood pressure four times during the 2 years, study findings are susceptible to error from measurement and from variation in blood pressure between measurement periods. However, the longitudinal nature of data collection and the large sample size have assisted in overcoming this limitation. Third, the study population was not selected at random, was of limited geographic variability (one school district), and only one school served as control. Last, although HOPS involved nutrition and healthful lifestyle curricula and physical activity components, the design did not include assessment of intervention exposures (eg, minutes curriculum used).

CONCLUSIONS

School-based obesity prevention interventions that include changes to school-provided meals, nutrition and healthful lifestyle education, and physical activity components show promise in improving health, particularly among elementary-school aged girls. School-based RDs are critical to ensuring successful prevention programming with respect to both dietary modification and nutrition curricula interventions. This pilot study suggests a correlation between weight/BMI percentile reduction and diastolic blood pressure improvements in children. If healthy weight and blood pressure can be maintained from an early age via prevention programs such as HOPS, children may be less likely to develop cardiovascular disease in early adulthood.

STATEMENT OF POTENTIAL CONFLICT OF INTEREST: No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT: All aspects of this research (design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript) were funded by the Agatston Research Foundation.

The authors thank David Ludwig, MD, PhD; Michelle Lombardo, DC, Karen McNamara, and The OrganWise Guys staff; Caitlin Heitz; colleagues at the US Department of Agriculture Food and Nutrition Service; study partners in Miami, FL (private schools); Osceola and St Johns Counties, FL; Harrison, MS; Batavia, IL; Evansville, IN; New Hanover, NC; Buffalo and Chenango, NY; and Brooke and Fayette Counties, WV, for their ongoing advice and help with the Healthier Options for Public School Children (HOPS) Study; generous donors to the Agatston Research Foundation; and the HOPS partners at The School District of Osceola County, FL, where interventions were conducted of which results are presented here. The authors also thank all the children who participated in the study.

References

1. *Preventing Childhood Obesity. Health in the Balance.* Washington, DC: National Academies Press; 2004.
2. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*. 2006;295:1549-1555.
3. New CDC study finds no increase in obesity among adults; but levels still high. Centers for Disease Control and Prevention Web site. http://www.cdc.gov/nchs/pressroom/07newsreleases/obesity.htm. November 28, 2007. Accessed November 9, 2008.
4. Ford ES, Chaoyang L. Defining the metabolic syndrome in children and adolescents: Will the real definition please stand up? *J Pediatr*. 2008;152:160-164.
5. Cook S, Auinger P, Li C, Ford ES. Metabolic syndrome rates in United States adolescents, from the National Health and Nutrition Examination Survey, 1999-2002. *J Pediatr*. 2008;152:165-170.
6. *The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)*. Bethesda, MD: National Institutes of Health; 2001. NIH Publication 01-3670.
7. Vanhala M, Vanhala P, Kumpusalo E, Halonen P, Takala J. Relation between obesity from childhood to adulthood and the metabolic syndrome: Population-based study. *BMJ*. 1998;317:319-320.
8. Guo SS, Roche AF, Chumlea WC, Gardner JD, Siervogel RM. The predictive value of childhood body mass index values for overweight at 35y. *Am J Clin Nutr*. 1994;59:810-819.
9. Wright RC, Whitaker JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337:859-873.
10. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: Findings from the third National Health and Nutrition Examination Survey. *JAMA*. 2002;287:356-369.
11. de Ferranti S, Ludwig DS. Storm over statins—The controversy surrounding pharmacologic treatment of children. *N Engl J Med*. 2008; 359:1309-1312.
12. Baker JL, Olsen LW, Sørensen TIA. Childhood body-mass index and the risk of coronary disease in adulthood. *N Engl J Med*. 2007;357: 2329-2337.
13. Ludwig DS. Childhood obesity—The shape of things to come. *N Engl J Med*. 2007;357:2325-2327.
14. Zametkin AJ, Zoon CK, Klein HW, Munson S. Psychiatric aspects of child and adolescent obesity: A review of the past 10 years. *J Am Acad Child Adolesc Psychiatry*. 2004;43:134-150.
15. Vila G, Zipper E, Dabbas M, Bertrand C, Robert JJ, Ricour C, Mouren-Simeoni MC. Mental disorders in obese children and adolescents. *Psychosom Med*. 2004;66:387-394.
16. Taras H, Potts-Datema W. Obesity and student performance at school. *J Sch Health*. 2005;75:291-295.
17. Mustillo S, Worthman C, Erkanli A, Keeler G, Angold A, Costello EJ. Obesity and psychiatric disorder: Developmental trajectories. *Pediatrics*. 2003;111(4 pt 1):851-859.
18. Ludwig DS, Gortmaker S. Programming obesity. *Lancet*. 2004;364: 226-227.
19. Kelder SH, Perry CL, Klepp KI, Lytle LL. Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *Am J Public Health*. 1994; 84:1121-1126.
20. Taras H, Duncan P, Luckenbill D, Robinson J, Wheeler L, Wooley S. Health, Mental Health and Safety Guidelines for Schools [Guideline 3-01]. http://www.nationalguidelines.org. Accessed August 5, 2008.
21. *Moving Into the Future: National Standards of Physical Education*. 2nd ed. Reston, VA: National Association for Sport and Physical Education; 2004.
22. Youth Risk Behavioral Surveillance—United States, 2003. *MMWR Morb Mortal Wkly Rep*. 2004;53(SS-2):1-97.
23. Briefel RR, Wilson A, Gleason PM. Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *J Am Diet Assoc*. 2009;109(suppl 1):S79-S90.
24. Dietary Guidelines for Americans 2005. http://www.health.gov/DietaryGuidelines/dga2005/document/default.htm. Accessed on July 14, 2009.
25. Code of Federal Regulations 7CFR210, Subchapter A-Child Nutrition Programs, Part 210-National School Lunch Program. http://www.fns.usda.gov/cnd/governance/regulations/7cfr210.pdf. Accessed on July 14, 2009.
26. Almon M, Gonzalez J, Agatston AS, Hollar TL, Hollar D. The HOPS Study: Dietary component and nutritional analyses. Presented at the Annual Nutrition Conference of the School Nutrition Association, July 17, 2006, Los Angeles, CA.
27. Almon M, Hollar D. The dietary intervention of the Healthier Options for Public Schoolchildren Study—A school-based holistic nutrition and healthy lifestyle management program for elementary-aged children. *J Am Diet Assoc*. 2006;106(suppl 2):A53.
28. Gonzalez J, Almon M, Agatston A, Hollar D. The continuation and expansion of dietary interventions of the Healthier Options for Public Schoolchildren Study—A school-based holistic nutrition and healthy lifestyle management program for elementary-aged children. *J Am Diet Assoc*. 2007;107(suppl 3):A76.
29. The OrganWise Guys Homepage. http://www.organwiseguys.com/. Accessed November 4, 2009.
30. Lombardo, M. The Delta H.O.P.E. Tri-State Initiative. Presented at the 2008 Annual Meeting of the American Public Health Association, October 29, 2008, San Diego, CA.
31. *Delta H.O.P.E. Tri-State Initiative. Final Report to the Mississippi Alliance for Self-Sufficiency for the period: August 2003 to June 2007*. Washington, DC: ILSI Research Foundation; 2007.
32. What is Take 10!? ILSI Research Foundation Web site. http://www.take10.net/whatistake10.asp. Accessed November 4, 2009.
33. Z Score Data Files. National Center for Health Statistics, National Health and Nutrition Examination Survey Web site. http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/zscore/zscore.htm Accessed November 7, 2008.
34. Katz DL. School-based interventions for health promotion and weight control: Not just waiting on the world to change. *Annu Rev Pub Health*. 2009;30:253-272.
35. Osganian LS, Webber SK, Feldman HA, Wu M, McKenzie TL, Nichaman M, Lytle LA, Edmundson E, Cutler J, Nader PR, Luepker RV. Cardiovascular risk factors among children after a 2 1/2-year intervention-The CATCH Study. *Prev Med*. 1996;25:432-441.
36. Luepker RV, Perry CL, McKinlay SM, Nader PR, Parcel GS, Stone

EJ, Webber LS, Elder JP, Feldman HA, Johnson CC. Outcomes of a field trial to improve children's dietary patterns and physical activity. The Child and Adolescent Trial for Cardiovascular Health (CATCH). *JAMA.* 1996;275:768-776.
37. Webber LS, Osganian SK, Feldman HA, Wu M, McKenzie TL, Nichaman M, Lytle LA, Edmundson E, Cutler J, Nader PR, Luepker RV. Cardiovascular risk factors among children after a 2 1/2-year intervention-The CATCH Study. *Prev Med.* 1996;25:432-441.
38. Coleman KJ, Tiller CL, Sanchez J, Heath EM, Sy O, Milliken G, Dzewaltowski DA. Prevention of the epidemic increase in child risk of overweight in low-income schools: The El Paso coordinated approach to child health. *Arch Ped Adolesc Med.* 2005;159:217-224.
39. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. *Pediatrics.* 2004;113:475-482.
40. Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, Allen K, Lopes M, Savoye M, Morrison J, Sherwin RS, Caprio S. Obesity and the metabolic syndrome in children and adolescents. *N Engl J Med*. 2004;350:2362-2374.
41. Paradis G, Lambert M, O'Loughlin J, Lavallee C, Aubin J, Delvin E, Levy E, Hanley JA. Blood pressure and adiposity in children and adolescents. *Circulation*. 2004;110:1832-1838.
42. Messiah SE, Arheart KL, Luke B, Lipshultz SE, Miller TL. Relationship between body mass index and metabolic syndrome risk factors among US 8- to 14-year-olds, 1999 to 2002. *J Pediatr*. 2008;153:215-221.
43. Hollar D, Hollar TL, Agatston AS. School-based early prevention interventions decrease body mass index percentiles during school year, but children experience increase in percentiles during summer. *Circulation*. 2007;116:843-844.
44. Hollar D, Messiah SE, Lopez-Mitnik G, Hollar TL, Agatston AS. The effect of summer vacation on weight and blood pressure in multiethnic elementary aged children participating in a school-based wellness and nutrition program. *J Am Diet Assoc*. 2008; 108(suppl 3):A12.