Impact of an After-School Physical Activity Program on Obesity in Children

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Objective To assess the impact of a 2-year recreational physical activity program in 1044 fourth- and fifth-grade primary schoolchildren from the Province of Cuenca, Spain.

Study design Cluster-randomized controlled trial with 10 intervention and 10 control schools. The program consisted of 3 90-minute sessions of physical activity per week, during 28 weeks every year. Changes in endpoints between baseline (September 2004) and the end of follow-up (June 2006) were compared between the control and intervention group by using mixed regression models, with adjustment for the baseline endpoint value, age, and the school.

Results Compared with control subjects, intervention girls reduced the frequency of overweight (odds ratio, 0.55; 95% CI, 0.39-0.78; $P < .001$). However, intervention was associated with an increase in the percentage of body fat in boys (0.97%; 95% CI, 0.14-1.81; $P = .02$). Girls in the intervention group had lower total cholesterol level (–6.86 mg/dL; 95% CI, –9.70-–4.01; $P < .001$) and apolipoprotein B level (–3.61 mg/dL; 95% CI, –6.27 -–0.95; $P = .008$) than control subjects. Results were similar in boys.

Conclusion In 2 years, the physical activity program lowered the frequency of overweight in girls and reduced total cholesterol and apolipoprotein B in both girls and boys. *(J Pediatr 2010;157:36-42)*.

The prevalence of overweight in Spanish children is among the highest in the world and increasing quickly.[1,2] According to the criteria of Cole et al,[3] the prevalence of overweight in schoolchildren aged 9 to 10 years from Cuenca (Spain) has risen from 24% in 1992 to 31% in 2004.[4] We recently evaluated an after-school program of recreational physical activity to control obesity and other cardiovascular risk factors in schoolchildren in Cuenca. This program, known as the MOVI program, reduced adiposity, increased serum apolipoprotein (apo) A-I concentration, and reduced apo B concentration in a 1-year period.[5]

Few studies, however, have evaluated the effectiveness of interventions lasting >1 year in reducing obesity in children. Six studies have evaluated mixed diet and physical exercise interventions,[6-11] and 2 studies have assessed physical activity interventions.[12,13] The results of the studies were inconsistent. One intervention reduced the frequency of obesity only in girls,[6] another one achieved a reduction in body mass index (BMI) only in boys[7], and 2 interventions prevented excessive weight gain in normal weight students.[11,13] The other studies showed no significant differences in the frequency of obesity between the control and intervention groups.[8-10,12]

This study assessed the 2-year impact of the MOVI program on obesity, blood lipid levels, and blood pressure in 9- to 10-year-old schoolchildren in Cuenca.

Methods

The study methods have been reported elsewhere.[5] In brief, a cluster randomized trial was conducted to prevent contamination between intervention and control participants. The design, execution, and reporting of the study adhered to CONSORT recommendations on cluster randomized studies.[14]

We selected 20 schools in 20 towns in the Cuenca Province. Except for the provincial capital (population, 48 000), all the towns were small (population range, 1800-6500), and their main economic activities were farming, food processing, and mechanical industries. All participating schools were public and had at least 1 complete fourth-grade class and 1 complete fifth-grade class. In towns with ≥2

apo	Apolipoprotein
BMI	Body mass index
cpm	Count per minute
DBP	Diastolic blood pressure
OR	Odds ratio
P	Percentiles
SBP	Systolic blood pressure
TST	Triceps skin-fold thickness

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schools, only 1 was chosen at random to avoid contamination of the intervention. The schools were randomized to the intervention and control groups (10 schools in each group). Schools were informed of the randomization results after they agreed to participate in the study.

Intervention was conducted during 2 academic years, the first from September 2004 to June 2005 and the second from September 2005 to June 2006. The boards of governors (community participatory group in each school) and the children's parents were informed of the study's aims and methods. Parents gave written consent at the beginning of each academic year for their children to participate. The study was also presented to the children at the beginning of each academic year, and they provided verbal consent. Participating children were free of serious learning difficulties and physical or mental disorders that could impede participation in the programmed physical activities. The Cuenca Clinical Research Ethics Committee approved the study, and an insurance policy was purchased to cover possible injuries during the physical activity program.

A thorough description of MOVI can be found at www.movidavida.org. In brief, MOVI was a noncompetitive and recreational physical activity program, adapted to the children's age and held after classes in the school's sports facilities. MOVI consisted of 3 weekly 90-minute sessions per week, during approximately 28 weeks every year. The physical activity sessions were planned by 2 qualified physical education teachers and were supervised by sports instructors. The activities included sports with alternative equipment (pogo sticks, frisbees, jumpimg balls, small parachutes, etc), cooperative games, dance, and recreational athletics. The sports instructors underwent a 2-day training program, and a written plan of activities for each session was developed to ensure program standardization in all 10 intervention schools. An RT3 Tri-axial accelerometer (Stayhealthy, Monrovia, California)[15] used in 75 randomly selected children found a mean count per minute (cpm) per session of 1345.48 (SD = 1023) and 33.5% of time dedicated to >1700 cpm activity during each session. In contrast, the mean cpm at the same time on days with no program session was 527.38 (SD = 741.28). The program cost was 28 Euros per child per month. Access by and participation of the children in the MOVI program was free of charge.

A system of rewards was developed (t-shirts, caps, and table games with the MOVI logo) to encourage adherence to the program during its 2-year duration. Finally, the children's parents were given a contact telephone number, through which they could obtain information, make suggestions, or ask about the program.

The standard physical education curriculum (3 hours per week of physical activity at low to moderate intensity) was also provided in both the control and intervention schools.

Both in the control and intervention groups, the endpoints were measured 3 times: at the beginning of the program (September 2004), at the end of the first year (June 2005), and at the end of the second year (June 2006). We measured weight with a Seca 770 portable electronic scale (Seca Inc., Hanover, Maryland), height with a Seca 222 stadiometer (Seca), triceps skin-fold thickness (TST) with a Holtain caliper (Holtain Inc., Crymych, United Kingdom), percentage (%) body fat with the Tanita BC-418 bioimpedance analysis system (Tanita Corp., Arlington Heights, Illinois), systolic and diastolic blood pressure (SBP and DBP) with the OMRON M5-I sphygmomanometer (Omron Advanced Systems, Inc., Santa Clara, California), and lipid levels in a 12-hour fasting blood sample collected in the morning. Methods for endpoint measurement have been reported in full elsewhere.[5] However, 2 trained and certified nurses performed the anthropometric and blood pressure measurements. To minimize variability, we used the mean of 2 measurements of weight and height, the mean of 3 measures of TST, and the mean of 3 readings of percent body fat. The reliability of the BMI obtained as weight in kg divided by squared height in cm, TST, and % body fat measurements was very high (intraclass correlation coefficient, 0.99 for BMI and 0.97 for both TST and percent body fat). International BMI cutoff points were used to define overweight (including obesity)[3] and thinness.[16]

By using methods that took cluster randomization in account,[17] we estimated that approximately 400 boys and 400 girls from 20 schools would be needed to show differences of 0.5 kg/m^2 (SD = 2 kg/m^2) in BMI between the intervention and control group with a 2-tailed $\alpha = 0.05$ and 80% power. On the basis of information from children of the same age enrolled in schools in Cuenca,[4] our calculations assumed a mean BMI of 18 kg/m^2 for boys and girls, a mean cluster (school) size of 55 pupils, and an intracluster correlation coefficient for BMI of 0.009.

The main level of inference was the comparison of changes from baseline (September 2004) to the end of the 2-year follow-up (June 2006) between intervention and control children. The primary endpoints were BMI, TST, and percent body fat, and the secondary endpoints were blood lipid level and blood pressure.

Data were analyzed with mixed regression models, in which the dependent variable was each endpoint at the end of the second year of intervention. Models were adjusted for the baseline values of each endpoint, age, and school (random effect). The effect of the intervention was included in the model as a fixed effect, by using an independent dummy term with a value of 1 for intervention schools and 0 for control schools. Results were expressed as the absolute difference between intervention and control children in the changes in endpoints from baseline to the end of the second year of follow-up, with its 95% CI. When the dependent variable was the frequency of excess weight (overweight or obesity) and thinness, the results were expressed as odds ratios (OR) with their 95% CI.

The models were built in boys and girls separately, because of different patterns of growth, height, skin-fold, and percent body fat. We tested whether the effect of intervention differed between boys and girls by using interaction terms that were the product of the intervention by sex. Because some earlier interventions in students have been associated with an increase in the prevalence of thinness,[18] the impact of the MOVI program on 3 BMI categories proposed by Cole et al[3,16] was also assessed. We also examined whether the results were sensitive to the school population, because 1 of the schools was located in the provincial capital, an urban population 10-times larger than that of the towns of the other schools. This was done by repeating the analyses after excluding this school.

Analyses were performed according to the intention-to-treat, with children analyzed in their original randomized allocation, regardless of the number of sessions of the MOVI program they attended. Analyses were replicated to assess the impact of MOVI from baseline to the end of the first year of follow-up.

Statistical significance was set at P value <.05. The analyses were performed with SAS software, version 9.1 (SAS Institute Inc., Cary, North Carolina).[19] Mixed generalized linear models were constructed with PROC GENMOD when the dependent variable was dichotomous and PROC MIXED when it was continuous. To check the validity of the analyses, we fitted comparable models with the PROC PHREG and PROC GLM procedures, and similar results were obtained.[20]

Results

Of the 20 schools invited, all agreed to participate in the intervention study. The age range of participating children was 9 to 11 years at study baseline. The 10 schools in the intervention group included 691 children. Of these children, 513 (74.2%) agreed to participate in the baseline measurements, and 375 (73.1%) remained in the study until the end of the second year1. In total, 90 of 234 (81.2%) boys, and 185 of 231 (80.1%) girls with baseline measures reported data at the end of the study. The 10 schools in the control group included 718 children; of these children, 606 (84.4%) agreed to participate in the baseline measurements, and 546 (90.1%) provided information at the end of the second year. Corresponding figures were 257 of 80 (91.8%) for boys, and 289 of 299 (96.6%) for girls (**Figure**; available at www.jpeds.com).

An average of 69 sessions of physical activity was conducted in the first year, and another 80 sessions were conducted in the second year in the intervention group at each school. The children attended 78.4% of the sessions in the first year and 71.6% of the sessions in the second year. Each student participated in an average of 54 physical activity sessions in the first year and in 57 sessions in the second year.

Changes in endpoints between baseline and the end of the second year of the study are shown in **Table I**. The intervention was associated with a lower frequency of overweight in girls (OR, 0.55; 95% CI, 0.39-0.78; $P < .001$), and also with increased height in girls (1.28 cm; 95% CI, 0.84-1.72 cm; $P < .001$) and boys (0.77 cm; 95% CI, 0.30-1.25 cm; $P < .001$). There were no statistically significant differences in the frequency of thinness and in mean TST between the intervention and control groups in either sex. However, in comparison with the boys of the control group, boys in the intervention group showed an increase in percent body fat (0.97%; 95% CI, 0.14-1.81; $P = .02$).

The girls in the intervention group had lower total cholesterol levels (–6.86 mg/dL; 95% CI, –9.70-–4.01; $P < .001$) and apo B levels (–3.61 mg/dL; 95% CI, –6.27-–0.95; $P = .008$). The results were similar for boys. However, the MOVI program was not associated with statistically significant changes in apo A-I, triglycerides, or blood pressure in either sex, although SBP increased 3.67 mm Hg (95% CI, 1.06-6.28; $P = .006$) in boys from the intervention compared with boys in the control group.

Of the interaction terms used to examine whether the effects of the intervention varied between girls and boys, only those for BMI ($P = .02$), percent body fat ($P < .001$), and SBP ($P = .04$) reached statistical significance. Results at the end of the first year of study are shown for comparison with the second year results (**Table I**).

In the course of the 2 years, the intervention was associated with a decrease in total cholesterol and apo B levels in each category of baseline BMI, although statistical significance was not achieved ($P = .08$) in the thinness category (**Table II**; available at www.jpeds.com). No statistically significant differences between children in the intervention group and children in the control group were observed in other endpoints, with the exception of a height increase in intervention children from the normal weight and overweight categories and a decrease in SBP in control children from the thinness category (**Table II**). The results did not vary substantially when the school located in the provincial capital was excluded from the analyses.

Discussion

Program effectiveness diminished in the second year compared with the first year. The intervention showed a good overall adherence rate, but 19.4% of the participants in the intervention in the first year did not finish the second year of the MOVI program. There were no major differences in the effectiveness of the program in the first year between the children who remained in the program until the end of the second year and the children who left, except in a stronger tendency toward lower TST in the students who stayed until the end of the program (**Table III**; available at www.jpeds.com). This suggests that the diminished effectiveness of MOVI in reducing adiposity at the end of the second year was caused by factors specific to the second year. Because the number of physical activity sessions was similar in both years of the program (54 sessions in the first year versus 57 sessions in the second year), a possible explanation for the diminished effectiveness of MOVI in the second year is change in the physical activity in the control group. MOVI was widely publicized in the mass media of Cuenca during its first year (>14 press reports, 20 radio and television interviews, and 1100 visits to the program website registered). The satisfaction of the students participating in the MOVI program and their families was high. These led

Table I. Changes in obesity, blood pressure, and blood lipids between baseline and the end of the second year of the study in intervention versus control schoolchildren, by sex

	Girls				Boys			
	Control n = 289	Intervention n = 185	Adjusted difference of intervention versus control (95% CI)*	*P* value	Control n = 257	Intervention n = 190	Adjusted difference of intervention versus control (95% CI)*	*P* value
% overweight or obesity								
Baseline	29	32			33	30		
After 1 year	28	30	0.81 (0.33-2.00)[†]	.64	31	27	0.82 (0.42-1.60)[†]	.57
After 2 years	27	26	0.55 (0.39-0.78)[†]	<.001	32	28	0.84 (0.38-1.85)[†]	.66
% underweight								
Baseline	10	9			7	11		
After 1 year	10	8	0.87 (0.26-2.95)[‡]	.82	7	7	0.25 (0.07-0.85)[‡]	.03
After 2 years	9	8	1.05 (0.41-2.69)[‡]	.92	6	9	0.67 (0.24-1.91)[‡]	.46
Weight (kg)[§]								
Baseline	36.0 (9.5)	36.2 (8.4)			37.2 (9.0)	36.2 (8.9)		
After 1 year	37.9 (9.8)	38.5 (8.6)	0.23 (–0.13-0.60)	.20	38.9 (9.3)	38.5 (9.4)	0.49 (0.17-0.82)	.003
After 2 years	43.1 (11.0)	43.6 (9.3)	0.28 (–0.31-0.87)	.34	43.3 (10.4)	43.3 (10.7)	0.95 (0.19-1.71)	.01
Height (cm)[§]								
Baseline	138.8 (7.1)	139.3 (6.9)			140.1 (6.7)	140.2 (6.9)		
After 1 year	141.6 (7.4)	143.0 (7.2)	0.87 (0.54-1.19)	<.001	142.5 (6.9)	143.1 (7.4)	0.59 (0.17-1.02)	.006
After 2 years	148.0 (7.6)	149.7 (7.3)	1.28 (0.84-1.72)	<.001	148.1 (7.5)	149.0 (8.1)	0.77 (0.30-1.25)	.001
BMI (kg/m^2)[§]								
Baseline	18.5 (3.7)	18.5 (3.3)			18.8 (3.4)	18.3 (3.5)		
After 1 year	18.7 (3.7)	18.7 (3.2)	–0.14 (–0.35-0.07)	.18	19.0 (3.4)	18.6 (3.5)	0.10 (–0.11-0.30)	.34
After 2 years	19.4 (3.8)	19.3 (3.3)	–0.18 (–0.42-0.06)	.15	19.6 (3.5)	19.3 (3.7)	0.26 (–0.02-0.54)	.07
TST (mm)[§]								
Baseline	17.2 (6.4)	18.4 (6.6)			15.5 (6.7)	15.2 (7.7)		
After 1 year	17.4 (6.5)	16.7 (6.2)	–1.61 (–2.45-–0.78)	<.001	15.9 (7.1)	14.5 (6.8)	–1.29 (–1.79-–0.79)	<.001
After 2 years	17.1 (6.5)	17.2 (6.4)	–0.67 (–1.55-0.22)	.14	16.2 (7.2)	15.7 (7.7)	–0.32 (–1.01-0.36)	.35
% body fat[§]								
Baseline	26.2 (6.2)	25.7 (6.0)			23.3 (6.8)	21.8 (6.7)		
After 1 year	26.1 (6.2)	25.0 (5.6)	–0.65 (–1.16-–0.15)	.01	23.2 (6.6)	21.6 (6.3)	–0.21 (–0.70-0.27)	.39
After 2 years	25.9 (5.9)	25.2 (5.7)	–0.23 (–0.99-0.53)	.55	22.7 (6.8)	22.1 (7.1)	0.97 (0.14-1.81)	.02
SBP (mm Hg)[§]								
Baseline	107.5 (9.5)	103.9 (10.1)			109.6 (9.6)	105.5 (7.9)		
After 1 year	103.1 (8.9)	101.5 (8.2)	0.08 (–1.71-1.88)	.93	105.6 (9.1)	105.0 (8.8)	1.43 (–0.26-3.12)	.10
After 2 years	105.0 (8.9)	104.8 (8.3)	0.93 (–1.65-3.50)	.48	105.6 (9.4)	107.3 (8.7)	3.67 (1.06-6.28)	.006
DBP (mm Hg)[§]								
Baseline	66.6 (7.4)	64.3 (7.0)			65.6 (7.7)	62.9 (6.6)		
After 1 year	63.9 (6.7)	62.8 (6.1)	–0.07 (–1.51-1.38)	.93	62.5 (6.6)	63.1 (6.5)	1.59 (–0.02-3.20)	.05
After 2 years	64.7 (6.1)	63.8 (5.9)	0.07 (–1.64-1.78)	.94	63.1 (6.8)	63.3 (6.8)	1.70 (–0.11-3.51)	.07
Total cholesterol (mg/dL)[§]								
Baseline	169.4 (26.0)	170.3 (28.8)			171.1 (30.5)	167.2 (25.2)		
After 1 year	163.2 (25.0)	165.3 (25.8)	0.68 (–2.71-4.08)	.69	164.1 (24.3)	164.1 (23.2)	2.16 (–0.77-5.08)	.15
After 2 years	160.5 (24.1)	154.8 (23.6)	–6.86 (–9.70-–4.01)	<.001	163.9 (26.2)	157.2 (22.0)	–4.39 (–7.94-–0.85)	.01
apo B (mg/dL)[§]								
Baseline	65.9 (14.1)	68.0 (15.4)			65.5 (16.8)	63.2 (13.1)		

(continued)

Table I. Continued

	Girls				Boys			
	Control n = 289	Intervention n = 185	Adjusted difference of intervention versus control (95% CI)*	*P* value	Control n = 257	Intervention n = 190	Adjusted difference of intervention versus control (95% CI)*	*P* value
After 1 year	72.0 (14.5)	68.3 (14.0)	−5.33 (-9.96—0.71)	.05	70.8 (14.8)	66.2 (13.1)	−4.29 (8.66-0.09)	.05
After 2 years	63.8 (13.1)	61.2 (14.1)	−3.61 (−6.27—0.95)	.008	64.9 (15.0)	60.6 (13.1)	−2.31 (−4.67-0.04)	.05
apo A-I (mg/dL)§								
Baseline	146.1 (21.0)	140.6 (18.3)			149.6 (20.4)	148.4 (19.6)		
After 1 year	138.4 (19.6)	150.1 (18.8)	14.76 (9.28-20.23)	<.001	144.4 (21.0)	157.4 (20.2)	14.50 (8.81-20.2)	<.001
After 2 years	147.2 (20.4)	145.7 (19.2)	2.06 (−2.43-6.55)	.37	152.9 (21.0)	152.2 (21.1)	0.87 (−3.27-5.01)	.68
Triglycerides (mg/dL)§								
Baseline	64.4 (30.3)	63.9 (29.3)			56.8 (26.5)	57.4 (31.2)		
After 1 year	67.5 (29.0)	63.8 (25.9)	−3.79 (−8.57-0.99)	.12	59.3 (26.5)	57.2 (28.1)	−0.57 (−7.57-6.42)	.87
After 2 years	69.1 (30.5)	71.1 (28.4)	2.65 (−4.90-10.21)	.49	59.7 (24.6)	67.8 (44.4)	7.03 (−4.14-18.20)	.22

*Differences adjusted for baseline value, age, and cluster (random effect) with generalized mixed linear models.
†OR of overweight or obesity in intervention versus control children, adjusted for baseline value, age, and cluster (random effect) with generalized mixed linear models.
‡OR of underweight in intervention versus control children, adjusted for baseline value, age, and cluster (random effect) with generalized mixed linear models.
§For continuous variables, means (SD) are shown in intervention and control schoolchildren.

local councils in towns with control groups to offer free-of-charge opportunities for physical activity at municipal facilities during the second year of the study.

Few studies of the effectiveness of physical activity in the prevention of obesity in children and adolescents have examined other cardiovascular risk factors, such as blood lipid concentration or blood pressure.[8,10,13] Luepker et al observed no differences in blood pressure or cholesterol level in treatment groups.[8] Other studies reported an increase in high-density lipoprotein cholesterol level in the intervention group, although were no differences in total cholesterol level.[10,13] In the MOVI program, favorable results were obtained for apo A-I level in the first year and for total cholesterol and apo B levels in the 2 years overall. These findings are consistent with those of a recent meta-analysis of controlled studies of aerobic exercise and serum lipid concentration in children and adolescents.[21] In this meta-analysis, the reduction of low-density lipoprotein cholesterol level with physical exercise increased as the children grew older, and the increase in high-density lipoprotein cholesterol level was greater in the children who had the lowest concentration at baseline. The older age of the children in the second year of the MOVI program could have influenced the greater reduction in apo B level found in the second year than in the first year. In contrast, the higher baseline levels of apo A-I at the end of the first year could have made it difficult to observe additional reductions in the second year.

There is no clear evidence that physical activity reduces blood pressure in normotensive children.[22] After a 4-year follow up, SBP and DBP showed a greater increase in intervention than in control children of a multilevel intervention study in French schools.[13] The MOVI program was not associated with changes in blood pressure, except an increase in DBP in the first year and in the SBP in the second year in boys. We do not know the reasons for these findings, but they could be related to changes in the percent body fat of boys.

A possible explanation of the greater effectiveness of the MOVI program in preventing obesity in girls is that the sport activities promoted by local councils were mainly soccer and basketball, for which boys have greater predilection than girls. As a result, boys in the control group may have had more physical activity overall than the girls. It also is possible that some boys, after participating for 1 year in the MOVI program, decided to stop practicing the sports that they had usually practiced because their schoolwork required more dedication as they grew older. In other words, boys may have compensated for their increased physical activity in the MOVI program by reducing their sports activity outside MOVI. Finally, we do not know the reasons for the increase in height in children of both sexes in the intervention group and for the gain in percent body fat in the boys in the intervention group.

Our study had several limitations. First, the study was conducted in a rural area, which calls for reproduction in an urban setting. Second, anthropometric and blood pressure measurements were not blinded to intervention allocation.

However, weight, percent body fat, and blood pressure were measured with automatic digital devices, which reduced observer error. Our study only used objective endpoints, with highly reproducible measurements, leading to the intervention being tested more rigorously than in studies with self-reported endpoints.[23] Third, because of cultural reasons and the limited privacy of school-based physical examinations, data on sexual maturity were not obtained. Because study children are likely to have had different stages of maturity, this type of information might have been useful to interpret differences between individuals in obesity, lipid profile, and blood pressure. Fourth, we did not measure waist circumference and blood levels of fasting glucose and insulin at baseline; thus, data are lacking on the impact of the MOVI program on essential components of cardiometabolic risk. Fifth, statistical analyses should have adjusted for leisure-time physical activity within and away from the schools, physical fitness, and food consumption. Unfortunately, this information was not collected. Sixth, a recent review has concluded that adiposity prevention is more effective when interventions are mandatory.[24] However, our intervention could be considered obligatory for the children who agreed to participate. It was scheduled as part of the afternoon activities offered by the school. Finally, the available sample size did not allow to present results broken down simultaneously by sex and BMI.

Our study also had an important strength. Physical activity in MOVI was the same for all participants, regardless of sex or BMI. In childhood, physical activity programs have educational and socializing value; thus, interventions with sex-specific components might be unsuitable because of possible sexist connotations. School interventions targeting only the obese children may have an unwanted stigmatizing effect. Therefore, we designed a physical activity program of sufficient duration and intensity to achieve a negative energy balance in overweight children, but without causing weight loss in children who were of normal weight or were underweight. Accordingly, the MOVI program produced a modest reduction in overweight in girls without increasing underweight.

Further research is needed to assess the incremental effectiveness of a few components that can be added to the MOVI program. The duration and frequency of the physical activity sessions could be increased as many as 2 hours per session during 4 days per week. Also, open-air physical activities in the area surrounding the participating schools could be added during the weekends, as part of a recreational program; specifically, biking and trekking might offer an opportunity for enjoying a time frequently spent in television-watching or in playing with computer and video games. ■

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50 Years Ago in *The Journal of Pediatrics*

Henoch-Schönlein Syndrome-Anaphylactoid Purpura

Blattner RJ. J Pediatr 1960:57:137-9.

Blattner analyzed the state of the art of Henoch-Schönlein syndrome-anaphylactoid purpura, emphasizing the underlying hypersensitivity phenomenon with acute inflammatory exudates that surrounds the small blood vessels of the corium and the characteristics of renal involvement. The author pointed out that although the true incidence was unknown, it appeared to be on the increase. Indeed, Henoch-Schönlein purpura is the most common childhood primary systemic vasculitis today. Clinically, the diagnosis is usually straightforward, and no single laboratory test is available. Well-validated criteria can help differentiate it from other processes with similar clinical features.

Henoch-Schönlein purpura is now well recognized as a leukocytoclastic vasculitis with a perivascular accumulation of neutrophils and mononuclear cells. Immunofluorescence studies have revealed vascular depositions of immunoglobulin A (IgA) and C3 in the affected skin, although similar changes may be observed in skin unaffected by the rash. The cause of Henoch-Schönlein purpura is unknown, but it is likely that IgA has a pivotal role in the pathogenesis of the disease, a hypothesis supported by the almost universal deposition of IgA in lesional vascular tissue. Galactose deficiency of O-linked glycans in the hinge region of IgA1 has recently been reported in adults with IgA nephropathy and children with Henoch-Schönlein purpura.

An important breakthrough has been the advancement in the knowledge of renal involvement from the pathologic patterns to the risk of developing end-stage renal disease. The success of therapy, however, is still awaiting more robust evidence than has been presented to date. Indications for diagnostic renal biopsy in children with Henoch-Schönlein purpura are well established. The basic pattern of glomerular involvement is that of mesangial injury or mesangial proliferative glomerulonefritis with varying degrees of hypercellularity, similar to the lesions in the IgA nephropathy. Glomerular changes were graded according to a classification devised by a pathologist from the International Study of Kidney Disease in Children. Occasionally, patients develop rapidly progressive glomerulonephritis accompanied by a high percentage of crescentic glomerular changes in renal biopsy results.

The severity of renal involvement is the major factor determining the long-term outcome of children with Henoch-Schönlein purpura nephritis. Currently, prescribed treatments for Henoch-Schönlein purpura nephritis are not adequately guided by evidence obtained in robust randomized placebo-controlled trials with outcome markers related to the progression to end-stage renal disease. Further studies are needed to arrive at well-grounded, evidence-based conclusions.

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Table II. Changes in obesity, blood pressure, and blood lipid level between baseline and the end of the second year of the study in intervention versus control schoolchildren, with baseline body mass index

	Control*	Intervention†	Adjusted difference of intervention vs control (95% CI)*	*P* value
Thinness (n = 82)				
Weight (kg)				
Baseline	26.8 (2.5)	25.6 (3.1)	0.13 (–0.66-0.92)	.75
After 2 years	32.4 (3.7)	31.0 (4.0)		
Height (cm)				
Baseline	137.9 (5.6)	135.1 (6.1)	0.53 (–0.65-1.71)	.37
After 2 years	146.9 (6.8)	143.9 (7.8)		
BMI (kg/m²)				
Baseline	14.0 (0.6)	14.0 (0.7)	0.008 (–0.30-0.31)	.95
After 2 years	15.0 (0.9)	14.9 (0.9)		
TST (mm)				
Baseline	8.8 (2.1)	8.7 (2.3)	–0.13 (–0.9-0.62)	.72
After 2 years	9.5 (2.6)	8.8 (2.2)		
% body fat				
Baseline	16.8 (2.5)	16.5 (2.7)	0.06 (–0.75-0.86)	.89
After 2 years	17.4 (3.3)	16.6 (2.7)		
SBP (mm Hg)				
Baseline	107.6 (8.5)	102.0 (8.4)	4.82 (0.95-8.69)	.01
After 2 years	102.7 (8.6)	105.4 (7.6)		
DBP (mm Hg)				
Baseline	63.6 (6.9)	62.1 (8.4)	1.04 (–2.28-4.29)	.54
After 2 years	61.7 (6.6)	62.4 (6.4)		
Total cholesterol (mg/dL)				
Baseline	166.5 (21.9)	166.9 (33.5)	–9.11 (–17.03-–1.19)	.02
After 2 years	162.9 (20.8)	154.2 (25.1)		
apo-B (mg/dL)				
Baseline	62.0 (16.6)	64.9 (15.4)	–3.92 (–7.67-–0.17)	.04
After 2 years	60.8 (12.1)	58.5 (11.7)		
apo-AI (mg/dL)				
Baseline	150.8 (22.1)	148.9 (24.6)	–1.09 (–7.78-5.60)	.74
After 2 years	155.6 (18.7)	155.1 (20.8)		
Triglycerides (mg/dL)				
Baseline	50.7 (19.5)	49.0 (16.6)	7.98 (–2.13-18.08)	.12
After 2 years	55.7 (18.5)	62.3 (25.8)		
Normal weight (n = 552)				
Weight (kg)				
Baseline	32.5 (4.4)	33.0 (4.8)	0.63 (−0.14;1.40)	.11
After 2 years	38.7 (5.8)	40.0 (6.1)		
Height (cm)				
Baseline	140.0 (6.4)	139.3 (6.5)	1.26 (0.81-1.71)	<.001
After 2 years	146.5 (7.1)	149.2 (7.5)		
BMI (kg/m²)				
Baseline	17.0 (1.4)	17.0 (1.5)	–0.03 (–0.37-0.31)	.86
After 2 years	17.9 (1.8)	17.9 (1.7)		
TST (mm)				
Baseline	13.5 (4.1)	13.9 (4.7)	–0.52 (–1.16-0.12)	.11
After 2 years	14.1 (4.7)	13.8 (4.6)		
% body fat				
Baseline	22.0 (4.1)	21.3 (3.9)	0.04 (–0.73-0.82)	.91
After 2 years	21.9 (4.4)	21.1 (4.0)		
SBP (mm Hg)				
Baseline	107.7 (9.5)	104.7 (8.8)	2.33 (–0.46-5.13)	.10
After 2 years	104.6 (8.9)	105.7 (9.0)		
DBP (mm Hg)				
Baseline	64.9 (7.1)	62.9 (6.6)	0.13 (–1.51-1.78)	.87
After 2 years	63.2 (6.1)	62.4 (6.2)		
Total cholesterol (mg/dL)				
Baseline	169.6 (28.9)	168.0 (25.9)	–4.82 (–8.22-–1.51)	.005
After 2 years	161.5 (25.1)	154.7 (21.9)		
apo-B (mg/dL)				
Baseline	64.5 (14.9)	64.1 (13.6)	–3.24 (–5.48-–1.00)	.005
After 2 years	63.3 (13.8)	58.7 (12.4)		
apo-AI (mg/dL)				
Baseline	149.3 (21.0)	146.6 (20.0)	2.88 (–2.02-7.78)	.25

(*continued*)

Table II. Continued

	Control*	Intervention†	Adjusted difference of intervention vs control (95% CI)*	*P* value
After 2 years	151.4 (20.7)	151.2 (20.6)		
Triglycerides (mg/dL)				
Baseline	53.7 (19.7)	55.4 (26.4)	5.31 (–3.05-13.67)	.21
After 2 years	60.9 (25.4)	66.2 (39.1)		
Overweight or obesity (n= 287)				
Weight (kg)				
Baseline	47.0 (8.4)	45.6 (7.0)	0.55 (–0.27-1.38)	.18
After 2 years	54.8 (9.7)	53.9 (8.1)		
Height (cm)				
Baseline	142.6 (7.1)	142.0 (7.0)	0.65 (0.09-1.21)	.02
After 2 years	151.4 (7.6)	151.4 (7.3)		
BMI (kg/m^2)				
Baseline	22.9 (2.6)	22.9 (2.8)	0.06 (–0.28-0.39)	.73
After 2 years	23.8 (2.9)	23.4 (2.6)		
TST (mm)				
Baseline	23.7 (4.6)	24.8 (5.0)	–0.26 (–1.54-1.01)	.69
After 2 years	23.8 (5.6)	24.2 (5.4)		
% body fat				
Baseline	32.0 (4.8)	31.5 (5.1)	0.72 (–0.27-1.71)	.15
After 2 years	30.9 (5.3)	30.8 (5.3)		
SBP (mm Hg)				
Baseline	110.0 (9.9)	107.2 (9.1)	1.00 (–1.11-3.11)	.35
After 2 years	107.6 (9.4)	107.1 (8.2)		
DBP (mm Hg)				
Baseline	69.1 (7.6)	66.0 (6.7)	1.21 (–0.62-3.04)	.19
After 2 years	66.2 (6.8)	66.0 (6.1)		
Total cholesterol (mg/dL)				
Baseline	171.0 (28.0)	171.9 (27.7)	–6.53 (–11.66-–1.41)	.013
After 2 years	162.5 (26.2)	158.6 (23.9)		
apo B (mg/dL)				
Baseline	68.6 (15.8)	69.9 (16.0)	–2.44 (–5.21-0.33)	.08
After 2 years	66.7 (14.3)	65.7 (14.9)		
Apo AI (mg/dL)				
Baseline	143.3 (20.3)	136.5 (15.4)	0.17 (–5.71-6.06)	.95
After 2 years	145.1 (20.8)	142.2 (19.2)		
Triglycerides (mg/dL)				
Baseline	77.1 (37.0)	74.4 (34.8)	0.008 (–11.07-11.08)	.99
After 2 years	75.2 (32.3)	76.6 (34.5)		

*Values are means (SD).
†Differences adjusted for baseline value, age, and cluster (random effect) with generalized mixed linear models.

Table III. Changes in obesity, blood pressure, and blood lipid level between baseline and the end of the first year of follow-up in intervention versus control schoolchildren, by participation in the second year of the study

	Children who participated in the program until the end of the second year	Children who withdrew from the program after the first year
	Adjusted difference of intervention versus control (95% CI)*	Adjusted difference of intervention versus control (95% CI)*
% overweight or obesity	0.80 (0.41-1.58)†	0.38 (0.06-2.17)†
BMI (kg/m^2)	–0.04 (–0.21-0.13)	0.06 (–0.41-0.53)
TST (mm)	–1.44 (–2.08-0.79)	0.06 (–1.73-1.84)
% body fat	0.45 (–0.87-0.02)	0.48 (–1.74-0.79)
SBP (mm Hg)	0.88 (–0.63-2.39)	0.58 (–3.21-4.37)
DBP (mm Hg)	0.81 (–0.56-2.17)	1.40 (–0.89-3.71)
Total cholesterol (mg/dL)	1.39 (–1.16-3.93)	–5.40 (–14.31-3.52)
apo B (mg/dL)	–4.82 (–9.07-–0.58)	–3.66 (–9.05-1.73)
apo A-I (mg/dL)	14.71 (9.56-19.86)	7.9 (–0.72-16.55)
Triglycerides (mg/dL)	–2.52 (–7.99-2.95)	–9.43 (–25.01-6.16)

*Differences adjusted for baseline value, age, and cluster (random effect) with generalized mixed linear models.
†OR of overweight or obesity in intervention versus control children, adjusted for baseline value, age, and cluster (random effect) with generalized mixed linear models.

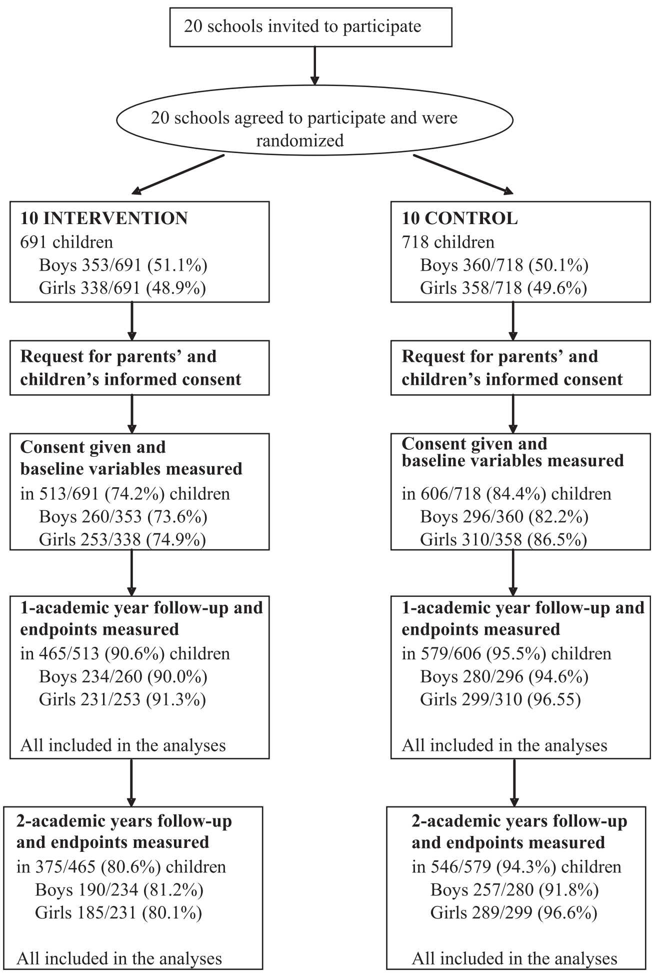

Figure. Flow chart with the progress of clusters and individuals across the trial.