Reducing Children's Television Viewing to Prevent Obesity

A Randomized Controlled Trial

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Context Some observational studies have found an association between television viewing and child and adolescent adiposity.

Objective To assess the effects of reducing television, videotape, and video game use on changes in adiposity, physical activity, and dietary intake.

Design Randomized controlled school-based trial conducted from September 1996 to April 1997.

Setting Two sociodemographically and scholastically matched public elementary schools in San Jose, Calif.

Participants Of 198 third- and fourth-grade students, who were given parental consent to participate, 192 students (mean age, 8.9 years) completed the study.

Intervention Children in 1 elementary school received an 18-lesson, 6-month classroom curriculum to reduce television, videotape, and video game use.

Main Outcome Measures Changes in measures of height, weight, triceps skinfold thickness, waist and hip circumferences, and cardiorespiratory fitness; self-reported media use, physical activity, and dietary behaviors; and parental report of child and family behaviors. The primary outcome measure was body mass index, calculated as weight in kilograms divided by the square of height in meters.

Results Compared with controls, children in the intervention group had statistically significant relative decreases in body mass index (intervention vs control change: 18.38 to 18.67 kg/m^2 vs 18.10 to 18.81 kg/m^2, respectively; adjusted difference –0.45 kg/m^2 [95% confidence interval {CI}, –0.73 to –0.17]; $P = .002$), triceps skinfold thickness (intervention vs control change: 14.55 to 15.47 mm vs 13.97 to 16.46 mm, respectively; adjusted difference, –1.47 mm [95% CI, –2.41 to –0.54]; $P = .002$), waist circumference (intervention vs control change: 60.48 to 63.57 cm vs 59.51 to 64.73 cm, respectively; adjusted difference, –2.30 cm [95% CI, –3.27 to –1.33]; $P < .001$), and waist-to-hip ratio (intervention vs control change: 0.83 to 0.83 vs 0.82 to 0.84, respectively; adjusted difference, –0.02 [95% CI, –0.03 to –0.01]; $P < .001$). Relative to controls, intervention group changes were accompanied by statistically significant decreases in children's reported television viewing and meals eaten in front of the television. There were no statistically significant differences between groups for changes in high-fat food intake, moderate-to-vigorous physical activity, and cardiorespiratory fitness.

Conclusions Reducing television, videotape, and video game use may be a promising, population-based approach to prevent childhood obesity.

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THE UNITED STATES HAS EXPERIenced alarming increases in obesity among children and adolescents.[1] However, most available treatments for obese children have yielded only modest, unsustained effects.[2] Consequently, prevention is considered to hold the greatest promise.[3] Unfortunately, most prevention programs that specifically attempt to reduce fat and energy intake and increase physical activity have been ineffective at changing body fatness.[4,5] As a result, there is a need for innovative approaches to prevent obesity.

There is widespread speculation that television viewing is one of the most easily modifiable causes of obesity among children. American children spend more time watching television and videotapes and playing video games than doing anything else except sleeping.[6] Two primary mechanisms by which television viewing contributes to obesity have been suggested: reduced energy expenditure from displacement of physical activity and increased dietary energy intake, either during viewing or as a result of food advertising.

Cross-sectional epidemiological studies have consistently found relatively weak positive associations between television viewing and child and adolescent adiposity.[7-21] Prospective studies are less common and have produced mixed results.[7,14] The consistently weak associations found in epidemiological studies may be due to the measurement error in self-reports of television viewing. As a result, additional epidemiological studies would not be expected to clarify the true nature of this relationship.[22]

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A causal relationship can only be demonstrated in an experimental trial, in which manipulation of the risk factor changes the outcome.[23] Therefore, we conducted a randomized, controlled, school-based trial of reducing third- and fourth-grade children's television, videotape, and video game use to assess the effects on adiposity and the hypothesized mechanisms of physical activity and dietary intake. We hypothesized that compared with controls, children exposed to the television reduction intervention would significantly decrease their levels of adiposity.

METHODS

All third- and fourth-grade students in 2 public elementary schools in a single school district in San Jose, Calif, were eligible to participate. Schools were sociodemographically and scholastically matched by district personnel. School principals and teachers agreed to participate prior to randomization. Parents or guardians provided signed written informed consent for their children to participate in assessments and for their own participation in telephone interviews. One school was randomly assigned to implement a program to reduce television, videotape, and video game use. The other school was assigned to be an assessments-only control. Participants and school personnel, including classroom teachers, were informed of the nature of the intervention but were unaware of the primary hypothesis. The study was approved by the Stanford University Panel on Human Subjects in Research, Palo Alto, Calif.

Intervention

To test the specific role of television, videotape, and video game use in the development of body fatness, as well as effects on dietary intake and physical activity, it was necessary to design an intervention that decreased media use alone without specifically promoting more active behaviors as replacements. This was accomplished by limiting access to television sets and budgeting use while simultaneously becoming more selective viewers or players.

The intervention, which was based in Bandura's social cognitive theory,[24] consisted of incorporating 18 lessons of 30 to 50 minutes into the standard curriculum that was taught by the regular third- and fourth-grade classroom teachers. The teachers were trained by the research staff, and the majority of lessons were taught during the first 2 months of the school year. Early lessons included self-monitoring and self-reporting of television, videotape, and video game use to motivate children to want to reduce the time they spent in these activities. These lessons were followed by a television turnoff,[25] during which children were challenged to watch no television or videotapes and play no video games for 10 days. After the turnoff, children were encouraged to follow a 7-hour per week budget. Additional lessons taught children to become "intelligent viewers" by using their viewing and video game time more selectively. Several final lessons enlisted children as advocates for reducing media use. The entire curriculum consisted of approximately 18 hours of classroom time. Newsletters that were designed to motivate parents to help their children stay within their time budgets and that suggested strategies for limiting television, videotape, and video game use for the entire family were distributed to parents.

To help with budgeting, each household also received an electronic television time manager (TV Allowance, Mindmaster, Inc, Miami, Fla). This device locks onto the power plug of the television set and monitors and budgets viewing time for each member of the household through use of personal identification codes. Because it controls power to the television, it also controls video cassette recorder (VCR) and video game use. Families could request additional units for every television in their homes, at no cost.

Outcome Measurements

Assessments were performed by trained staff, blinded to the experimental design, at baseline (September 1996) and after the completion of the intervention (April 1997). At each time point, on the same days in both schools, children completed self-report questionnaires on 2 non-Monday weekdays. A research staff member read each question out loud. Classroom teachers did not participate in the assessments. Physical measures were performed during 2 physical education periods at each time point, by the same staff in both schools. Parents were interviewed by telephone at baseline and after the intervention by trained interviewers following a standardized protocol. Parents, children, and teachers were not aware that the primary outcome was adiposity.

Body mass index (BMI), defined as the weight in kilograms divided by the square of the height in meters, was the primary measure of adiposity.[26,27] Standing height was measured using a portable direct-reading stadiometer and body weight was measured using a digital scale, according to established guidelines.[28,29] Test-retest reliabilities were high (intraclass Spearman $r>0.99$ for height, $r>0.99$ for weight). Triceps skinfold thickness was included as a measure of subcutaneous fat and was measured on the right arm, according to established guidelines.[28,29] Test-retest reliability was $r>0.99$ and skinfold thickness was highly correlated with BMI ($r = 0.82$).

Waist and hip circumferences were measured with a nonelastic tape at the level of the umbilicus and the maximal extension of the buttocks, respectively, according to established guidelines.[28,29] Test-retest reliabilities were $r>0.99$. Waist and hip circumferences were correlated with BMI ($r = 0.87$, $r = 0.90$, respectively) and triceps skinfold thickness ($r = 0.72$, $r = 0.78$, respectively). The waist-to-hip ratio was calculated as a measure of body fat distribution.

Children reported the time they spent "watching television," "watching movies or videos on a VCR," and "playing video games," separately for before school and after school, "yesterday" and "last Saturday" on the first assessment day, and "yesterday" on the second assessment day. Prior to reading these items, the research staff led children

through several participatory time-estimating exercises. This instrument was adapted from a similar instrument previously used in young adolescents with high test-retest reliability ($r = 0.94$).[15]

Parents estimated the amount of time their child spent watching television, watching videotapes on the VCR, and playing video games on a typical school day and on a typical weekend day. Similar items have produced accurate estimates compared with videotaped observation.[30] There was moderate agreement between parent and child reports of children's media use (Spearman $r = 0.31$, $P<.001$ for television viewing; $r = 0.17$, $P = .03$ for videotape viewing; $r = 0.49$, $P<.001$ for video game playing). A previously validated 4-item instrument was used to assess overall household television viewing.[31]

Children and parents also estimated the amount of time the child spent in other sedentary behaviors, including, using a computer, doing homework, reading, listening to music, playing a musical instrument, doing artwork or crafts, talking with parents, playing quiet games indoors, and at classes or clubs (parent-child agreement Spearman $r = 0.16$, $P<.05$).

On both days children reported their previous day's out-of-school physical activities, using a previously validated activity checklist.[32] Responses from the 2 days were averaged and weighted for levels of intensity using standard energy expenditure estimates.[33] Parents estimated the amount of time their child spent in organized physical activities (such as teams or sports classes) and nonorganized physical activities (such as playing sports, bicycling, rollerblading, etc) (parent-child agreement Spearman $r = 0.16$, $P = .05$).

On both days, children completed 1-day food frequency recalls for 60 foods in 26 food categories, based on instruments previously validated in third- through sixth-grade children.[34,35] High-fat foods were those previously identified as the major contributors of fat in the diets of children[35] and adults,[36] and were identified through focus groups with children, parents, and school lunch personnel. Highly advertised foods included 3 categories representing sugary cereals, carbonated soft drinks, and foods from fast-food restaurants.

Children also reported how often they ate breakfast and dinner in a room with the television turned on during the past week, on 4-point scales ranging from never to every day, and they reported the proportion of time they were eating or drinking a snack (not including meals) while watching television or videotapes or playing video games, on a 3-point scale. Parents responded to the same questions about their children, reporting the number of days in the last week for meals (parent-child agreement Spearman $r = 0.24$, $P = .003$) and the percentage of time for snacking (parent-child agreement Spearman $r = 0.02$, $P>.05$).

The maximal, multistage, 20-m, shuttle run test (20-MST) was used to assess cardiorespiratory fitness.[37] The 20-MST has been found to be reliable (test-retest $r = 0.73$-0.93),[37-39] a valid measure of maximum oxygen consumption as measured by treadmill testing ($r = 0.69$-0.87),[38-42] and sensitive to change[42] in children.

Statistical Analysis

Baseline comparability of intervention and control groups was assessed using nonparametric Wilcoxon rank sum tests for scaled variables and χ^2 tests for categorical variables. As a primary prevention program, the intervention was designed to target the entire sample. Effects were expected and intended to occur throughout the entire distribution of adiposity in the sample—not just around a defined threshold. Thus, for purposes of establishing the efficacy of this intervention, it is most appropriate to compare the full distributions of BMI between intervention and control groups. Therefore, to test the primary hypothesis, accounting for the design with school as the unit of randomization (adjusting for intraclass correlation), a mixed-model analysis of covariance approach was used, with postintervention BMI as the dependent variable; the intervention group (intervention vs control) as the independent variable; and baseline BMI, age, and sex as covariates (SAS MIXED procedure, SAS version 6.12, SAS Institute Inc, Cary, NC).[43] The same analysis approach was used for all secondary outcome variables, triceps skinfold thickness, waist and hip circumferences, waist-to-hip ratio, and measures of dietary intake and physical activity. Each outcome also was tested for intervention by sex and intervention by age interactions. All analyses were completed on an intention-to-treat basis, and all tests of statistical significance were 2-tailed with $\alpha = .05$.

With an anticipated sample size of approximately 100 participants per group and using the above analysis, the study was designed to have 80% power to detect an effect size of 0.20 or greater. This corresponded to estimated differences between groups of about 0.75 BMI units, 1.2 mm of triceps skinfold, 1.8 cm of waist circumference, and 2 hours per week of television, videotape, and video game use.

In children of this age, BMI, triceps skinfold thickness, waist circumference, and hip circumference were all expected to increase over the course of the experiment, as part of normal growth, in both the intervention and control groups. Therefore, effect sizes are reported as changes in the intervention group relative to changes in the controls (relative differences). A negative difference is termed a *relative decrease* in comparison with the controls, even if the actual value increased as a result of normal growth and development.

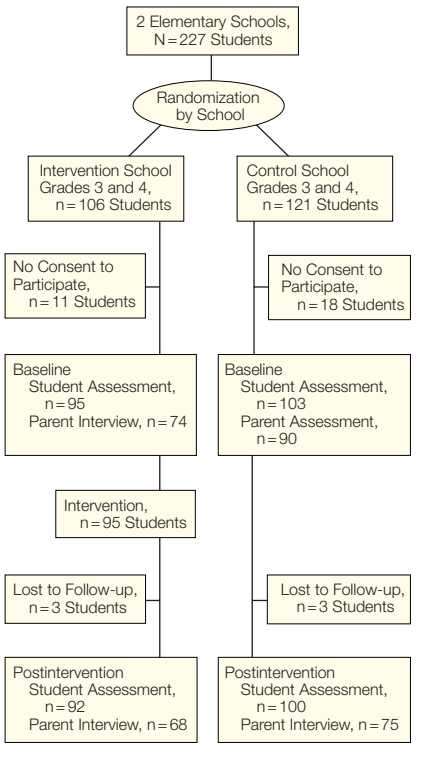
RESULTS

The study design and participation are shown in the FIGURE. Ninety-two (86.8%) of 106 eligible children in the intervention school and 100 (82.6%) of 121 eligible children in the control school participated in baseline and postintervention assessments. Intervention and control participants, respectively, were comparable in age (mean [SD], 8.95 [0.64] vs 8.92 [0.70] years, $P = .69$), sex (44.6% vs 48.5%

girls, $P = .59$), mean (SD) number of televisions in the home (2.7 [1.3] vs 2.7 [1.1], $P = .56$), mean (SD) number of video game players (systems) (1.5 [2.3] vs 1.2 [1.7], $P = .49$) and percentage of children with a television in their bedroom (43.5% vs 42.7%, $P = .92$). Physical measures but not self-reports were included in the analysis for 11 children who were classified by their teachers as having limited English proficiency or having a learning disability.

Baseline and postintervention telephone interviews were completed by 68 (71.6%) and 75 (72.8%) of the parents of participating children in the intervention and control schools, respectively. Intervention school parents reported greater maximum household education levels than participating control school parents (45% vs 21% college graduates, $P = .01$) but did not differ significantly in ethnicity (80% vs 70% white, $P = .19$), sex of respondent (82% vs 88% female, $P = .33$) or marital status (77% vs 67% married, $P = .22$).

Figure. Study Design and Participant Flow



Participation in the Intervention

Teachers reported teaching all lessons, although we did not collect detailed data determining whether the lessons were delivered as they were intended. Ninety-five (90%) of 106 students in the intervention school participated in at least some of the television turnoff and 71 (67%) completed the entire 10 days without watching television or videotapes or playing video games. During the budgeting phase of the intervention, 58 (55%) of the students turned in at least 1 signed parent confirmation that they had stayed below their television and videotape viewing and video game playing budget for the previous week. Forty-four parents (42%) returned response cards reporting they had installed the TV Allowance and 29 families (27%) requested 1 or more additional TV Allowances.

Effects on Adiposity

Results of anthropometric measures are presented in TABLE 1. At baseline, both groups were comparable ($P > .10$) on all baseline measures of body composition. As expected for children of this age, BMI, triceps skinfold thickness, waist circumference, and hip circumference all increased in both intervention and control children during the course of the school year. However, compared with controls, children in the intervention group had statistically significant relative decreases in BMI, triceps skinfold thickness, waist circumference, and waist-to-hip ratio (Table 1). There were no significant interventions by sex or intervention by age interactions for any of the body composition outcomes. The results did not change when ethnicity and parent education were included as additional covariates for children with completed parent interviews.

Although the sample size was insufficient to formally test for effects within subgroups, it was desirable to further characterize the effects of the intervention on participants with varying levels of adiposity, with a descriptive analysis. Intervention and control group changes were compared within strata defined by baseline levels of BMI, triceps skinfold, waist circumference, and waist-to-hip ratio. For all body composition measures, effects of the intervention occurred across the entire distribution of baseline adiposity, with greater intervention vs control differences evident among the middle and higher strata of body fatness.

Effects on Media Use, Diet, and Physical Activity

Child measures are presented in TABLE 2 and parent measures are presented in TABLE 3. Both groups were well matched at baseline, although intervention group children reported eating significantly more meals while watching television, and participating intervention group parents reported significantly less overall household television use and that their children spent significantly more time in other sedentary behaviors at baseline.

The intervention significantly decreased children's television viewing, compared with controls, according to both child and parent reports (relative reductions of about one third from baseline). Intervention group children also reported significantly greater reductions in video game use than controls. The intervention also resulted in greater, but not statistically significant, decreases in parent reports of children's video game use, parent and child reports of videotape viewing, and parent reports of overall household television viewing. There were no significant intervention by sex or intervention by age interactions for any of the media use outcomes.

The intervention significantly reduced the frequency of children eating meals in a room with the television turned on. Intervention group children also reported relative reductions in servings of high-fat foods compared with controls, although these differences were not statistically significant. There were no significant intervention effects on reports of children's physical activity levels or performance on the 20-MST of physi-

cal fitness. There were no significant intervention by sex or intervention by age interactions for any of the diet or activity outcomes.

COMMENT

This is the first experimental study to demonstrate a direct association between television, videotape, and video game use and increased adiposity. Because the intervention targeted reduction of media use alone, without substituting alternative behaviors, a causal

Table 1. Children's Anthropometric Measures*

	Baseline		Postintervention			
	Intervention	Control	Intervention	Control	Adjusted Change (95% CI)†	*P* Value
Body mass index, kg/m^2	18.38 (3.67)	18.10 (3.77)	18.67 (3.77)	18.81 (3.76)	–0.45 (–0.73 to –0.17)	.002
Triceps skinfold thickness, mm	14.55 (6.06)	13.97 (5.43)	15.47 (5.95)	16.46 (5.27)	–1.47 (–2.41 to –0.54)	.002
Waist circumference, cm	60.48 (9.91)	59.51 (8.91)	63.57 (8.96)	64.73 (8.91)	–2.30 (–3.27 to –1.33)	<.001
Hip circumference, cm	72.78 (8.91)	72.70 (8.78)	76.53 (7.94)	76.79 (8.37)	–0.27 (–1.08 to 0.53)	.50
Waist-to-hip ratio	0.83 (0.05)	0.82 (0.05)	0.83 (0.06)	0.84 (0.05)	–0.02 (–0.03 to –0.01)	<.001

*Baseline and postintervention values are unadjusted mean (SD). At baseline, both groups were comparable (*P*>.10) on all measures of body composition.
†Change estimates and 95% confidence intervals (CIs) are the differences between intervention group and control group after adjustment by mixed-model analysis of covariance for the baseline value, age, and sex.

Table 2. Child Measures of Television Viewing, Diet, and Physical Activity and Fitness*

	Baseline		Postintervention			
	Intervention	Control	Intervention	Control	Adjusted Change (95% CI)†	*P* Value
Hours per week						
Television	15.35 (13.17)	15.46 (15.02)	8.80 (10.41)	14.46 (13.82)	–5.53 (–8.64 to –2.42)	<.001
Videotapes	4.74 (6.57)	5.52 (10.44)	3.46 (4.86)	5.21 (8.41)	–1.53 (–3.39 to 0.33)	.11
Video games	2.57 (5.10)	3.85 (9.17)	1.32 (2.72)	4.24 (10.00)	–2.54 (–4.48 to –0.60)	.01
Meals in front of television, 0-3 scale	2.38 (1.75)	1.84 (1.78)‡	1.70 (1.49)	1.99 (1.78)	–0.54 (–0.98 to –0.12)	.01
Frequency of snacking in front of the television, 1-3 scale	2.20 (0.56)	2.15 (0.61)	1.94 (0.51)	2.05 (0.59)	–0.11 (–0.27 to 0.04)	.16
Daily servings of high-fat foods	6.15 (3.63)	6.62 (5.85)	5.14 (3.50)	6.17 (4.88)	–0.82 (–1.87 to 0.23)	.12
Daily servings of highly advertised foods	1.36 (0.96)	1.55 (1.20)	1.47 (1.10)	1.48 (1.06)	0.06 (–0.24 to 0.36)	.71
Other sedentary behaviors, h/d	4.66 (3.81)	4.47 (6.37)	3.81 (2.66)	4.05 (4.53)	–0.34 (–1.21 to 0.52)	.44
Physical activity, metabolic equivalent–weighted, min/wk	396.8 (367.8)	310.2 (250.7)	362.3 (235.2)	337.8 (277.3)	–16.7 (–78.6 to 45.3)	.60
20-m shuttle test, laps	15.21 (9.60)	14.80 (8.56)	19.72 (11.40)	18.18 (10.72)	0.87 (–1.41 to 3.15)	.45

*Baseline and postintervention values are unadjusted mean (SD).
†Change estimates and 95% confidence intervals (CIs) are the differences between groups after adjustment by mixed-model analysis of covariance for the baseline value, age, and sex.
‡Groups were significantly different (*P*<.05) at baseline by a nonparametric Wilcoxon rank sum test.

Table 3. Parent Reports of Children's Television Viewing, Diet, and Physical Activity*

	Baseline		Postintervention			
	Intervention	Control	Intervention	Control	Adjusted Change (95% CI)†	*P* Value
Children's hours per week						
Television	12.43 (5.65)	14.90 (7.10)	8.86 (4.91)	14.75 (7.37)	–4.29 (–5.89 to –2.70)	<.001
Videotapes	4.96 (4.21)	4.41 (3.72)	3.87 (2.87)	3.91 (3.21)	–0.25 (–1.19 to 0.69)	.60
Video games	1.84 (2.73)	2.71 (3.78)	1.44 (1.96)	2.57 (4.41)	–0.76 (–1.75 to 0.22)	.13
Overall household television use, 0-16 scale	7.09 (3.97)	8.60 (3.51)‡	6.09 (3.64)	7.76 (3.26)	–0.77 (–1.69 to 0.14)	.10
No. of children's meals eaten in front of the television, 0-14 meals	3.18 (3.69)	3.53 (3.71)	2.19 (2.95)	3.43 (3.64)	–1.07 (–1.96 to –0.18)	.02
Percentage of children's viewing when snacking	17.28 (20.91)	18.83 (41.24)	19.54 (22.43)	20.25 (22.70)	–1.94 (–9.06 to 5.17)	.59
Children's other sedentary behaviors, h/wk	44.89 (19.76)	39.79 (20.27)‡	41.31 (20.89)	43.37 (26.75)	–4.88 (–11.69 to 1.93)	.16
Children's physical activity, h/wk	11.19 (7.16)	9.19 (5.77)	16.08 (8.45)	17.21 (9.32)	–2.00 (–4.58 to 0.59)	.13

*Baseline and postintervention values are unadjusted mean (SD).
†Change estimates and 95% confidence intervals (CIs) are the differences between groups after adjustment by mixed-model analysis of covariance for the baseline value, age, and sex.
‡Groups were significantly different (*P*<.05) at baseline by a nonparametric Wilcoxon rank sum test.

inference might be made.[23] In one previous obesity treatment study, obese children who were reinforced (ie, rewarded) for decreasing sedentary activity (including television viewing and computer games, as well as imaginative play, talking on the telephone, playing board games, etc) along with following an energy-restricted diet lost significantly more weight than obese children reinforced for increasing physical activity or those reinforced for both.[44] Although that study did not directly test the role of television, videotape, and video game use, the similar findings support our results.

This experiment was designed to overcome the dependence of epidemiological studies on error-prone measures of television viewing behaviors by using BMI as the primary outcome. However, the intervention did produce statistically significant decreases in reported television viewing and video game use, compared with controls. Previous studies of reducing children's television viewing have been uncontrolled and limited to a small number of families.[45-47] This study, therefore, also represents a promising model for studying other hypothesized effects of television and videotape viewing and video game use.

Because this study involved children in only 2 elementary schools, the possibility that the results were due to differences in the groups that were unrelated to the intervention cannot be ruled out completely. This possibility is made less likely, however, because the schools were in a single school district and participants were comparable at baseline on almost all measured variables. In addition, the patterns of the results strengthen the case for causal inference. The crossover patterns of the changes in BMI, triceps skinfold thickness, waist circumference, and waist-to-hip ratio lessen the likelihood of scaling (a "ceiling effect"), regression, and selection-maturation biases as alternative interpretations of the results.[48,49]

Effects of the intervention on diet and activity were less clear. Compared with controls, children in the intervention group significantly reduced the number of meals they reportedly ate in front of the television set. There were no significant effects on reports of snacking while watching television or intake of high-fat and highly advertised foods. However, because snacking while watching television was assessed as a proportion, even no change in this variable might result in decreased energy intake as total viewing was decreased. Epidemiological studies have found associations among hours of television viewing and children's fat and energy intakes,[15,50] and experimental studies have shown that food advertising affects children's snack choices and consumption.[51,52]

Some epidemiological studies have found weak inverse associations between hours of television viewing and physical activity[14,18] and fitness.[8,16] Our intervention did not result in a significant change in physical activity or cardiorespiratory fitness. However, because only moderate- and vigorous-intensity activities were assessed, it is also possible that reductions in television viewing resulted in increased energy expenditure via more low-intensity activity. This is consistent with the finding that reductions in television, videotape, and video game use did not result in compensatory increases in other sedentary pursuits. Larger experimental studies and improved measures of diet and activity are needed to more definitively assess the specific mechanisms that account for changes in adiposity in response to reduced television, videotape, and video game use.

With a few exceptions, previous prevention interventions that have attempted to increase physical activity and decrease dietary fat and energy intake have been relatively ineffective at reducing body fatness.[4,5] In contrast, this intervention targeting only television, videotape, and video game use produced statistically significant and clinically significant relative changes in BMI, triceps skinfold thickness, waist circumference, and waist-to-hip ratio over a period of 7 months. These changes occurred over the entire sample, shifting the entire distribution of adiposity downward. Even a small shift downward in the population distribution of adiposity would be expected to have large effects on obesity-related morbidity and mortality.[53] Additional experimental studies with larger and more sociodemographically diverse samples are needed to evaluate the generalizability of these findings. However, this study indicates that reducing television, videotape, and video game use may be a promising, population-based approach to help prevent childhood obesity.

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In science, read, by preference, the newest works; in literature, the oldest.
—Edward George Bulwer-Lytton (1803-1873)