Increasing Children's Physical Activity During School Recess Periods

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Objectives. We examined whether schools' participation in the Recess Enhancement Program (REP) in the spring of 2011 was associated with higher rates of children's vigorous physical activity.

Methods. In REP, a coach guides children through age-appropriate games aimed at increasing their physical activity. During recess at 25 New York City public elementary schools (15 REP, 10 non-REP), researchers visually scanned predetermined areas (n = 1339 scans), recording the number of sedentary, walking, and very active children.

Results. Multivariate statistical analysis found that participation in REP was a significant predictor ($P = .027$) of the rate of vigorous physical activity (percentage very active in scan area) whose least-squares means were 41% in REP schools and 27% in non-REP schools. A significantly higher rate in REP schools persisted when the coach was not in the scan area, suggesting a change in the recess culture of REP schools.

Conclusions. The rate of vigorous physical activity in REP schools was 14 percentage points, or 52%, higher than the rate in non-REP schools. This low-cost intervention might be a valuable addition to the tools for combating childhood obesity and worth replicating elsewhere. (*Am J Public Health.* 2013;103:1229–1234. doi:10.2105/AJPH.2012.301132)

A substantial number of children fail to engage in any physical activity outside of school,[1] suggesting that school-based physical education classes and recess periods may be especially important opportunities for getting children to meet federal exercise guidelines. These guidelines recommend that children and adolescents engage in physical activity for 1 hour each day,[2] but many schools have cut back on physical education. Dale et al.,[3(p241)] for example, found that "student participation in physical education classes [in the Unites States] declined from 3.6 days to 3 days per week" between 1984 and 1994 in part because of budgetary constraints. Only "3.8% of public and private elementary schools required daily physical education for all students in 2006."[4(p265)] New York City, where our study took place, reflects national trends. A study by the New York City Public Advocate found that "fifty-seven percent of the elementary schools surveyed offer[ed] P.E. only once per week,"[5(p3)] violating state regulations requiring daily physical education. Recess is offered substantially more frequently than physical education classes,[4] but recess periods may not be used well for physical activity because some schools allow children to stay indoors during recess to finish homework or play games on computers.[3]

Increasing children's physical activity levels is an important public health objective, especially in light of increases in childhood obesity rates. After 1980, "the prevalence of BMI for age at or above the 95th percentile (sometimes termed 'obese')... tripled among school-age children and adolescents,"[6(p242)] and then stabilized at about 17% for most children starting in 1999. High body mass index rates among children have not decreased since then, and have actually increased for boys (6–19 years old) at the highest body mass index-for-age levels (≥ 97th percentile), despite the implementation of a wide range of obesity prevention initiatives.[6] Overweight children are at risk for elevated lipid levels and high blood pressure[7] and for obesity in adulthood.[8,9] Obese adults are at increased

> risk of morbidity from hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems, and endometrial, breast, prostate, and colon cancers. Higher body weights are also associated with increases in all-cause mortality.[10(pxi)]

Benefits of physical activity for youth include increased cardiorespiratory fitness and muscular strength, favorable body composition (i.e., lower body fat percentage), increased cardiovascular and metabolic health, bone health, and improved mental health.[11]

Inadequacies in schools' physical education programs may be difficult to remedy if there are substantial fiscal constraints. Capital improvements to add recreational infrastructure and facilities, which are positively correlated with increased physical activity,[12,13] may also be out of reach for many schools. The potential importance of adult encouragement of children to be physically active,[14] as well as structured time and adult supervision, which are associated with increased children's physical activity,[15,16] suggests that there may be less costly approaches that can work within already existing school activities. Relatively consistent findings in the literature that boys are generally more active than girls[13,16–19] suggest that intervention approaches should aim to be equally inclusive of both genders. A review of previous studies found that "indicators of socioeconomic status were not related to children's physical activity. Most studies found ethnic minority children were as active as non-Hispanic whites."[13(p965)]

We examined whether schools' participation in the Recess Enhancement Program (REP) in the spring of 2011 was associated with higher rates of children's vigorous physical activity.

RECESS ENHANCEMENT PROGRAM

The REP aims to increase children's physical activity during school recess periods through play coaches who teach children inclusive, age-appropriate games. A number of previous studies assessed interventions designed to

increase children's physical activity, but most of the school-based interventions described in the literature involved modifying existing physical education classes, introducing new workshops or trainings in the classroom or after school, or changing the physical environment of playgrounds (e.g., painting markings on playground to encourage play, adding sports equipment). The evidence supporting these interventions' effectiveness were mixed.[20] Very few of the intervention studies in the academic literature involved programmatic intervention (e.g., training, coaching) during daily recess or other "noncurricular" periods (e.g., lunch),[21] which are perhaps the most viable times to promote physical activity, given the low frequency of physical education classes in many schools. We were able to identify 2 published studies of recess-based or noncurricular programmatic interventions in schools; both differed from the present study in that they involved only minimal coaching and relied heavily on equipment (we also found 1 published abstract[22] and 1 unpublished study by Jago et al. referenced in a review article[21]). In 1 of the 2 published studies, which found significant increases in children's physical activity levels, children were provided with simple playground equipment (e.g., jump ropes, beach paddles) and activity cards that described how to use the equipment. Teachers encouraged the children to use the equipment, but did not otherwise provide structured coaching.[23] In the other study, children were introduced to a new equipment-based playground activity each week over 3 consecutive weeks and were encouraged by teachers at the start of recess to use the equipment, but were not coached beyond that.[24] The study had mixed results and indicated that more structured activities might be more effective in increasing younger children's physical activity levels.

Compared with these programs, the REP intervention involved more adult supervision and less equipment, which reduced not only cost but also barriers to children's playing the games later on their own. Developed by Asphalt Green, a New York City–based nonprofit organization committed to assisting individuals of all ages to achieve health through a lifetime of sports and fitness, REP aims to transform the culture of recess in New York City public schools by engaging students in a variety of cooperative games led by a play coach, who provides guidance and structure to create a safe environment where children can have fun and be physically active while maintaining a sense of independence and ownership of the recess period. Play coaches visit each school twice a week during recess or lunch periods so that children spend about 70 recess periods or 30 hours in a play coach's presence in a school year. Play coaches also train school staff members in the games and encourage them to facilitate play when the coaches are not present. The REP curriculum includes a wide variety of age-appropriate games and activities, most of which require no equipment. The games can be implemented on large playgrounds or in smaller indoor spaces like cafeterias, gyms, or auditoriums during inclement weather. To be as inclusive as possible, REP games are guided by a "no outs" or "everyone can play" philosophy. Tag games, for example, are easily learned, enable students to join or leave without disrupting the game's flow, and can accommodate varying numbers of children. Tag game rules of play can be adapted to include children of various age groups and physical capabilities. The program, currently under way in 50 New York City public elementary schools and reaching more than 20 000 children, helps children utilize the full 25-minute recess period, getting them closer to fulfilling federal guidelines calling for an hour of daily exercise through "activities that are appropriate for their age, that are enjoyable, and that offer variety."[2(pvii)]

METHODS

We examined rates of physical activity among children on playgrounds during recess at New York City public elementary schools, comparing schools in and not in the REP. We sought to determine whether schools' participation in REP was associated with higher rates of vigorous physical activity among students.

Data Collection

With the cooperation of Asphalt Green, 15 schools in REP and 10 comparison schools not in REP were recruited by convenience into the study. We approached all 34 schools participating in REP at the time (Spring 2011) and accepted the first 15 that responded; similarly, for the comparison schools, we approached 30 schools that had participated or expressed interest in other Asphalt Green programs, such as their school day learn-to-swim program, and accepted all 10 that responded. Based on pilot data, we expected that this sample size would allow us to detect small to medium effects.

We used the System for Observing Play and Leisure Activity in Youth (SOPLAY) method for documenting playground characteristics and children's physical activity levels on the playground.[25–27] SOPLAY is a direct observation method of documenting children's physical activity specifically during free play. In reviews of the various methods for measuring physical activity among children, Welk et al.[28] and Sirard and Pate[29] suggested that direct observation was one of the best criterion measures of physical activity. Accelerometers could provide a potentially more objective method of measuring physical activity and could also document physical activity changes at the individual level.[16] Previous research, although mixed, suggested that 3-dimensional accelerometers, in particular, might provide valid measures of physical activity,[29] but accelerometers might discount short bursts of movement especially characteristic of children's physical activity.[28] We chose not to use accelerometers because their additive value was deemed insufficient in relation to the increases in cost, study complexity, and participant burden that would result from attaching accelerometers to all children on playgrounds at 25 schools.

Graduate research assistants were recruited and trained to conduct the playground mappings and observations, which took place from April 2011 through early June 2011. In their first visit to each school, observers mapped the playground, using a standardized instrument to systematically document its shape, dimensions, and permanent physical improvements (e.g., basketball hoops, soccer goals). On their playground maps, they divided the playground into up to 8 scan areas to guide their subsequent observations.

Observers then made 2 additional visits to each school to observe children's physical activity during recess periods. For REP schools, visits were scheduled only on days the play coach was scheduled to be at the school. During most visits, the observers were able to observe at least 2 25-minute recess periods, during which time they were able to scan the entire playground multiple times, moving

systematically through the scan areas in sequential order. Observers scanned the entire playground as many times as they were able to (usually 2–4 times) within the recess period. In the scanning process, observers visually scanned each scan area from left to right and used hand-held counters to note the number of sedentary, walking, or very active children in each scan. Following SOPLAY protocols, observers recorded the level of activity the child was engaged in at the moment the observer's visual scan passed the child. For each scan area, 1 scan was conducted just for girls, immediately followed by a second scan for boys.

The SOPLAY method was previously validated with interobserver intraclass correlations ranging from 0.95 to 0.98 for counts of sedentary and walking girls and sedentary, walking, and very active boys; the intraclass correlation for very active girls was lower at 0.76 "because of the low frequency of occurrence."[27(p72)] Because the method was previously validated, we conducted a limited assessment of interobserver consistency in a structured setting before sending observers into the field. After being trained, 6 observers each rated 5 videos of children's physical activity that were produced by the research team specifically for this purpose. Shrout and Fleiss' intraclass coefficient, type 3,1,[30] was used to assess interrater reliability of the 6 raters, as recommended by Portney and Watkins when "the raters represent the only raters of interest."[31(p590)] Intraclass coefficient(3,1) for our dependent variable (percent very active) was 0.72.

Observers used a standardized instrument to record the physical activity levels of girls and boys in the scan areas and other relevant factors, including grade levels present on the playground and whether the observation occurred before or after lunch. At the scan area level, the instrument captured whether the play coach was present in the scan area and whether the scan area was supervised by someone other than the play coach. It was not feasible to capture demographic characteristic information other than gender of the observed children. However, we gathered demographic characteristic information at the school level using the schools' Accountability and Overview reports, which are required by the New York State Education Department and are available online. For each school, we captured data on size of total student body, racial and gender breakdown of the total student population, and the percentage of students eligible for free or reduced-cost lunches.

Analysis

Differences between REP and non-REP schools for each physical activity level (sedentary, walking, very active) were tested using multivariate statistical analysis. Each individual scan of a scan area was treated as a case. Because scan areas are embedded in schools, we used PROC GLIMMIX in SAS version 9.1 (SAS Institute, Cary, North Carolina) to correct for intraclass correlation at the school level, thereby creating a higher bar for establishing statistical significance of differences.

The main dependent or outcome variable of interest was the rate of "vigorous activity," expressed as the percentage of boys or girls in the scan area who were noted as being very active during the scan. The main independent variable of interest was scan area type, which had 3 categories: scan area in non-REP school, scan area in REP school with play coach not present in scan area, and scan area in REP school with coach present in scan area.

The control variables also included in our multivariate model were the density of children in the scan area (number of children per square foot), the grade levels on the playground (expressed as a single mean of the grade levels present), whether the observation was done before or after lunch, the gender being observed in the scan (boys or girls), whether the scan area was supervised by someone other than the play coach, and the number of types of permanent improvements in the scan area (such as basketball hoops or soccer goals). At the school level, additional control variables were the percentage of children in the school's student population who were White, African American, Hispanic, Asian/Pacific Islander, male, and eligible for free or reduced-cost lunches.

RESULTS

Twenty-five NYC public elementary schools (10 not in REP and 15 in REP) were recruited into the evaluation study. Table 1 shows schools' demographic characteristics, with each characteristic (except size of total student body) expressed as a mean percentage of the total student body. Non-REP schools tended to have a higher percentage of African American students (mean = 40.91%, compared with 34.54% for REP schools). REP schools tended to have a higher representation of Asian/Pacific Islander and Hispanic students. There was a low percentage of White and American Indian students in the schools overall. Both REP and non-REP schools had more male than female students. REP schools had a higher percentage of students eligible for free or reduced-cost lunches (86.33%) compared with non-REP schools (81.90%). None of the school-level differences between REP and non-REP schools were significant in parametric and nonparametric 2-sample tests.

Scan Area Characteristics

We had complete data for a total of 1339 scans: 500 (37.3%) scans were in non-REP schools, 595 (44.4%) were in REP schools with the coach not present in the scan area, and 244 (18.2%) were in REP schools with the coach present in the scan area. Table 2 shows scan area characteristics by scan area type. Scan area types had similar characteristics. One notable exception was that REP scan areas with the coach present had a very high level of supervision by adults who were not the play coach. It should also be noted that the boy and girl scans were not equal because some scan areas had only 1 gender at the time of the scan.

Multivariate Analysis

After controlling for all of the school-level and scan area–level characteristics included in Tables 1 and 2, we found that there were statistically significant differences in the rate of vigorous activity between scan area types, with the rate of vigorous activity progressively increasing when moving from non-REP, to REP without a coach, and to REP with a coach scan areas. The same model was used to analyze rates of sedentary and walking behavior as the dependent variable. These analyses produced the least-squares means for rates of sedentary and walking behavior shown in Figure 1, but no statistically significant differences were found for rates of sedentary and walking behavior by scan area type.

Table 3 shows significance levels for each of the independent variables in the model, with the rate of vigorous activity (percent very active) as the dependent variable. Scan area

TABLE 1—School Characteristics by Schools' Participation in Recess Enhancement Program (REP): New York City, Academic Years 2008–2009

	Non-REP (n = 10), Mean or %	REP (n = 15), Mean or %	Total (n = 25), Mean or %
Total student population	406.70	578.40	509.72
Race/ethnicity			
American Indian	0.96	0.71	0.81
Asian/Pacific Islander	4.62	11.75	8.90
African American	40.91	34.54	37.09
Hispanic	46.91	48.34	47.77
White	6.70	3.50	4.78
Gender			
Female	48.59	47.70	48.06
Male	51.41	52.36	51.98
Reduced/free lunch	81.90	86.33	84.56

Source. Data were compiled from review of each school's Accountability and Overview Report, which are required by the New York State Education Department.

type (the independent variable of primary interest) was a statistically significant predictor ($P = .027$). Gender observed was also statistically significant ($P = .022$), with boys having higher rates of vigorous activity than girls, which was consistent with the literature.

Percentage of Whites in the student body was also a statistically significant predictor, with a positive association with rate of vigorous activity; percentage of Asian/Pacific Islanders, percentage of African Americans, and percentage of Hispanics also had positive, but not statistically significant, associations with rate of vigorous activity. The positive associations between percentages of a racial group and rates of vigorous activity suggested that a preponderance of any single racial group in a school might be conducive to more vigorous physical activity.

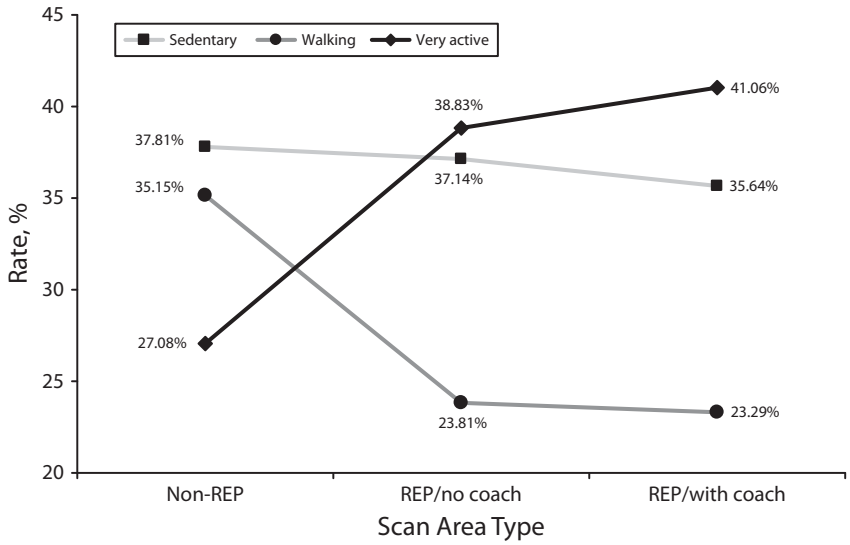
Figure 1 shows the least-squares means of the rates of sedentary, walking, and vigorous activity by scan area type resulting from our multivariate model. Looking just at the very active line, the rate of vigorous activity was 27% in non-REP scan areas, 39% in REP scan areas (no coach), and 41% in REP scan areas (with coach). The rate of vigorous activity for REP (with coach) scan areas was 14 percentage points, or 52%, higher than the rate for non-REP scan areas.

In a post hoc pairwise *t*-test using least-squares means, the difference in the rates of vigorous physical activity between the 2 extremes (non-REP vs REP with coach present scan areas) was statistically significant ($P = .007$). The difference in rates of vigorous physical activity between non-REP and REP without a coach scan areas was also significant ($P = .016$). The difference between the 2 REP

TABLE 2—Scan Area Characteristics by Schools' Recess Enhancement Program (REP) Status and Play Coach Presence in Scan Area: New York City, 2011

	Non-REP (n = 500), Mean (SD) or %	REP no Coach (n = 595), Mean (SD) or %	REP with Coach (n = 244), Mean (SD) or %	TOTAL (n = 1339), Mean (SD) or %
		Within scan areas		
Very active children, %	34.30 (30.38)	35.50 (33.66)	40.49 (32.86)	35.96 (32.38)
Density	0.0088 (0.0102)	0.0091 (0.0099)	0.0102 (0.0085)	0.0092 (0.0098)
Grade level	2.72 (1.24)	2.94 (1.54)	2.98 (1.74)	2.86 (1.48)
		Distribution of scan area types		
Scan time				
Before lunch	23.6	27.7	43.0	29.0
After lunch	76.4	72.3	57.0	71.0
Gender observed				
Boy scans	50.8	52.9	49.2	51.5
Girl scans	49.2	47.1	50.8	48.5
Supervision of scan area				
Not supervised	41.6	43.2	15.2	37.5
Supervised	58.4	56.8	84.8	62.5
Equipment in scan area				
0 improvements	22.8	23.9	19.7	22.7
1 improvement	47.6	50.3	45.1	48.3
2 improvements	25.2	19.5	27.0	23.0
3 improvements	3.6	4.7	8.2	4.9
4 improvements	0.8	1.7	0.0	1.0

Note. Totals may not add to 100% because of rounding.



Note. Rate determined by least squares means. Totals may not add to 100% because of rounding.

FIGURE 1—Rates of sedentary, walking, and very active behavior by scan area type: Recess Enhancement Program (REP), New York City, 2011.

scan area types (no coach vs coach present) was not statistically significant ($P=.362$).

DISCUSSION

It was notable that the differences in rates of vigorous physical activity were statistically significant both between non-REP and REP with a coach present scan areas and between non-REP and REP without a coach scan areas. The persistence of differences between non-REP and REP schools, regardless of whether the coach was present in the scan area, suggested that the REP intervention might have had a more lasting impact on schools' recess culture because the differences between non-REP and REP schools remained even when the coach was not immediately present in the scan area. Anecdotal observations provided support for this interpretation. Observers noted that teachers and other school personnel enjoyed watching and learning from play coaches and sometimes led children in the REP games when the coach was absent. This observation was consistent with the disproportionately high rate of noncoach adult supervision in the REP with coach scan areas (Table 2).

Because the line for rate of walking in Figure 1 drops substantially as scan area type moves from non-REP to REP no coach to REP with coach, and the line for sedentary behavior stays fairly constant across scan area types, it appeared that the REP intervention might have been more successful at motivating walkers to become very active and not as good at motivating sedentary children. The pattern should not be overinterpreted because the differences in rates of sedentary and walking behavior by scan area type were not statistically significant. The patterns were suggestive, however, and were consistent with observers' anecdotal observations in the field, which indicated that children who were sedentary were likely to be playing hand-held video games or using other electronic devices and had little response to the presence of the play coach. By contrast, walking children seemed to be looking for something to do.

Because the study used a cross-sectional design, rather than a longitudinal design with random assignment, it was not possible to determine that the REP intervention caused increases in vigorous physical activity. We could only establish that there were higher rates of vigorous physical activity in REP schools compared with non-REP schools, and that these differences were not the result of random variation between schools, but rather to a systematic difference between REP and non-REP schools. The study design did not allow us to definitively identify the REP intervention or presence of the play coaches as the causes of the differences in rates of vigorous physical activity by scan area type. Still, the results of the study were suggestive of the program's effectiveness.

Although obesity rates have recently leveled off for most children, high rates persist despite the implementation of a wide range of programs and policy initiatives directed toward reducing obesity rates. Clearly, more can be done to decrease childhood obesity rates and

TABLE 3—Type III Tests of Fixed Effects, Percent Very Active as Dependent Variable, Recess Enhancement Program (REP): New York City, 2011

Effect	*df*, Numerator	*df*, Denominator	*F*	Pr > *F*
School population characteristics				
Asian/Pacific Islander	1	1301	3.02	0.0825
African American	1	1301	3.65	0.0562
Hispanic	1	1301	3.54	0.0603
White	1	1301	4.23	0.0399
Male	1	1301	1.50	0.2215
Reduced/free lunch	1	1301	0.04	0.8337
Scan area characteristics				
Scan area type (REP/coach)	2	1301	3.62	0.0271
Density	1	1301	1.13	0.2885
Grade level	1	1301	2.72	0.0994
Scan time (before/after lunch)	1	1301	2.31	0.1284
Gender observed (boys/girls)	1	1301	5.26	0.0220
Supervision	1	1301	0.00	0.9872
Equipment	4	1301	1.30	0.2691

Note. Pr > *F* = probability of obtaining an *F* ratio equal or greater under the null hypothesis.

improve children's overall metabolic health. Increasing children's physical activity in schools is an essential element of this work. In line with Healthy People 2020 objectives,[4] the REP provides a low-threshold, low-cost method for increasing children's physical activity during school recess periods, using an approach that is age-appropriate and fun for children, as recommended in the federal Physical Activity Guidelines for Americans.[2] Increasing physical activity levels of children through teacher training and implementation of school-based programs is also one of the objectives of the National Physical Activity Plan.[32] Our multivariate analysis suggested that the REP intervention might be effective in increasing children's physical activity through working with children directly and possibly through altering the recess culture so that both children and school personnel can engage in and lead the REP games even when the play coach is not present. Our results indicated that the REP model might be worth replicating in other areas to increase children's physical activity without adding inordinately to schools' costs. The model used in New York City of partnering between a nonprofit organization and public schools could increase feasibility if schools' budgets are limited. Additional research using a longitudinal model with random assignment might be warranted to further understand the program's effectiveness. ■

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Contributors

J. Chin was responsible for overseeing the implementation of the study, analyzing data, and writing up study findings. D. Ludwig coordinated research assistant training and recruitment of schools and assisted with interpreting results. Both authors contributed to developing the research design.

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Human Participant Protection

Study protocols were approved by the Hunter College/City University of New York and New York City Department of Education institutional review boards.

References

1. Centers for Disease Control and Prevention (CDC). Physical activity levels among children aged 9-13 years–United States, 2002. *MMWR Morb Mortal Wkly Rep.* 2003;52(33):785–788.

2. *2008 Physical Activity Guidelines for Americans.* Washington, DC: US Department of Health and Human Services; 2008.

3. Dale D, Corbin CB, Dale KS. Restricting opportunities to be active during school time: do children compensate by increasing physical activity levels after school? *Res Q Exerc Sport.* 2000;71(3):240–248.

4. US Department of Health and Human Services. *Topics and Objectives Index - Healthy People.* Washington, DC: US Department of Health and Human Services; 2011.

5. Browne D, Woltman M, Tumarkin L, Dyer S, Han S, Brodsky D, et al. *State of Play: A Four-Year Follow-Up Survey on NYC Students' Access to Physical Education.* New York, NY: Office of the New York City Public Advocate; 2008.

6. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA.* 2010;303(3):242–249.

7. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. Risk factors and adult body mass index among overweight children: the Bogalusa Heart Study. *Pediatrics.* 2009;123(3):750–757.

8. Ferraro KF, Thorpe RJ Jr, Wilkinson JA. The life course of severe obesity: does childhood overweight matter? *J Gerontol B Psychol Sci Soc Sci.* 2003;58(2):S110–S119.

9. Serdula MK, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T. Do obese children become obese adults? A review of the literature. *Prev Med.* 1993;22(2):167–177.

10. National Institutes of Health. *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report.* Rockville, MD: National Institutes of Health; 1998.

11. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report, 2008.* Washington, DC: US Department of Health and Human Services; 2008.

12. Davison KK, Lawson CT. Do attributes in the physical environment influence children's physical activity? A review of the literature. *Int J Behav Nutr Phys Act.* 2006;3(19):1–17.

13. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc.* 2000;32(5):963–975.

14. McKenzie TL, Sallis JF, Elder JP, et al. Physical activity levels and prompts in young children at recess: a two-year study of a bi-ethnic sample. *Res Q Exerc Sport.* 1997;68(3):195–202.

15. Sallis JF, Conway TL, Prochaska JJ, McKenzie TL, Marshall SJ, Brown M. The association of school environments with youth physical activity. *Am J Public Health.* 2001;91(4):618–620.

16. Saint-Maurice PF, Welk GJ, Silva P, Siahpush M, Huberty J. Assessing children's physical activity behaviors at recess: a multi-method approach. *Pediatr Exerc Sci.* 2011;23(4):585–599.

17. Kohl HW 3rd, Hobbs KE. Development of physical activity behaviors among children and adolescents. *Pediatrics.* 1998;101(3 Pt 2):549–554.

18. Trost SG, Pate RR, Dowda M, Saunders R, Ward DS, Felton G. Gender differences in physical activity and determinants of physical activity in rural fifth grade children. *J Sch Health.* 1996;66(4):145–150.

19. Zask A, van Beurden E, Barnett L, Brooks LO, Dietrich UC. Active school playgrounds-myth or reality? Results of the "move it groove it" project. *Prev Med.* 2001;33(5):402–408.

20. van Sluijs EM, McMinn AM, Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. *BMJ.* 2007;335(7622):703.

21. Jago R, Baranowski T. Non-curricular approaches for increasing physical activity in youth: a review. *Prev Med.* 2004;39(1):157–163.

22. Connolly P, McKenzie TL. Effects of a games intervention on the physical activity levels of children at recess. *Res Q Exerc Sport.* 1995;66(1):A60.

23. Verstraete SJ, Cardon GM, De Clercq DL, De Bourdeaudhuij IM. Increasing children's physical activity levels during recess periods in elementary schools: the effects of providing game equipment. *Eur J Public Health.* 2006;16(4):415–419.

24. Stellino MB, Sinclair CD, Partridge JA, King KM. Differences in children's recess physical activity: recess activity of the week intervention. *J Sch Health.* 2010;80(9):436–444.

25. McKenzie TL. *Sample SOPLAY/SOPARC Mapping Strategies.* San Diego, CA: San Diego State University; 2005.

26. McKenzie TL. *SOPLAY System for Observing Play and Leisure Activity in Youth, Description and Procedures Manual.* San Diego, CA: San Diego State University; 2006.

27. McKenzie TL, Marshall SJ, Sallis JF, Conway TL. Leisure-time physical activity in school environments: an observational study using SOPLAY. *Prev Med.* 2000;30(1):70–77.

28. Welk GJ, Corbin CB, Dale D. Measurement issues in the assessment of physical activity in children. *Res Q Exerc Sport.* 2000;71(2, suppl):S59–S73.

29. Sirard JR, Pate RR. Physical activity assessment in children and adolescents. *Sports Med.* 2001;31(6):439–454.

30. Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychol Bull.* 1979;86(2):420–428.

31. Portney LG, Watkins MP. *Foundations of Clinical Research: Applications to Practice.* 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall; 2009.

32. The National Coalition for Promoting Physical Activity. *National Physical Activity Plan for the United States.* Washington, DC: The National Coalition for Promoting Physical Activity; 2010.