Supplementary Table 6. School-Based Approaches to Improving Diet and Physical Activity

Interventions Targeting Both Diet and Physical Activity

Author, y	Study Type	Population	Outcomes	Duration	Intervention/Exposure	Findings
Brown and Summerbell, 2009[225]	Systematic review of RCTs	RCTs evaluating school children, age kindergarten through 18 y, and published by September 2007	Effects of diet and physical activity interventions on BMI Only studies reporting a weight outcome were reviewed.	Interventions of at least 12 wk	Among 38 identified trials of school-based lifestyle interventions that focused on improving diet and/or physical activity behaviors to reduce BMI, 20 trials focused on both diet and physical activity.	Diet plus physical activity intervention vs control (20 trials): • Of 20 studies, 9 studies showed significant improvements in BMI *z* score. • In a 6-mo intervention in 5 Chilean primary schools, a program of active recess, parental involvement, health kiosks, and activities led to maintained BMI among boys in the intervention group, whereas boys in the control group had increased BMI. • In 10 US schools, the Planet Health program focused on dietary change plus reduction of sedentary behaviors, especially TV time, in 12-y-olds. 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 y. • In Crete, a Know Your Body program to improve cardiovascular health demonstrated long-term improvements in BMI and skin-fold measurements, including reduction in BMI of 0.7 kg/m^2 at 3 y ($P<0.001$), and 3.7 kg/m^2 at 6 y ($P<0.05$). • An intervention among 8-y-old children in the United States led to reduced weight gain at 2 y. The lowering of BMI *z* score by the intervention was seen in normal-weight (–0.29; 95% CI, –0.38, –0.21), not overweight (–0.02, 95% CI, –0.16, 0.12) children. • A 12-wk New York public school intervention in 14-y-olds to reduce diabetes risk showed improved BMI and percent body fat. • The Wellness, Academics and You (WAY) program in 9–11-y-olds showed a reduction in risk of becoming overweight in the children in the intervention group.
WHO, 2009[36]	Review of RCTs	School-age children	Diet and/or physical activity	Variable	Multiple school-based interventions reviewed from 107 peer-reviewed articles on 55 interventions, mostly from North America	• Effective interventions for diet and/or physical activity are comprehensive and multicomponent and include – Curriculum on diet and/or physical activity taught by trained teachers – Supportive school environment/policies – Parental/family component – Physical activity program – Healthy food options in school cafeterias, vending machines, etc • There is also evidence for moderate additional effectiveness of the following: – A focused approach with other supportive activities in the

						curriculum – A formative assessment that addresses the needs of the school and cultural contexts
Jiang et al, 2007[228]	Nonrandomized controlled trial	N=2425 children in 5 primary schools in Beijing, China	Prevalence of overweight and obesity	3 y (dates not reported)	Intervention schools: Nutrition education was aimed at both children and parents and included regular talks and printed materials on diet, physical activity, and sedentary behaviors. Overweight, obese, and nonfit children were also asked to run for 20 min per day after class, monitored by PE teachers. Control schools: no intervention	• After 3 y, prevalence of overweight and obesity decreased in intervention schools and increased in control schools. • Compared with controls, intervention schools had a lower prevalence of overweight (9.8 vs 14.4%; $P<0.01$) and obesity (7.9 vs 13.3%; $P<0.01$). • Dietary intake, physical activity, and other obesity-related behaviors were not assessed.
Hoelscher et al, 2010[232]	Nonrandomized controlled trial	30 low-income primary schools in central Texas, ≈60% Hispanic	Serial cross-sectional evaluations of ≈1000 4th grade students each year, including BMI, self-reported diet, and physical activity using the SPAN questionnaire	Spring 2007–spring 2008	CATCH BP (control): Multicomponent school intervention for diet and physical activity, including altering the school environment in the classroom, cafeteria, and PE curriculum, with additional family/home components CATCH BP + Community: The above plus additional intensive community involvement based on principles of community-based participatory research	Comparison of CATCH BP + Community with CATCH BP alone: • Diet: Percentage of students eating breakfast increased and consumption of unhealthy foods decreased ($P<0.05$ each); a trend toward greater consumption of fruits and vegetables was also seen ($P=0.07$). • Physical activity: No significant differences were seen. • Sedentary activity: less time at the computer ($P=0.003$) and trends toward less time watching TV ($P=0.10$). • Prevalence of overweight/obesity decreased by 1.3 percentage points in CATCH BP schools vs 8.3 percentage points in CATCH BP + Community schools ($P=0.05$). Similar declines were seen in boys, girls, Hispanics, and non-Hispanics.
Marcus et al, 2009[229]	RCT	N=3135 children, grades 1-4, in 10 schools in	• Physical activity assessed by accelerometer • BMI *z* score • Prevalence of	4 school years, August 2001–June 2005	Intervention schools: STOPP—Vegetables, low-fat dairy products, and whole grains were	• At baseline, the prevalence of overweight plus obesity was higher in intervention vs control schools (20.3% vs 16.1%). Prevalence decreased in intervention schools (to 17.1%) and increased in control schools (to 18.9%) ($P<0.05$ for comparison of changes). • Differences in changes in mean BMI *z* scores were not

		Stockholm, Sweden	overweight and obesity		introduced and promoted; sweets and sweetened drinks were eliminated. Physical activity was increased by 30 min per day during school; sedentary behavior during afterschool programs was reduced.	significant. • There was a nonsignificant trend toward higher physical activity assessed by accelerometer in intervention vs control schools (P=0.10). • Eating habits at home were healthier in intervention vs control schools.
Hollar et al, 2010[227]	Nonrandomized controlled trial	N=2494 children age 6-13 y in 5 elementary schools in Osceola County, central Florida	• Systolic and diastolic BP • BMI percentiles and weight	August 2004–June 2006	Multicomponent: 4 nonrandomly selected intervention schools (N=2029 students) received a multicomponent intervention including 10–15-min physical activity breaks during academic lessons, changes in school meals to meet US Dietary Guidelines for Americans, and changes in school curriculum to teach children, parents, and teachers about good nutrition and the benefits of physical activity. Control schools: no intervention	After 2 academic years: • Systolic BP was lower than baseline in intervention schools (≈1 mm Hg lower in boys and ≈1.5 mm Hg lower in girls), whereas no changes were seen in control schools, but these differences were not statistically significant (P=0.30 for boys, P=0.15 for girls). • Changes in diastolic BP were also not different in boys (P=0.79). • Girls in the intervention schools had a significant decline in diastolic BP (≈1.8 mm Hg lower) compared with controls (P=0.04). • Comparing intervention vs control schools, BMI z scores and weight z scores decreased significantly for girls (–0.03 vs 0.0, P=0.003 and –0.05 vs –0.03, P=0.01, respectively) but not for boys (P=0.86 and P=0.59).
Foster et al, 2010[230] Jago et al, 2011[231]	RCT	N=4603 students in 42 US middle schools at 7 US sites, with schools having at least 50% of children	BMI, waist circumference, fasting glucose, fasting insulin Metabolic syndrome risk factors, fitness assessed by 20-m shuttle run, and self-reported	Fall 2006 (start of 6th grade) –spring 2009 (end of 8th grade)	"HEALTHY" schools: Multicomponent intervention targeting diet, physical activity, and behavioral knowledge/skills. Changes were made in quantity and quality of foods and drinks in cafeterias,	Comparison of intervention vs control schools at the end of follow-up: • Declines in prevalence of overweight and obesity in both groups of ≈4 percentage points (OR=0.99; 95% CI, 0.82, 1.19, P=0.92) • Greater declines in BMI z score (–0.05 vs –0.01, P=0.04) and waist circumference >90th percentile (–8.1 vs –5.9%, P=0.04 • Smaller increases in fasting insulin (+3.8 vs 4.0, P=0.04) • No significant difference in fasting glucose • No significant differences in prevalence of metabolic syndrome, although low numbers (only 5% at baseline) • No significant differences in objective fitness or self-reported

		eligible for federally subsidized meals or at least 50% black or Hispanic	moderate to vigorous physical activity		vending machines, a la carte options, snack bars, school stores, fundraisers, and classroom parties. PE curriculum was revised to increase time in moderate to vigorous physical activity. Education included self-monitoring and goal setting, plus peer involvement, communication strategies, and social marketing. Control schools: no intervention	moderate to vigorous physical activity
Rosenkranz et al, 2010[226]	RCT	N=76 girls age 9-13 y in Girl Scout troops Intervention (N=3 troops, 34 girls) Standard care control: (N=4 troops, 42 girls) (Included due to similarity of this troop-based approach to school-based approaches)	• BMI *z* score • Physical activity assessed by accelerometry • Self-reported intake of fruits and vegetables and sugar-sweetened beverages, physical activity • Parental survey of intake of fruits and vegetables and sugar-sweetened beverages, family meals, physical activity, and BMI of parent, frequency of eating while	October 2007–November 2008	Intervention: Social cognitive theory interactive health curriculum during troop meetings, led by briefly trained (2 h) troop leaders, targeting behaviors (frequent family meals, parent/child physical activity, no TV during meals, water over sugar-sweetened beverages, adding fruits and vegetables to meals, manners, and preparation/clean-up of family meals), goal setting, activity (dancing, yoga, etc), snack/recipe preparation, role-playing, and take-home projects	• Most effects were not significantly different from the control troops, including child BMI *z* score, parent BMI, and most behavioral variables. • However, girls in the intervention troops did accumulate less sedentary activity (P=0.01), more moderate physical activity (P=0.004), and more moderate to vigorous physical activity (P<0.001) as assessed by accelerometry.

			watching TV, family cohesion, and parenting style			
Interventions Targeting Diet						
Author, y	**Study Type**	**Population**	**Outcomes**	**Duration**	**Intervention/Exposure**	**Findings**
Robinson-O'Brien et al, 2009[233]	Review of RCTs and quasi-experimental studies of garden-based interventions	Children age 5-15 y	Consumption of fruits and vegetables, preferences for fruits and vegetables, and willingness to try fruits and vegetables	Variable	Garden interventions: 11 studies of garden-based educational programs (N=5 on school grounds, N=3 after school, N=3 community) Half of the studies included formal control groups; half used pre/post tests. Assessment methods included 24-h diet recalls, workbooks, surveys, interviews, and focus groups.	Garden-based nutrition education programs led to • In 3 of 4 studies, increased intake of fruit and vegetable intake • In 2 of 6 studies, increased preferences for fruits and vegetables • In 2 of 3 studies, increased willingness to taste fruits and vegetables (eg, spinach, carrots, peas, and broccoli in kindergarteners and 1st graders). • In 4 of 6 studies, increased nutrition knowledge, such as ability to identify food groups or recognize the health benefits of fruits and vegetables.
Parmer et al, 2009[234]	RCT	N=115 in 6 2nd grade classes, 3 groups, age 7-8 y	• 16-question survey on fruits and vegetables with nutrient-food matching and nutrient-job matching • Fruits and vegetables preference questionnaire with identification of fruits and vegetables and willingness to taste fruits and vegetables • Lunchroom observation: pre-/postintervention	28 wk	School-based garden: NE+G: 1 h of nutrition education every other week; 1 h of gardening classes in the alternate weeks, including planting carrots, broccoli, spinach, and cabbage and watering, weeding, and managing pests (with adult supervision). Students then prepared a "Party Confetti Salad" from the produce they had grown. NE only: 1 h nutrition	• Knowledge (food matching, nutrient matching, identification of fruits and vegetables) increased in both intervention groups compared with control ($P<0.001$). Gains were ≈20% greater in the NE+G vs NE group but not statistically significant. • Both intervention groups were more willing to try fruits and vegetables and also rated fruits and vegetables as better tasting ($P<0.001$). Gains were ≈50% greater in the NE+G vs NE group but not statistically significant. • The NE+G group was more willing to choose vegetables at lunch than the control group was ($P<0.01$). The NE group was also more willing, but the effect was about half as large and not statistically significant. • The NE+G group ate more vegetables overall than the control group did. The NE group had no significant change.

					education every other week Control: no treatment	
Somerset and Markwell, 2009[235]	Quasi-experimental study (historical control)	Intervention in 4th to 7th graders, age 8-13 y: 4th (N=25), 5th (N=21), 6th (N=34), and 7th (N=40) Historical controls: 4th (N=30), 5th (N=37), 6th (N=38), and 7th (N=22)	• Identification of fruits and vegetables survey using 3-point Likert scale • 38 questions • 1st: given 1 mo before intervention • 2nd: given in subsequent autumn	12 mo (2 data years)	School-based garden: • Part used as an outdoor classroom • Garden-based teacher hired to incorporate garden activities into curriculum. • Children had classes on composting, propagation, planting, harvesting, and cooking. • Weekly garden activities were also planned.	• Children developed a greater ability to identify fruits and vegetables, had enhanced confidence in preparation of fruits and vegetables, and had changes in perceived consumption. • Preference for whether vegetables taste good increased in 4th graders from 36% to 74%, in 5th graders from 64% to 68%, and in 6th graders from 30% to 42%. In 7th graders, preference decreased from 36% to 31%. • The proportion of children saying they liked to eat vegetables every day increased in 4th graders from 33% to 50%; in 5th graders from 47% to 65%; and in 6th graders from 26% to 35%. In 7th graders, the proportion decreased from 23% to 18%. • There was an increase in children saying yes when asked if their friends were eating "lots of vegetables": in 5th graders from 24% to 70%, 6th graders from 11% to 32%, and 7th graders from 19% to 23%. (Results in 4th graders not reported.)
Day et al, 2009[240]	RCT (pilot)	Intervention schools (5): N=246 Control schools (5): N=198 Age: 4th and 5th graders	• KAP survey • 24-h recall • FFQ • Food Choices Scale for Children • Teacher-recorded logs	12 wk	Action Schools! • School received classroom activities/menu for implementation • 1.5 h of training • Each teacher received (Canada) $12.50 per month for fruit and vegetable tasting activities	• Servings of fruits increased at intervention schools ($P<0.05$). • There were no effects on willingness to try new fruits and vegetables. • Percentage of fruits and vegetables tried increased from 78% to 83% in intervention schools.
Davis et al, 2009[237]	RCT	Intervention school (1): N=4800 Control school (1): N=3500 Age: high school, grades 9-12	Anonymous postintervention surveys that assessed intake of fruits and vegetables and demographics, including N=2080 intervention and N=1610 control students	Spring 2006, fall and spring 2006-2007	Fresh Fruit and Vegetable Program: During the 2006-2007 school year, baskets of fresh fruits (apples, oranges, pears, plums, pineapple, and kiwi) and vegetables (carrots and celery with low-fat ranch	• Only 1 in 5 students from both the intervention and control schools consumed >5 servings per day of fruits, fruit juices, or vegetables. • More intervention students consumed fruit/100% fruit juice at least twice a day (39.3% vs 27.3%; $P<0.05$). • More intervention students consumed a total of 5+ fruit juices/vegetables per day (22% vs 18.4%; $P<0.05$) and 1+ fruits day (59.1% vs 40.9%; $P<0.05$). • There were no differences in eating vegetables.

			Restricted to those with demographic info (N=1515 and N=1377)		dip) were given to each homeroom (N=180). Students could select fruits and vegetables from the baskets, and teachers were encouraged to discuss fruits and vegetables in class.	
Coyle et al, 2009[239]	Quasi-experimental (pre- vs postintervention)	N=725, including N=207 with 24-h diet recalls, from a sample of kindergarten through 12th grade students from 5 schools in Mississippi	• Attitudes toward, familiarity, and preferences for fruits and vegetables • Consumption of fruits and vegetables	Pre- vs postintervention during the 2004-2005 school year	Fresh Fruit and Vegetable Program**:** **A** federally funded initiative provided free fresh fruit and vegetable snacks to students. During the 2004-2005 school year, the Mississippi Department of Education Child Nutrition Programs initiated a pilot program to distribute free fruits and vegetables to students in kindergarten through 12th grade during the school day.	• Results showed greater familiarity with fruits and vegetables at all grade levels ($P<0.05$) • Increased preferences for fruit were observed among 8th and 10th grade students ($P<0.01$). • 8th graders also reported more positive attitudes toward eating fruits and vegetables ($P<0.01$), increased perceived self-efficacy to eat more fruit ($P<0.01$), and increased willingness to try new fruit. • Student consumption of fruit in school and overall increased significantly, by 0.34 and 0.61 servings per day, respectively ($P<0.01$). • In-school vegetable intake decreased ($P=0.05$), whereas overall vegetable consumption did not change.
Brown and Summerbell, 2009[225]	Systematic review of RCTs	RCTs evaluating school children, age kindergarten through 18 y, and published by September 2007	Effects of diet and physical activity interventions on BMI Only studies reporting a weight outcome were reviewed.	Interventions of at least 12 wk	Diet policy interventions and adiposity: Among 38 identified trials of school-based lifestyle interventions that focused on improving diet and/or physical activity behaviors to reduce BMI, 3 trials focused on diet alone.	Diet intervention vs control (3 trials): • Of 3 trials, 2 trials showed improvements in BMI *z* score. • 2 UK schools (11-y-olds) tested a low-intensity 12-mo intervention to reduce intake of sugar-sweetened beverages. At 12 mo, the percentage of overweight/obese increased in the control group and was unchanged in the intervention group (mean absolute difference 7.7%; 95% CI, 2.2%, 13.1%). At 3 y, prevalence of overweight had increased in both groups, and between-group differences were no longer significant. • A school in Norway (15-y-olds) evaluated whether dietary habits/school performance improved when participants ate breakfast. At 4 mo, BMI increased in the control group but not in the intervention group in both boys and girls ($P<0.05$). • A school in Italy (12-y-olds) tested the efficacy of board games in providing nutrition knowledge/promoting healthy dietary behavior. There was no effect on BMI *z* score at 24 wk.
Foster et	RCT	N=1349	Primary:	2 y	Diet policy	• Significantly fewer children in the intervention schools (7.5%)

al, 2008[238]		students in grades 4-6 from 10 schools (5 intervention, 5 control) in a US city in the Mid-Atlantic region with at least 50% of students eligible for free or reduced-price meals	Incidences of overweight and obesity Secondary: Prevalence and remission of overweight and obesity; BMI *z* score; intake of total energy, fat, and fruits and vegetables; body dissatisfaction; hours of activity and inactivity		interventions and adiposity: Schools were matched on school size and type of food service and randomly assigned to intervention or control groups. The School Nutrition Policy Initiative included the following components: school self-assessment, nutrition education, nutrition policy, social marketing, and parent outreach.	than in the control schools (14.9%) became overweight after 2 y, a 50% reduction. • Prevalence of overweight was also lower in the intervention schools. • No differences were observed in incidence or prevalence of obesity or in remission of overweight or obesity at 2 y.
Muckelbauer et al, 2009[241]	RCT	N=2950 2nd and 3rd graders from 32 elementary schools (17 intervention, 15 control) in socially deprived areas of Dortmund and Essen, 2 neighboring cities in Germany	• Daily water consumption • Risk of overweight	1 y, August 2006–June 2007	School water Randomization was performed at the city level. Intervention included installation of 1-2 water fountains in schools, providing children with reusable water bottles, and teachers encouraging use of the water bottles. Other components were education (4 45-min classroom lessons regarding water needs of the body and the water circuit in nature) and goal setting (at 3 mo, teachers introduced a motivation unit that used a goal-setting strategy for a sustained increase in water consumption,	At the end of 1-y follow-up: • Daily water consumption was 1.1 glasses (200 mL) greater in the intervention group. • Compared with the control group, the odds of overweight were 31% lower in the intervention group (P=0.04).

					including quantitative targets and feedback). Control schools: no intervention	
Patel et al, 2011[242]	Nonrandomized intervention study (pilot)	1 intervention and 1 comparison middle school in lower-income areas of Los Angeles, California	Daily water consumption at school, based on surveys of 7th grade students (N=793) and recordings of water used in cafeterias	5 wk, with assessment at 2 mo, in 2008	School water: In the intervention school, cold filtered drinking water was provided in 19-L dispensers in the cafeteria, reusable water bottles were distributed to students and staff, and education activities promoted drinking water. The comparison school received no intervention.	At 2 months postintervention, adjusting for sociodemographic characteristics and baseline intake of water at school: • The proportion of children drinking any water at school (adjusted OR=1.76), drinking from fountains (OR=1.45), or drinking from reusable water bottles (OR=1.99) was higher in the intervention school than in the comparison school (P<0.01 for each). • No statistically significant differences were seen in consumption of other beverages, including sodas, sports drinks, or 100% juice.
Loughridge and Barratt, 2005[243]	Nonrandomized intervention study (pilot)	3 secondary schools in North Tyneside, United Kingdom	Average water consumption at school	3 mo	School water: Intervention schools received either cooled filter water plus active promotion or water alone. The control school received no intervention.	At the end of the 3-mo follow-up: • The average volume of water drunk by students in the water plus promotion school was greater (P=0.05) than in the water-alone or control schools. • The volume of soft drinks purchased by students in all 3 schools before and during the intervention did not significantly change.
Interventions Targeting Physical Activity						
Author, y	**Study Type**	**Population**	**Outcomes**	**Duration**	**Intervention/Exposure**	**Findings**
Willenberg et al, 2010[249]	Observational, cross-sectional	23 schools, N=3006 children 12 focus groups, N=91, to identify children's ideas about what's fun and healthy	• SOPLAY scans • Focus groups: concept map, group discussion, drawing, photographic ordering	October 2004–December 2005 Focus groups in 2005-2006	School equipment: Availability and types of playground equipment at schools	• 44% of children engaged in sedentary behavior, 30% in MPA, and 27% in VPA. • MPA was higher in schools with fixed equipment, eg, slides, monkey bars (35% vs 20%; P<0.001) • MPA was greater where the blacktop was marked with court markings/goals (34% vs 20%; P<0.001); play line markings were also higher (25% vs 20%; P=0.04). • VPA was higher when loose equipment (33% vs 20%; P<0.001) and supervision (29% vs 22%; P<0.001) were available. • In focus groups, children expressed concern about blacktop surfaces due to fear of injuries and falls. • Children had an overriding preference for metal surfaces to

		Age: 9-11 y				wooden ones because they thought they were better for safe play and "attractive and fun" and thought that colored surface markings were better for playing. • Children often were quick to point out that adults shouldn't assume that older kids don't want to play on fixed play equipment and also stated that as the school year went on, less loose equipment was available for play.
Nielsen et al, 2010[250]	Observational, cross-sectional	7 schools, N=417 children age 5-12 y, participating in the APPLE study	Physical activity measured by Actical accelerometer worn at the hip for 2-5 d, put on in the morning and taken off at bedtime	September –November 2004	School equipment: number of permanent play facilities in schools, such as swings, playground markings (eg, hopscotch), courts, sandpits, slides, tower forts, and monkey bars	• The number of play facilities in schools ranged from 14 to 35 and was positively associated with both total physical activity and time engaged in MPA/VPA. • For each additional play facility, average accelerometry counts were 3.8% higher at school (P<0.001) and 2.7% higher overall (P<0.001). • Each additional facility was also associated with 2.3% (P=0.001) or 4 min more vigorous activity during school hours and 3.4% (P<0.0001) or 9 min more MPA/VPA over the day. • Higher activity at school wasn't compensated for by decreased activity later. • For each additional 5 play facilities, overall activity increased by 15%-20%. • The effects of play facilities were seen in both sexes and all ages.
Ridgers et al, 2010[251]	RCT	15 UK intervention schools (N=256, 130 boys, 126 girls) 11 UK control schools (N=214, 102 boys, 112 girls) Age: elementary school	• Physical activity: heart rate telemetry/accelerometry • All wore a heart rate monitor. • 300 wore an accelerometer during points of measure. • BMI • Recess duration: all had morning and lunch recess, and 11 also had recess in the afternoon.	12 mo	School equipment: • Intervention schools each received £20,000 (≈$31,174 US) to change the playground environment funded by the Department for Education and Skills as part of a national sporting playground initiative. • Changes included the addition of playground markings (sports area, multiactivity area, quiet play area); physical structures, such as	• During lunch recess, VPA was 1.4% greater in intervention schools compared with control schools (P<0.05). • Playground markings/structures increased the proportion of morning recess heart rate spent in MPA (from baseline 0.2±0.1% to 3.1±3.1%) and VPA (from baseline 0.2±0.1% to 3.6±2.1%) (P<0.05 each). • There were similar positive effects on lunch recess heart rate for both MPA (from baseline 0.2± 0.01% to 3.0± 2.1%) and VPA (from baseline 0.2± 0.1% to 0.9± 1.3%). • Effects were stronger at 6 mo postintervention than at 12 mo. • As age increased, physical activity during morning and lunch recess decreased.

					soccer goal posts, basketball hoops, fencing, seating; and greater supervision.	
Brown and Summerbell, 2009 [225]	Systematic review of RCTs	RCTs evaluating school children, age kindergarten through 18 y	Effects of diet and physical activity interventions on BMI Only studies reporting a weight outcome were reviewed.	Interventions of at least 12 wk	Among 38 identified RCTs of school-based lifestyle interventions that focused on improving diet and/or physical activity behaviors to reduce BMI, 15 RCTs focused on physical activity alone.	Physical activity intervention vs control (15 trials): • 5 of 15 trials showed improvements in BMI *z* score. • 1 trial showed that 2 h per week of extra PE class improved BMI at 6 mo but not over longer periods. • 1 trial showed that a 12-wk, 150 min per week aerobic dance class reduced BMI (–0.8 kg/m^2). • 10 of 15 trials showed no improvement (eg, 6-mo intervention promoting supportive school, 12-wk intervention encouraging walking in girls, 4-mo intervention promoting additional PE classes, 12-wk intervention with individual counseling from a school nurse; 66-session aerobic/dance/gymnastics program).
Harris et al, 2009[259]	Systematic review and meta-analysis of RCTs	RCTs of school-based interventions with objective data on change in BMI, published through September 2008	Effect of school-based physical activity interventions on change in BMI in children	School-based interventions of at least 6 mo	• 18 RCTs involving 18,141 children, primarily in elementary school • Duration of studies ranged from 6 mo to 3 y. In 15 of 18 studies, there was some type of cointervention.	Physical activity intervention vs control (18 trials): • In overall pooled meta-analysis, physical activity interventions did not improve BMI compared with controls: weighted mean difference: –0.05 kg/m^2; 95% CI, –0.19, 0.10. • Similarly, no consistent changes were seen in other measures of body composition. Outcome measures reported included percentage of body fat, waist circumference, waist-to-hip ratio, triceps skin-fold thickness, subscapular skin-fold thickness, total lean mass, total fat mass, and skin-fold sum. Among 10 studies evaluating 18 such measures, only 3 of the 18 measures found significant improvement with physical activity intervention,1 demonstrated deterioration with physical activity intervention, and 14 did not show any significant change. • Only 5 trials evaluated objective measures of physical activity. Three studies used SOFIT and found more physical activity in the intervention group; 2 studies used accelerometers and found no difference in physical activity in intervention vs control groups.
Jago et al, 2009[260]	Quasi-experimental pilot study (pre- vs postintervention)	• Pilot study for the STOPP-T2D 2003 study: 6 US schools (N=585) • 2004	Monitored heart rate as a measure of MVPA	2003-2004	2003 activity study: • School received $10,000 for equipment • Specialist PE teacher provided • 56 instruction cards designed for lesson plans to result in high levels of	2003: • Mean heart rate during PE ranged from 143 to 150 bpm. The percentage of class time with heart rate >130-140 bpm ranged from 66% to 76%, equivalent to ≈16 min of physical activity during a 45-min class. • For each day of the intervention, there was an increase of 0.2 bpm (P<0.0001) in mean heart rate during PE. An increase was also seen in the percentage of time spent in activities producing a heart rate >130 bpm (P<0.0001) and >140 bpm (P<0.0001) of about 0.3% per day for both.

		study: 7 US schools (N=1544) • Age: 6th graders			MVPA 2004 curriculum study • School received $10,000 worth of equipment • 5 units: basketball, Frisbee, jump rope, soccer, team ball; 8-12 lesson plans • Master PE teacher and TA provided	2004: • The percentage of class time with heart rate >130 bpm increased from 63% in week 3 to 72% in week 8, and with heart rate >140 bpm, from 49% in week 3 to 58% in week 8.
Kriemler et al, 2010[257]	RCT	N=502 students in 28 1st and 5th grade elementary school classrooms from 15 schools in Switzerland	• Body fat (sum of 4 skin folds) • Aerobic fitness (shuttle run test) • Physical activity (accelerometry on weekdays) • Quality of life • BMI, metabolic risk (average *z* scores of waist circumference, BP, blood glucose, inverted HDL cholesterol, and triglycerides)	1 academic year (August 2005–June 2006)	Multicomponent PE+activity • Participants in both groups received 3 45-min PE classes per week. • The intervention group (16 classrooms) also received structuring of the 3 existing PE classes; 2 additional 45-min PE classes per week; daily short activity breaks (3-5 per day during academic lessons, lasting 2-5 min each); and daily physical activity homework.	After adjustment for grade, sex, baseline values, and clustering within classes: • Children in the intervention classrooms showed a greater decrease in skin-fold thickness *z* score (–0.12; 95% CI, –0.21, –0.03; *P*=0.009), increase in shuttle run *z* score (+0.17; 95% CI, 0.01, 0.32; *P*=0.04), and total daily MPA/VPA *z* score (+0.44; 95% CI, 0.05, 0.82; *P*=0.03), with the latter due to increased activity during school hours (+1.19; 95% CI, 0.78, 1.60; *P*<0.001). • The intervention also reduced BMI *z* score (–0.12; 95% CI, –0.19, –0.04; *P*<0.003) and cardiovascular risk *z* score (–0.18; 95% CI, –0.29, –0.06; *P*<0.003). • No significant differences were seen in *z* scores for overall daily physical activity (0.21; –0.21 to 0.63), physical quality of life (0.42; –1.23 to 2.06), or psychological quality of life (0.59; –0.85 to 2.03).
Jansen et al, 2011[261]	RCT	N=2622 children in grades 3-8 (age 6-12 y) in 20 schools in multiethnic, low-income areas in Rotterdam, Netherlands	• BMI • Waist circumference • Fitness assessed by 20-m shuttle run	1 school year	Multicomponent PE+activity: • "Lekker Fit" schools: 3 PE sessions per week by trained teacher, additional sport/play outside school hours, physical activity education • Control schools: no intervention.	Comparing intervention with control schools after 1 y: • No significant differences overall in grades 6-8 • In grades 3-5 only: – Lower prevalence of overweight (OR=0.53; 95% CI, 0.36, 0.78) – Lower waist circumference (–1.29 cm; 95% CI, –2.16, –0.42) – Greater fitness (+0.57 laps; 95% CI, 0.13, 1.01)

Jurg et al, 2006[258]	Nonrandomized controlled trial	N=510 students, grades 4-6, in 4 intervention and 2 control schools in Amsterdam, Netherlands	• Physical activity assessed with a questionnaire	August 2002–June 2003	Multicomponent, including activity breaks • JUMP-in program: Schools received an intervention including accessible school exercise activities around or within the school, structured PE by school teachers with a goal of 60+ min of MPA per day, regular breaks during usual lessons for physical activity, relaxation, and posture exercises, and parental support. • Control schools: no intervention	• After multilevel analysis and adjustment for baseline physical habits and activities, pupils in the intervention schools were more likely to meet the guidelines (at least 60 min of MPA daily): OR 1.63; 95% CI, 1.02, 2.61. • This difference was only significant among 6th grade students (OR 4.33; 95% CI, 1.82, 10.32), not 4th grade (OR 0.84; 95%CI, 0.34, 2.09) or 5th grade (OR 1.16; 95% CI, 0.48, 2.79) students.
Stewart et al, 2004[252]	Intervention study but without control or pre- vs postintervention comparison	N=71 students in a nonrandomized sample from 3 classrooms (grades 1, 3, 5) in a school in Georgia; of the students, 88% were black, 7% Hispanic, and 5% white	• Exercise intensity in METs, estimated from step counts measured using accelerometer parameters • Calculated energy expenditure	Spring 2001	Activity breaks • A 10-min classroom-based physical activity program implemented by teachers at least once a day in the intervention school (TAKE10!) • No control	• During the program, exercise intensity ranged from 6.2 to 6.4 METs across all grades during activity and in the moderate to vigorous range of energy expenditure during all sessions. • Average energy expenditure ranged from 25 to 37 kcal during each session and increased with grade. • Change in exercise intensity or expenditure before or after the program was not assessed.
Mahar et al, 2006[253]	RCT	N=243 students in 15 classes from	• Daily steps during school hours, measured by a pedometer	12-wk period from August–	Activity breaks • Intervention classes (N=135 students) received a 10-min	• Students in the intervention classes took more daily steps in school than those in the control classes (5587 vs 4805, +782; effect size=0.49; $P<0.05$).

		kindergarten through 4th grade in a public school in North Carolina		November (year not stated)	classroom-based physical activity program implemented by teachers. • Control classes (N=108 students): no intervention	
Liu et al, 2008[254]	Nonrandomized controlled trial	N=753 boys and girls age 6-12 y from 2 elementary schools in Beijing, China	• Duration of total physical activity per day assessed by validated 7-d questionnaire • Average energy expenditure per day calculated from activity questionnaire • BMI	October 2004–June 2005	Activity breaks • Intervention school: a 10-min classroom-based physical activity program implemented by teachers at least once per day (Happy 10 program) • Control school: no intervention	• Duration of total physical activity increased from 2.8 to 3.3 h per day in the intervention school but decreased from 4.4 to 2.9 h per day in the control school (P<0.05 for comparison of change). • Average energy expenditure increased from 15.0 to 18.2 kcal/kg in the intervention school but decreased from 24.3 to 14.7 kcal in the control school (P<0.05 for comparison of change). • Among boys, BMI increased similarly in both intervention (18.1-19.0 kg/m^2) and control (18.0-18.7 kg/m^2) schools (P=NS for comparison of change). • Among girls, BMI decreased in the intervention (18.6-18.2 kg/m^2) but increased in the control (16.4-17.1 kg/m^2) school (P<0.05 for comparison of change).
Donnelly et al, 2009[255]	RCT	N=1527 students, grades 2-3, in 24 schools in Northern Kansas	• BMI (primary) • Daily physical activity assessed in a subset using accelerometers	2003-2006	Activity breaks • Physical Activity Across the Curriculum: 14 intervention schools received a 90 min per week MVPA lesson delivered intermittently in the school day in addition to 60 min per week of PE. • 10 control schools received 60 min per week of PE.	• There was no significant change in BMI or BMI percentile between the intervention and control schools. End BMI: 19.9 vs 20.0; change in BMI: 2.0±1.9 vs 2.0±1.9, P=0.83. • Intervention schools had higher mean accelerometer counts (851 vs 744 over 4 d, P=0.007) due to greater activity during both school hours and on weekends and more time spent in MVPA (98 vs 72 min over 4 d, P=0.001) • In post hoc observational analyses, intervention schools complying with 75+ min per week of intervention (N=9) had a smaller increase in BMI than intervention schools with <75 min per week of intervention (N=5). Change in BMI: 1.8±1.8 vs 2.4±2.0, P=0.02. • The significance of change in BMI in compliant intervention schools (1.8±1.8) vs control schools (2.0±1.9) was not reported but did not appear to be statistically significant.
Katz et al, 2010[256]	RCT	N=1214 students grades 2-4 at 5 schools in Missouri	• BMI • Maximal oxygen consumption • Measured abdominal strength, upper body strength, back extensor strength, and	September 2007–April 2008	Activity breaks • Students in 3 intervention schools (N=655) received a range of multiple structured physical activity breaks, implemented by teachers during times when students	• Over 1 academic year, students in the intervention group had a significantly greater increase in BMI than controls (median BMI change 0.3 vs 0.1; P=0.02) and a trend toward a greater BMI z score (P=0.07 Lean muscle mass was not assessed. • • The intervention group showed greater improvements in median abdominal strength (curl-ups: +9.0 vs 0.0; P<0.01), upper-body strength (90-degree push-ups: +2.0 vs 0.0; P<0.01), and trunk extension (trunk lifts: +1.0, IQR 0.0, 3.0, vs 1.0, IQR 0.0, 2.0;

			flexibility		were not concentrating maximally in class. • Students in 2 control schools (N=559) received no intervention.	$P<0.01$). • No significant differences were seen in flexibility or maximal O_2 consumption.
Mendoza et al, 2009[266]	Nonrandomized controlled trial	3 urban, socioeconomically disadvantaged public elementary schools (1 intervention vs 2 controls) in Seattle, Washington, kindergarten to 5th grade (age 5-11 y)	Evaluated change in walking vs all other forms of transport to school, assessed by serial cross-sectional surveys (n≈650 each) at baseline and 1-y follow-up	1 y	Walking school bus • Part-time coordinator • Parent volunteers	• At baseline, the proportions of students walking to school did not differ at the intervention (20±2%) vs control (15±2%) schools ($P=0.39$). • At 1 y, more students walked to school at the intervention (25±2%) vs control (7±1%) schools ($P=0.001$). • No significant changes were seen in the percentage of students riding in a car or taking the school bus at baseline or 1 y (all $P>0.05$).
Heelan et al, 2009[265]	Nonrandomized controlled trial	2 intervention schools (N=464) 1 control school (N=227) Age: elementary school	• Trial assessed how children got to school (walking, biking, riding in car/bus) for 1 wk 3 times per year. • A subset (N=201) received objective activity measures. • BMI, skin-fold thickness, and percentage of body fat were measured twice per year.	2 y	Walking school bus • Children walked to school in groups with set stops along the way. • Adults were present as "bus drivers" for supervision. • Walk stops were within a 1.6-km radius of the school. • 8 routes were created for the 2 participating schools. • Participants walked an average of 1.04 km each way.	• After 2 y, 36% of children at the intervention schools actively commuted at least 50% of the time (meeting the HP 2010 goal) vs 26% of children at the control school ($P<0.05$). • In the subset with objective measures, the effects were greater: 71% of intervention participants met the HP 2010 goal compared with 25% of control participants. • Over 2 y, there were no statistically significant differences in BMI, BMI *z* score, or percentage of body fat between children at the intervention and control schools. • In observational analyses, there was a significant difference in change in BMI over 2 y between frequent walkers (ΔBMI=0.80 kg/m^2) vs passive commuters (ΔBMI=1.57 kg/m^2), $P<0.05$. • Frequent walkers vs passive commuters also had a smaller increase in sum of skin folds (2.40±5.80 vs 5.55±4.66) and percentage of body fat (1.55%±3.84% vs 3.72%±3.31).

RCT indicates randomized controlled trial; BMI, body mass index; OR, odds ratio; CI, confidence interval; WHO, World Health Organization; SPAN, School Physical Activity and Nutrition; PE, physical education; CATCH BP, Coordinated Approach to Child Health–Blood Pressure; STOPP, Stockholm Obesity Prevention Program; BP, blood pressure;

NE, nutrition education; NE+G, nutrition education plus gardening; KAP, Knowledge, Attitude, and Practice; FFQ, food frequency questionnaire; SOPLAY, System for Observing Play and Leisure Activity in Youth; VPA, vigorous physical activity; MPA, moderate physical activity; APPLE, A Pilot Programme for Lifestyle and Exercise; SOFIT, System for Observing Fitness Instruction Time; STOPP-T2D, Studies to Treat or Prevent Pediatric Type 2 Diabetes; MVPA, moderate to vigorous physical activity; PE, physical education; bpm, beats per minute; HDL, high-density lipoprotein; METs, metabolic equivalents; NS, not significant; IQR, interquartile range; and HP 2010, Healthy People 2010.

Note: Reference numbers (eg, Brown and Summerbell, 2009[218]) appearing in this supplementary table correspond with those listed in the reference section of the statement. For the purposes of this supplementary table, these meta-analyses or systematic reviews (see "Author, y" column) are considered the primary citation. Additional studies mentioned in the primary citation may be included in the "Intervention/Exposure" and "Findings" columns. The additional studies can be accessed through the primary citation.