Safe Play Spaces To Promote Physical Activity in Inner-City Children: Results from a Pilot Study of an Environmental Intervention

Thomas A. Farley, MD, MPH, Rebecca A. Meriwether, MD, MPH, Erin T. Baker, MS, Liza T. Watkins, MA, Carolyn C. Johnson, PhD, and Larry S. Webber, PhD

Objectives. We evaluated the effect of providing a safe play space on the physical activity level of inner-city schoolchildren.

Methods. In 1 of 2 matched neighborhoods, we opened a schoolyard and provided attendants to ensure children's safety. Over the next 2 years we directly observed the number of children and their physical activity levels in the schoolyard, as well as in the surrounding intervention and comparison neighborhoods. We also surveyed children in the schools in the intervention and comparison neighborhoods regarding sedentary activities.

Results. After the schoolyard was opened, a mean of 71.4 children used it on weekdays and 25.8 used it on weekends during the school year. When observed, 66% of these children were physically active. The number of children who were outdoors and physically active was 84% higher in the intervention neighborhood than the comparison neighborhood. Survey results showed that children in the intervention school reported declines relative to the children in the comparison school in watching television, watching movies and DVDs, and playing video games on weekdays.

Conclusion. When children were provided with a safe play space, we observed a relative increase in their physical activity. Provision of safe play spaces holds promise as a simple replicable intervention. (*Am J Public Health.* 2007;97:1625–1631. doi:10.2105/AJPH.2006.092692)

The prevalence of overweight is rising rapidly in children.[1] Among African Americans the problem is severe: 21.8% of African American children aged 12 to 19 years are overweight.[1] The relation between inadequate physical activity and weight gain is strong and consistent.[2,3] In spite of national recommendations for greater physical activity, American children engage in low levels of physical activity.[4,5]

There is increasing evidence that features of physical and social environments influence levels of physical activity.[6–9] A sense of safety in the neighborhood appears to be one important environmental determinant. Adults who perceive their neighborhoods to be unsafe are substantially more likely to be physically inactive than are adults who perceive their neighborhoods as safe.[10] Outdoor safety is especially important for children, because time spent outdoors is strongly associated with physical activity.[11,12] Parents rank safety as the most important factor in deciding whether to let their young children play in a given location.[13] A recent study found that children whose parents perceived their neighborhoods to be particularly unsafe were more than 4 times as likely to be obese than children whose parents perceived their neighborhoods to be safe.[14]

Changes in family structure and work have accentuated the effect of neighborhood safety on physical activity. The proportion of children whose mothers are employed outside the home has increased in recent decades. Although preschool children whose mothers work often attend structured daycare programs or are cared for by relatives, 23% of school-aged children whose mothers are employed outside the home are left alone during afterschool hours.[15] One multisite study found that when children are in self-care, their most frequent activity by far is watching television,[16] a sedentary activity that is strongly associated with obesity.[17] The Institute of Medicine recognizes that children need more opportunities for physical activity and has recommended that schools be used as community centers for physical activity during afterschool hours.[18]

In spite of the recognition of environmental effects, few interventions have been developed that increased physical activity or reduced obesity in children by changing their environment. We implemented a pilot intervention in which we provided a safe play space in a low-income, inner-city neighborhood and evaluated its effect on the physical activity of local children.

METHODS

Setting

Our study took place in 2 low-income neighborhoods in New Orleans that were approximately 1 mile apart but were separated by a canal. According to the 2000 census, the intervention and comparison neighborhoods were similar for median household income ($19 185 and $21 297 per year, respectively), percentage of African Americans (99% and 90%), and percentage of households headed by women (both 37%); the intervention neighborhood had a slightly lower population density (10 144 vs 14 717 residents per square mile, respectively). Each neighborhood had a district public elementary school with a schoolyard, which (before the study) was locked when the school was not in operation. The catchment districts for the 2 schools were such that nearly all students lived within 0.5 miles of their respective neighborhood school. The intervention school taught children in prekindergarten through sixth grades, and the comparison school taught children in prekindergarten through fifth grades. In both schools, more than 99% of the children were African American. The intervention school had a higher "school performance score" than the comparison school (69.6 vs 38.3, respectively), a composite measure based on standardized test scores and attendance for which the highest performing schools in the city scored 130.

Intervention

The intervention took place between April 2003 and May 2005 and consisted of providing a safe, supervised schoolyard where children could engage in nondirected play. On days when school was in session, the schoolyard was open from school dismissal time, usually 3:00 PM, until 5:30 PM or dark. It was open on Saturdays from 10:00 AM until 3:00 PM and on Sundays from 12:00 PM until 3:00 PM. By April 2004, the Sunday session was discontinued because of low attendance. During the summer of 2003, the schoolyard was open on the same days and hours as during the school year. During the summer of 2004, the schoolyard was open on this same schedule until it was closed on July 10 and then reopened at the beginning of the next school year. The schoolyard at the comparison school remained locked when school was not in session until January 2005 when another program began to use that location for a small limited-enrollment afterschool program.

Any child who had written parental permission and either was in second grade through eighth grade or was in kindergarten or first grade and was accompanied by an older sibling or parent was allowed to use the intervention schoolyard during its hours of operation, regardless of whether he or she attended the school. No fees were charged. Children were required to check in with an attendant when they entered the yard each day to verify parental permission, but afterward they could enter and exit freely. Three to 4 attendants (almost all of whom were teachers) were paid to prevent fights or bullying among children, prevent vandalism or theft of recreational equipment, and prevent adults or children outside of the designated age range from entering the schoolyard. Attendants did not organize, require, or even suggest specific activities to children. Parents could accompany their children in the schoolyard, but almost none did. To address liability concerns, the project purchased additional liability insurance for the school, at a cost of $550 per year. The cost for 12 months of salaries, for all of the attendants and a custodian when school was not in session, was $49 000, which was paid by the research project.

The intervention schoolyard was approximately 5800 m^2 in size. It included an installed play structure with impact-absorbent surfacing, large paved areas in which basketball hoops were stationed and a 4-square court was painted, and an open grassy field. The research project provided and maintained ample sports equipment such as footballs, basketballs, playground balls, hula hoops, jump ropes, Frisbees, and parachutes. A compact disk player and radio was also provided to supply music for dancing, and a sprinkler was installed during the summer months.

Evaluation

Attendance. The number of children who used the schoolyard was taken from attendance records kept by schoolyard staff.

Physical activity. We measured by direct observation the number of children and their physical activity levels in the schoolyard and in the neighborhoods surrounding each school. Observations occurred after school on 5 randomly selected weekdays and 4 randomly selected weekend days during a 4-week period before the intervention began and during each quarter (every 3 months) throughout most of the intervention period (April 2003–October 2004). During the last 2 quarters (November 2004–January 2005 and February–April 2005) observations were increased to 10 randomly selected weekdays (2 for each weekday) and 2 randomly selected Saturdays.

The physical activity of the children in the schoolyard during the designated hours was assessed using a modified version of the System of Observing Play and Leisure Activity in Youth.[19,20] The system involves momentary time-sampling in which periodic scans in a target area are made according to an established schedule. At each scan and in each target area, counts are made of the number of children who are engaged in each of 3 different levels of physical activity: sedentary (lying, sitting, or standing), walking, or very active (e.g., running, jumping rope, climbing on play equipment). Two observers used mechanical counters mounted on boards and independently counted boys and girls at each activity level; their results were averaged.

We developed a modification of the System of Observing Play and Leisure Activity in Youth to measure physical activity of children in the neighborhoods that surrounded the schoolyards. For each neighborhood we defined a "Neighborhood Measurement Area" of 8 blocks by 8 blocks (approximately two thirds of a mile by two thirds of a mile area) that surrounded the school; the areas approximated 2 census tracts in the intervention area and 3 census tracts in the control area. In each Neighborhood Measurement Area, a driver and an observer drove at 10 mph or slower on standard routes that traversed every street oriented north–south. An observer in the passenger seat identified children outdoors both on the streets that were traveled and on the cross-street blocks to the east of all intersections. Children playing in backyards could not be observed and were thus not included in the measurement. Each identified child who appeared to be in the target age range (second through eighth grade) was counted and coded according to the child's activity level. In the comparison neighborhood, the areas observed included the comparison schoolyard.

To control for the effect of weather on outdoor activity, we scheduled observations so that they occurred simultaneously in the intervention and comparison neighborhoods, as well as in the intervention schoolyard. To control for interobserver bias, we rotated 3 observer teams among the neighborhoods and the intervention schoolyard. To assess the interobserver reliability of the method, we conducted 16 paired observations from the same car driving through intervention and comparison neighborhoods. The intraclass correlation coefficient of the observers' counts of active children was 0.962.

Sedentary activities. To assess the effect of the intervention on sedentary activities, we conducted annual self-report surveys of children. For practical reasons, these surveys were conducted with children in the second through fifth grades who were enrolled in the schools in the intervention and comparison neighborhoods. All children in these grades who had written parental consent and were available in school were surveyed. Surveys were administered simultaneously in intervention and comparison schools on Tuesdays in March or April. Students were asked about activities during the previous afternoon and evening, on the previous Saturday morning, and on the previous Saturday afternoon and

evening. We used the procedure and questions developed by Robinson for third and fourth grade students[17]; for each activity, children coded their answers on a 9-level, semiquantitative scale that ranged from "none" to "6 hours or more."

Body composition. We measured height, weight, and an estimate of body fat using bioelectrical impedance analysis before the intervention began (in February 2003) and again in May 2004 and May 2005. Children included in the measurements were in second through fifth grades in the intervention and comparison neighborhoods. Measurements were performed using the Quantum II Body Composition Analyzer (RJL Systems, Clinton Township, Mich), with procedures used by Houtkooper et al.[21] Children were measured supine in the late morning or early afternoon.

Informed consent procedures for human subjects were followed according to guidelines established by the institutional review board of Tulane University; parents or guardians of children returned a form specifically stating whether or not they wanted their children to participate.

Data analysis

To assess the relation between time period (before vs after the intervention began) and neighborhood (intervention vs comparison) in the number of children outdoors and physically active, we used the χ^2 test to calculate *P* values; the paired *t* test was used to calculate confidence intervals (CIs) for the differences in the number of children observed.

Data from self-reported surveys on time spent doing sedentary activities were dichotomized into any time versus no time. To assess statistical significance of changes from baseline between the 2 schools in the reporting of sedentary activities, we dummy-coded the 3 survey years and built logistic regression models; the reported *P* values are for school-by-year interactions.

Children's fat-free mass was estimated from their weight, height, and bioelectrical impedance using the formula derived by Houtkooper[21];

$$(1)\quad \mathrm{FFM} = 0.61 \times \mathrm{H}^2 \div \mathrm{R} + 0.25 \times \mathrm{W} + 1.31,$$

where FFM is the fat-free mass in kilograms, H is the height in centimeters, R is the resistance in ohms, and W is the weight in kilograms.

To assess changes in means for body mass index (BMI; weight in kilograms divided by height in meters squared) and body composition in the serial cross-sectional samples, we used analysis of variance. For the children who were measured at baseline and again 2 years later, we conducted a 2-sample *t* test to compare the intervention and comparison schools for the change in BMI over the 2 years.

RESULTS

The schoolyard was immediately popular upon opening. Attendance varied little by season but did vary substantially by whether school was in session. During the school year, the mean number of children attending the schoolyard each day was higher on the weekdays (71.4) than on the weekends (25.8); during the summer, the mean attendance of children each day was 27.8 on weekdays and 14.2 on weekends. Approximately 80% of children who used the yard were in grades 2–5, 18% were in grades 6–8, and the remaining children were younger siblings in kindergarten or first grade. Attendance was nearly equal for boys (50.5%) and girls (49.5%).

During the 12 months that included the 2003–2004 academic year and the 2004 summer, 710 children attended the schoolyard at least once, of which 506 (71%) were enrolled at the intervention school and the remainder attended other schools. Only 1 child from the comparison school visited the intervention schoolyard, and he visited 1 day only. Of the 379 children enrolled in grades 2–5 in the intervention school for the 2003–2004 school year, 283 (75%) visited the schoolyard at least once over 12 months, and among these 283 students, the mean number of days attended over 12 months was 32 (median 22).

Of the children observed in the schoolyard, 66% were physically active when observed: 33% were recorded as "very active" and 33% as "walking." Interestingly, this did not differ by gender (66% of boys and 67% of girls were active).

Data about observed activity in the intervention and comparison neighborhoods surrounding the schoolyard, as well as the intervention schoolyard, are shown in Table 1. In the 4 weeks before the intervention began, the mean number of children per day observed to be outdoors and physically active (i.e., categorized as "walking" or "very active") in the intervention neighborhood was 3% lower than it was in the comparison neighborhood (65.1 vs 67.4). After the intervention began, the mean number of children observed outdoors (exclusive of the intervention schoolyard) was lower in both neighborhoods, but in each of the 8 quarters, the number of active children was greater in the intervention neighborhood (exclusive of the schoolyard) than it was in the comparison neighborhood. For all 8 quarters combined, we observed 30% (95% CI=18%, 43%) more active children in the intervention neighborhood compared with the comparison neighborhood (50.4 vs 38.7, respectively; $P<.001$). For the entire intervention period, 84% (95% CI=66%, 101%) more children were outdoors and active in the intervention neighborhood and schoolyard combined than were in the comparison neighborhood (71.1 vs 38.7, $P<.001$).

Table 2 shows data about consent for children to participate in surveys regarding sedentary activities and anthropometry at baseline and the 2 follow-up measurement periods. Consent was provided by parents for 67% to 81% of the enrolled children. Of those for whom consent was provided, 90% or more were surveyed and 92% or more were measured.

Data for trends in self-reported sedentary activities the day before the survey are shown in Figure 1. At baseline, children in the intervention school were more likely to report most types of sedentary activities, but over the 2 follow-up surveys, children in the comparison school tended to show an increase in sedentary activities, and children in the intervention school tended to show a decline. For example, from baseline to the 2-year follow-up surveys, the percentage of children who reported watching television increased from 83% to 92% in the comparison school and decreased from 92% to 88% in the intervention school ($P=.018$ for school-by-year interaction). Similarly, the percentage of children who reported watching movies or DVDs

TABLE 1—Observed Physical Activity in Intervention Schoolyard, Intervention Neighborhood, and Comparison Neighborhood: New Orleans, La, 2003–2005

	Mean Children per Day				% Difference Between Intervention and Comparison Neighborhood		Mean Children per Day in Intervention Schoolyard		% Difference Between Intervention Neighborhood and Schoolyard, and Comparison Neighborhood	
	Intervention Neighborhood (Excluding Schoolyard)		Comparison Neighborhood							
Year and Quarter	Total	Active[a]	Total	Active[a]	Total	Active[a]	Total	Active[a]	Total	Active
Preintervention[b]	97.8	65.1	102.0	67.4	–4	–3	0.0	0.0	–4	–3
2003, second	85.3	48.9	81.9	44.1	4	11	21.2	11.6	30	37
2003, third	84.0	51.1	80.0	37.3	5	37	21.9	12.7	32	71
2003, fourth	66.8	41.3	61.8	37.1	8	11	34.3	20.8	64	68
2004, first	88.6	61.4	68.2	40.2	30	53	36.8	24.4	84	114
2004, second	56.9	35.6	51.5	25.8	10	38	11.8	7.8	33	68
2004, third	80.2	53.6	50.4	31.2	59	72	53.0	38.2	165	194
2004, fourth	61.8	43.3	57.5	40.8	8	6	32.3	23.8	64	64
2005, first[c]	90.2	62.9	75.8	50.5	19	25	30.4	18.8	59	62
Mean during intervention	77.1	50.4	65.4	38.7	18	30	31.1	20.7	66	84

[a]Active was defined as running, jumping rope, climbing on play equipment, and so on.
[b]Preintervention measurements made over a 4-week period.
[c]Comparison neighborhood figures include mean of 7.9 children per day (5.7 active children per day) observed in comparison schoolyard.

TABLE 2—Consent to Participate in Surveys and Anthropometry at Intervention and Comparison Schools: New Orleans, La, 2003–2005

	2003		2004		2005	
Participants	Intervention School	Comparison School	Intervention School	Comparison School	Intervention School	Comparison School
Enrollment in grades 2–5, no.	366	344	379	318	381	278
Consented, no. (%)	267 (73)	232 (67)	282 (74)	234 (74)	309 (81)	214 (77)
Refused, no. (%)	36 (10)	33 (10)	27 (7)	24 (8)	40 (10)	33 (12)
Form not returned, no. (%)	63 (17)	79 (23)	70 (18)	60 (19)	32 (8)	31 (11)
Surveyed, no. (% of those consenting)	257 (96)	208 (90)	270 (96)	215 (92)	300 (97)	211 (99)
Measured, no. (% of those consenting)	245 (92)	225 (97)	264 (94)	221 (94)	304 (98)	206 (96)

increased from 61% to 70% in the comparison school and fell from 60% to 50% in the intervention school (P=.004). The percentage of children who reported playing video games increased from 55% to 61% in the comparison school and fell from 62% to 48% in the intervention school (P=.001). These changes were greater in the second year of follow-up than in the first and achieved statistical significance only after the second follow-up year. Changes in computer use, homework, and reading were not statistically significantly different across the surveys between schools.

From the baseline to the 2-year follow-up measurement, there were increases in both the comparison and intervention schools in children's mean body weight (3.89 kg and 2.04 kg, respectively) and BMI (1.12 kg/m^2 and 0.32 kg/m^2, respectively). These changes were not significantly different between the intervention and comparison schools after we controlled for age and gender (P>.40). Similarly, there were no significant differences between schools in the increase in fat mass (kg; body weight [kg] minus fat-free mass [kg]) or percentage body fat (fat mass divided by total body mass) (Table 3).

A cohort of 160 second and third grade children was enrolled in the study at baseline and measured again 2 years later. In this embedded cohort, the mean BMI change increased 2.25 kg/m^2 in the intervention school and 2.39 kg/m^2 in the comparison school (P=.68).

DISCUSSION

We found that when a safe play space was made available within a low-income residential neighborhood, many children used it for nondirected play and most of those who used it were physically active. We also found a substantial (84%) increase in the total number of children outdoors and physically active in the intervention area relative to the comparison area, as well as evidence suggesting the intervention may have reduced the time children spent participating in sedentary activities. Overall, the results provide additional evidence that perceived lack of neighborhood safety may be an important determinant of physical activity in children and suggest that physical activity levels of low-income urban children may be increased through simple environmental interventions that provide safety.

Several research groups have demonstrated that by engaging children in organized physical activity programs they can increase their physical activity levels, and some of these interventions have resulted in reduced body fat in intervention-group children compared with children in comparison groups.[22–29] However, these interventions are generally complex and require substantial training and oversight of staff.[29–32] There is a need to develop additional models for the promotion of physical activity at the community level, models that are less complex to implement and are sustainable. Our interven-

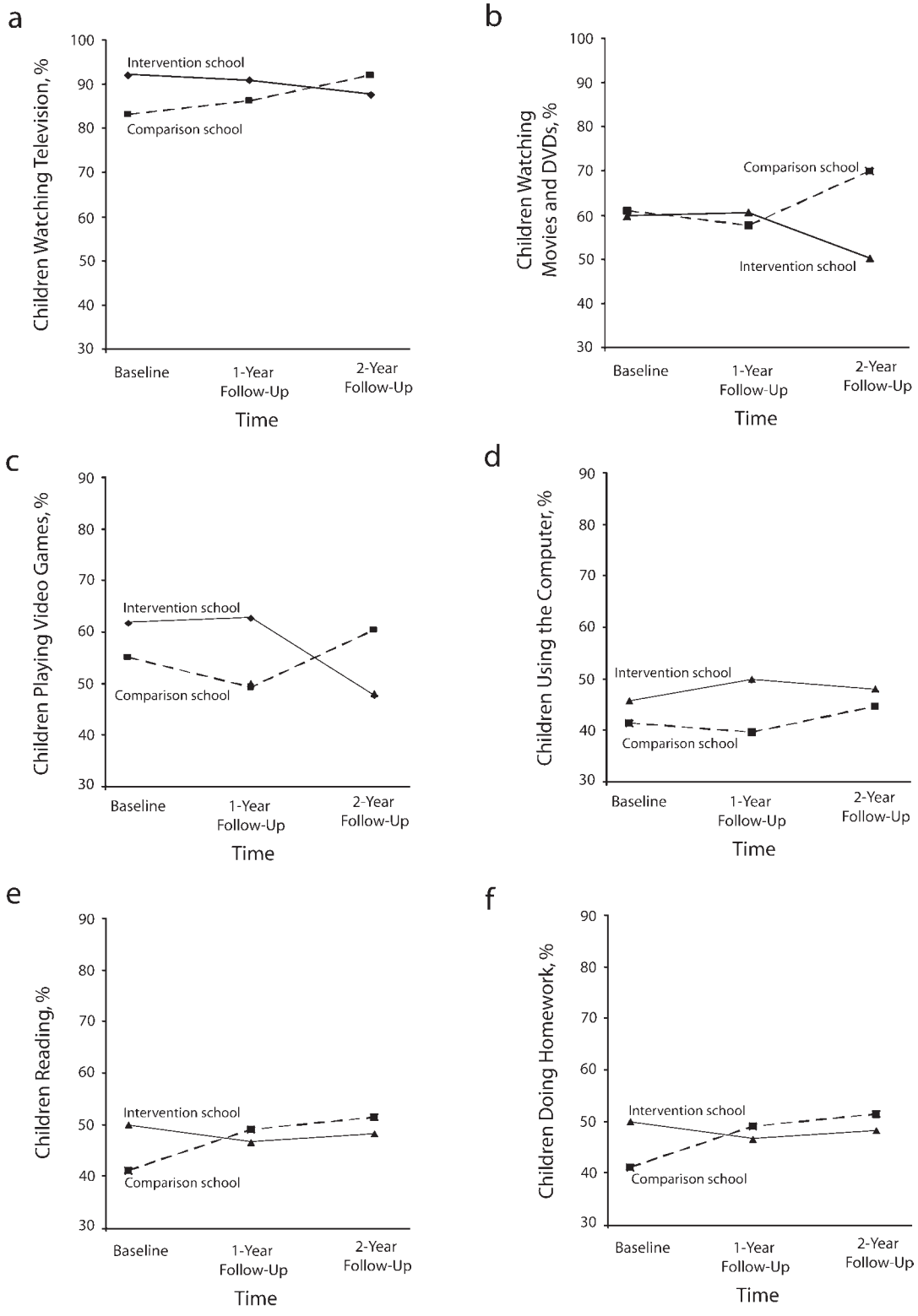

FIGURE 1—Trends in the percentage of children in intervention and comparison schools from baseline to 2-years postintervention who reported participating the previous weekday afternoons and evenings in watching television (a), watching movies and DVDs (b), playing video games (c), using the computer (d), reading (e), and doing homework (f).

TABLE 3—Body Mass and Body Composition of Children in Intervention and Comparison Schools: New Orleans, La, 2003–2005

	2003		2004		2005		Change 2003–2005[a]	
Measure	Intervention School	Comparison School	Intervention School	Comparison School	Intervention School	Comparison School	Intervention School	Comparison School
N	245	225	264	221	304	206		
Weight, kg	37.59	36.19	39.79	38.13	39.63	40.08	2.04	3.89
BMI, kg/m^2, mean	19.49	18.78	19.95	19.23	19.81	19.90	0.32	1.12
Fat-free mass,[b] kg, mean	29.23	28.64	29.67	29.18	30.10	30.51	0.87	1.87
Fat mass,[c] kg, mean	8.36	7.56	10.00	8.99	9.54	9.57	1.18	2.01
% body fat,[d] mean	19.6	19.3	23.0	21.9	21.9	21.1	2.3	1.9

Note: BMI = body mass index (defined as weight in kilograms divided by height in meters squared).
[a]$P > .40$ after we controlled for age and gender; therefore, none of the changes over time are statistically significant.
[b]Children's fat-free mass was estimated from their weight, height, and bioelectrical impedance using a formula derived by Houtkooper.[21] See "Methods" section for details.
[c]Fat mass was measured as body weight (kg) minus fat-free mass (kg). Body weight was measured using bioelectrical impedance analysis. Measurements were performed using the Quantum II Body Composition Analyzer (RJL Systems, Clinton Township, Mich).
[d]Percentage body fat measured as fat mass divided by total body mass.

tion was simple to implement and required almost no staff training. Although it cost our project $49 000 per year, we believe it could be implemented for less in many schoolyards by employing fewer staff. Interestingly, the children who participated in our project spent a greater proportion (66%) of their time physically active than did elementary-school children in other studies who participated in standard physical education classes (37%)[33] or in the Child and Adolescent Trial for Cardiovascular Health project (52%).[23] This may be because in our project, unlike in organized programs, none of children's time was spent in instruction.

Besides the many health benefits of active play, as well as the potential social benefits of children spending time with other children, an intervention such as the one in this project can have health benefits if it simply reduces time spent in sedentary activities, particularly watching television. In fact, in 1 successful school-based intervention to reduce obesity in middle-school children, the benefit was found to be almost entirely mediated by a reduction in television watching.[24] We attempted to assess the effect of our intervention on television watching and other sedentary activities through self-report surveys of children. The trends were encouraging: over the course of the study, there were relative reductions in watching television, watching movies or DVDs, and playing video games. However, it is difficult to draw a firm conclusion from these self-report data, because the reductions occurred in the second year after the intervention began and because much of the relative change appeared to reflect increases in sedentary activities in the comparison school.

Our observation data demonstrated a consistent and substantial increase in the number of children who were outdoors and physically active in the intervention neighborhood (exclusive of the schoolyard) relative to the comparison neighborhood, for the entire intervention period. However, we also found a decrease between pre- and postintervention in the mean number of children active outdoors in both neighborhoods. Weather and other neighborhood environmental factors that change over time are likely to influence outdoor play. Our preintervention measurements were made over a 4-week period, during which the weather was particularly pleasant, and our postintervention measurements were made over 3 months, during which the weather was more varied. We were unable to control for time-dependent environmental factors in the pre- versus postintervention comparison. However, for the neighborhood comparison, we conducted observations simultaneously in both neighborhoods and therefore believe that the interneighborhood comparisons are the most valid measures of intervention effect. Nonetheless, future implementations of this intervention should be evaluated with longer baseline periods to better assess its effect over time as well as across a larger number of neighborhoods. These evaluations should also assess any possible "spillover" effect into surrounding neighborhood areas.

The relative increases in the number of children who played outdoors in the neighborhood are encouraging. However, the fact that the schoolyard was used by children far more on weekdays than on weekends, and more during the school year than during the summer, suggests that connection to the school day is important to the success of this intervention.

Our study has clear limitations. First, because it included only 1 intervention neighborhood and 1 comparison neighborhood, changes in measures of sedentary activities or outdoor play outside of the schoolyards could have been caused by factors unrelated to the intervention. Second, although our measures of physical activity of children in the afternoons were by direct observation and thus were objective, we did not measure objectively their physical activity during the remainder of the day; our measures of sedentary activities were on the basis of self-report by young children, which have limited validity. Objectively measuring 24-hour physical activity in young children has proven to be difficult, which makes evaluation of interventions for this age group challenging.[34,35]

In spite of these limitations, the results of this pilot project are encouraging. Because physical activity levels in US children are uniformly low,[4,5] there is a need to develop interventions that can be applied to large numbers of children at low cost. The simple intervention of providing safe play spaces should be implemented in larger trials and evaluated for its effect on physical activity, sedentary activities, perceived neighborhood safety, and physical activity of children in neighborhoods beyond these play spaces. ■

About the Authors

Thomas A. Farley, Erin T. Baker, Liza T. Watkins, Carolyn C. Johnson, and Larry S. Webber are with the School of

Public Health and Tropical Medicine, Tulane University, New Orleans, La. At the time of the study, Rebecca Meriwether was with the School of Medicine, Tulane University, New Orleans.

Requests for reprints should be sent to Thomas Farley, Tulane University School of Public Health and Tropical Medicine, 1440 Canal St. TW–19, New Orleans, LA 70112 (e-mail: tfarley@tulane.edu).

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Contributors

T.A. Farley and R.A. Meriwether originated the project, designed it with help from the other authors, and oversaw the implementation. T.A. Farley and E.T. Baker analyzed the data, and T.A. Farley wrote the article. E.T. Baker and L.T. Watkins managed the intervention and data collection. C.C. Johnson and L.S. Webber provided advice throughout the project on study design, data collection, and issues regarding conducting research projects in schools.

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Human Participant Protection

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