The Stanford Sports to Prevent Obesity Randomized Trial (SPORT)

Dana L. Weintraub, MD; Evelyn C. Tirumalai, MPH; K. Farish Haydel, BA; Michelle Fujimoto, RD; Janet E. Fulton, PhD; Thomas N. Robinson, MD, MPH

Objective: To evaluate the feasibility, acceptability, and efficacy of an after-school team sports program for reducing weight gain in low-income overweight children.

Design: Six-month, 2-arm, parallel-group, pilot randomized controlled trial.

Setting: Low-income, racial/ethnic minority community.

Participants: Twenty-one children in grades 4 and 5 with a body mass index at or above the 85th percentile.

Interventions: The treatment intervention consisted of an after-school soccer program. The “active placebo” control intervention consisted of an after-school health education program.

Main Outcome Measures: Implementation, acceptability, body mass index, physical activity measured using accelerometers, reported television and other screen time, self-esteem, depressive symptoms, and weight concerns.

Results: All 21 children completed the study. Compared with children receiving health education, children in the soccer group had significant decreases in body mass index z scores at 3 and 6 months and significant increases in total daily, moderate, and vigorous physical activity at 3 months.

Conclusion: An after-school team soccer program for overweight children can be a feasible, acceptable, and efficacious intervention for weight control.

Trial Registration: clinicaltrials.gov Identifier: NCT00186173


Current clinical childhood obesity treatment programs require substantial resources, are able to serve limited numbers of children, are not available in all communities, and have generally demonstrated only modest efficacy.² As the prevalence of childhood overweight has grown,² feasible, effective, and cost-efficient programs are needed to help overweight children control their weight.

Although children involved in team sports tend to be more physically fit than their uninvolved peers and have greater involvement in physical activity across time,⁴ team sports have not yet been tested as an approach to involve overweight children in regular physical activity or to reduce weight gain. An organized after-school team sports program may address neighborhood safety concerns that may keep children indoors.⁸,¹² Playing sports; being part of a team; receiving mentoring, modeling, and friendship from young adult coaches; and having opportunities to demonstrate skills in front of friends and family may all be fun for children and thus highly motivating.¹³ Research on youth physical activity participation supports perceived competence and skill level as strong influences on participation.¹⁰ Specifically, studies¹⁴,¹⁵ have shown that overweight children perceive more barriers to physical activity participation than normal-weight children. We hypothesized that when provided in a supportive environment and including only other overweight children, team sports would be an attractive physical activity opportunity. If team sports prove to be an efficacious intervention for increasing physical activity and reducing weight gain in overweight children, it would represent an alternative or a supplement to standard weight control treatments that could be rapidly diffused and tested for effectiveness in other settings. We evaluated the feasibility, acceptability,
ity, and 6-month efficacy of an after-school team sports program for reducing weight gain, increasing physical activity, and improving psychological health in low-income overweight children.

**METHODS**

**DESIGN AND PARTICIPANTS**

This was a 6-month, 2-arm, parallel-group, pilot randomized controlled trial of an after-school team sports program compared with traditional health education. Children were recruited through primary care physician offices and clinics, schools, and community centers. Eligible children had a body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) at or above the 85th percentile for age and sex on the 2000 Centers for Disease Control and Prevention BMI charts (http://www.cdc.gov/growthcharts) and were in grades 4 and 5 in a low-income community in northern California. To enhance the internal validity of this preliminary study, children were not eligible if they had been diagnosed as having a medical condition that affected their growth, were taking medications that affected their growth, or had a condition that limited their participation in the interventions or assessments. The study was implemented in schools in collaboration with school district personnel. Parents or guardians provided signed written informed consent for their children to participate and for their own participation in interviews. Children provided signed written assent for participation. Medical clearance for sports participation was required from a primary care professional. After completing baseline assessments, children were randomized using a computer by the Database Manager (K.F.H.) to either an after-school team sports program or a traditional nutrition and health education program. Children were notified by the study coordinator (E.C.T.) of their assigned intervention. The study was approved by the Stanford University Panel on Protection of Human Subjects in Medical Research. Recruitment and follow-up took place between April 11, 2005, and February 27, 2006.

**TREATMENT INTERVENTION**

We chose coed soccer as the team sport based on (1) preferences stated in our past clinical and research experiences with children in this community, (2) responses of overweight children surveyed in clinics in this community, and (3) recommendations of school district personnel and recreational staff of other community youth programs. All sources indicated that soccer was the most popular sport among children in this community. Soccer is also easy to teach to children with varying skill and experience levels. A 3-month feasibility study with 13 children demonstrated that the intervention model was feasible, acceptable, and promising for slowing BMI gain and improving psychosocial outcomes.

The soccer program was initially offered 3 days per week but was increased to 4 days a week during month 5 of the study at the request of participating children and parents. One day per week was game day, with the other days being practice days. Sessions were approximately 2½ hours long and started with a homework period, followed by approximately 75 minutes of activity. The activity period began with a supportive, team-building check-in followed by 15 minutes of warm-up and stretching. The remainder of practice was devoted to learning soccer skills in the context of fun skill-building exercises and concluded with a scrimmage. Practices were structured to promote positive experiences through sport with an emphasis on respect for self and others, inclusion, and teamwork. Shin guards, uniforms, and water bottles were provided to each player. Each practice ended with a celebratory cheer and recognition of individual players' efforts and teamwork. Matches involving the children, their parents, and the coaches were held quarterly. At the conclusion of the program, children received certificates of accomplishment and medals.

Trained Stanford University undergraduate and medical students served as volunteer coaches and homework tutors. All coaches and tutors completed training and certification in the Protection of Human Research Subjects and the Health Insurance Portability and Accountability Act, as well as training in youth development, group management, and the soccer curriculum. All equipment and uniforms were provided by the study.

**“ACTIVE PLACEBO” CONTROL INTERVENTION**

To minimize the possibilities of compensatory rivalry and resentful demoralization,15 limit loss to follow-up of controls, and implement a randomized controlled trial design acceptable to a low-income, racial/ethnic minority population, we used an active placebo control intervention.13,17,18 The active placebo condition contains certain “active” ingredients that may affect behavior, but these ingredients differ from the conceptually relevant ingredients being tested.17,18 Children in the active placebo condition received a 25-session, state-of-the-art, information-based nutrition and health education intervention consisting of weekly after-school meetings conducted by trained volunteer Stanford University undergraduate and medical students under the guidance of the investigators. Program content included materials and activities promoting healthful nutrition and physical activity produced by federal health agencies and national nongovernmental health organizations.

**MEASURES**

Assessments were performed by trained members of the research team following objective protocols. Assessments were conducted at baseline (before randomization) and again 3 and 6 months after randomization. Assessments were completed at school sites and in participants’ homes during mornings, evenings, and weekends to facilitate greater participation by lower-income and higher-risk families by removing barriers to their participation (eg, transportation to a clinical research facility and time away from work or school). Owing to limited staffing for this pilot study, data collectors were not blinded at follow-up assessments.

The BMI was the primary measure of body fatness. Height was measured twice with participants barefoot using a direct-reading stadiometer (Shorr Productions, Olney, Maryland), with methods to account for hair. Weight was measured twice with participants barefoot and wearing light clothing using an electronic scale (model 5602; Scaletronix, White Plains, New York). The mean of the replicate measures was used in the analysis. Age- and sex-standardized BMI (BMI z score) was calculated using the LMS method from the Centers for Disease Control and Prevention BMI charts (http://www.cdc.gov/growthcharts).

Physical activity was assessed on 6 consecutive days using accelerometers (ActiGraph; Manufacturing Technologies Inc, Fort Walton Beach, Florida) worn on belts at the right hip. Mean daily counts per minute, minutes of moderate physical activity (MPA), and minutes of vigorous physical activity (VPA) between 7 AM and 10 PM were used in the analysis. The percent-minute thresholds for MPA (≥3000-5200) and VPA (≥5200) were based on those derived by Treuth et al.19 To assess screen time, we used self-report instruments demonstrated to be sensitive to change in previous studies of re-
STATISTICAL ANALYSIS

Individual changes in BMI, physical activity, television and other screen time, self-esteem, depressive symptoms, and weight concerns were calculated from baseline to 3 months and from baseline to 6 months. Experimental groups were compared using analysis of covariance, with follow-up measure as the dependent variable, treatment group as the independent variable, and the baseline value of the dependent variable and the treatment group × baseline value interaction as covariates. As a feasibility and pilot study, this randomized controlled trial was not powered to detect all meaningful differences between groups. For a sample of 10 or 11 children in each group and a 2-sided α = .05, there were approximately 60% power and 20% power to detect standardized effect sizes (Cohen d) of 1.0 or greater and 0.5 or greater, respectively. 26

RESULTS

The study design and participation are shown in the Figure. Twenty-one children were enrolled in the study: 9 to the soccer intervention and 12 to the health education intervention. The mean (SD) age of the children was 9.50 (0.58) years for the soccer group and 10.34 (0.84) years for the health education group. Two children in the soccer group had a BMI at or above the 85th to the 94th percentile, and 7 had a BMI at or above the 95th percentile. All 12 children in the health education group had a BMI at or above the 95th percentile. Six of 9 families in the soccer group (67%) and 9 of 12 families in the health education group (75%) had total household incomes less than $40 000. Six of 9 families in the soccer group (67%) and 7 of 12 families in the health education group (58%) had a highest parent or caregiver level of education of high school graduate or below. Self-reported ethnicities were 8 Hispanic/Latino and 1 black or African American in the soccer group and 10 Hispanic/Latino, 1 black or African American, and 1 Native Hawaiian or other Pacific Islander in the health education group.

Fourteen of 21 enrolled children (67%) had never previously participated on a sports team. Reasons for not having been part of a team are reported in Table 1. Of the 9 children randomized to the soccer group, only 2 had previously participated on a team, both for less than 1 month. Mean (SD) attendance for the soccer group was 42% (24%) (range, 14%-86%) of all possible days: 53% (24%) (range, 13%-85%) for the first 3 months and 35% (32%) (range, 0%-88%) for the second 3 months. The 1 child with 0% attendance for the second 3 months was unable to attend owing to a conflict with a required academic after-school program. Mean (SD) attendance for the health education group was 46% (32%) (range, 3%-94%) of all possible days: 45% (34%) (range, 0%-100%) for the first 3 months and 49% (36%) (range, 0%-100%) for the second 3 months. No participants were lost to follow-up.

Baseline and 3- and 6-month results and group comparisons are reported in Table 2. Differences show medium to large beneficial effects on BMI, BMI z score, total daily physical activity, MPA, and VPA at 3- and 6-month follow-up. Inconsistent results were seen for watching television and other screen time and for depressive symptoms. There was no evidence of differences between groups in measures of overweight concerns or self-esteem. All 9 children randomized to the soccer group and 5 of 12 children (42%) randomized to the health education group had lower BMI z scores at 3 and 6 months. There were significant baseline BMI z scores by treatment interactions at 3 months (P = .03) and 6 months (P = .04). Effects of the team sports intervention compared with health education were greater for children with lower BMI z scores at baseline. At the 6-month follow-up, 8 of 9 children (89%) in the soccer

<table>
<thead>
<tr>
<th>21 Children enrolled and randomized</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 in the treatment intervention</td>
</tr>
<tr>
<td>12 in the active placebo control</td>
</tr>
<tr>
<td>9 in the 3-mo postintervention assessment</td>
</tr>
<tr>
<td>12 in the 3-mo postintervention assessment</td>
</tr>
<tr>
<td>9 in the 6-mo postintervention assessment</td>
</tr>
<tr>
<td>12 in the 6-mo postintervention assessment</td>
</tr>
</tbody>
</table>

Figure. Study design and participation.

Table 1. Baseline Question for 14 Children: Why Have You Not Been Part of a Sports Team?

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have always wanted to play but have not made a decision yet.</td>
<td>1</td>
</tr>
<tr>
<td>It was too hard for me, and the coach made us run a lot and other girls run faster than me.</td>
<td>1</td>
</tr>
<tr>
<td>I do not like to play basketball too much.</td>
<td>1</td>
</tr>
<tr>
<td>I do not feel like going to sports.</td>
<td>1</td>
</tr>
<tr>
<td>I have never entered one.</td>
<td>1</td>
</tr>
<tr>
<td>My dad works and does not have time to pick me up.</td>
<td>1</td>
</tr>
<tr>
<td>I have never heard of a team before.</td>
<td>1</td>
</tr>
<tr>
<td>I did not find one.</td>
<td>1</td>
</tr>
<tr>
<td>I was not born here and my parents were not able to sign me up.</td>
<td>1</td>
</tr>
<tr>
<td>I never signed up for one.</td>
<td>1</td>
</tr>
<tr>
<td>My dad does not let me.</td>
<td>1</td>
</tr>
<tr>
<td>I do not know (n=2).</td>
<td>2</td>
</tr>
<tr>
<td>I have always wanted to play but have not made a decision yet.</td>
<td>1</td>
</tr>
</tbody>
</table>

There are games I do not want to play.
It was too hard for me, and the coach made us run a lot and other girls run faster than me.
I do not like to play basketball too much.
I do not feel like going to sports.
I have never entered one.
My dad works and does not have time to pick me up.
I have never heard of a team before.
I did not find one.
I was not born here and my parents were not able to sign me up.
I never signed up for one.
My dad does not let me.
I do not know (n=2).
I have always wanted to play but have not made a decision yet.

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program stated that they would like to continue to play on a soccer team. The other child reported that she wished to spend more time with her family. One child assigned to the soccer group who had requested “randomization” to health education when enrolling in the study not only continued with the soccer program but also joined the soccer team at her school. Although we did not systematically measure participation on other sports teams, we heard testimonial reports that many children from the soccer group became involved with teams at their schools.

Child and parent responses to the soccer and health education programs were enthusiastic. What children reported liking most about the SPORT program and playing on a sports team or being a part of a health club included having fun, making friends, being part of a team or club, the coaches, and exercising or learning about health. Parents reported that SPORT helped their children by improving their weight and eating habits, increasing physical activity, and increasing confidence and self-esteem. Most parents in both groups reported that it worked well for their children to be in a program only with other kids who were overweight for their age. Specifically, parents reported that their children felt more comfortable, confident, and safe playing with children of similar weight. The soccer group had 3 adverse events (skin rash, car collision, and newly diagnosed hypothyroidism). The health education group had 6 adverse events (foot injury, knee pain while ice skating, eye pain and headaches, ingrown toenail, ear infection, and skin rash). None of the adverse events was judged to be related to participation in the study.

Compared with children randomized to a 25-session information-based nutrition and health education program, children randomized to participate on a soccer team experienced medium to large beneficial effects on BMI and BMI z scores. Cohen d standardized effect sizes of approximately 0.5 and 0.8 are generally considered medium and large effects, respectively.26 Despite being low powered as a pilot study, differences in BMI z scores and in total daily physical activity, MPA, and VPA measured using accelerometers were large enough to be statistically significant at 3 months, and BMI z score differences were statistically significant at 6 months. The effect sizes in other outcomes suggest that a larger trial with greater statistical power is also warranted. Treatment effects were seen across the entire sample. Baseline BMI z score, however, was a statistically significant moderator of the effects of team sports. Children who started with relatively lower BMI z scores responded the most to the intervention. This result suggests that future studies of team sports interventions for overweight children should recruit sufficient numbers to be able to stratify on baseline BMI z scores to formally test this result.27

High retention rates were seen in the soccer group and the health education group. Offering an intervention on-site at schools may overcome barriers to attendance seen in more traditional weight management programs located at medical centers, which may be less accessible to low-income, racial/ethnic minority populations.28 Other factors specific to the after-school programs, suggested

Table 2. Baseline, Follow-up, and Treatment and Control Group Changes in Primary and Secondary Outcome Measures

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Soccer Group, Mean (SD)</th>
<th>Health Education Group, Mean (SD)</th>
<th>Adjusted T−C Difference (95% CI)</th>
<th>P Value</th>
<th>Effect Size (Cohen d)</th>
<th>Adjusted T−C Difference (95% CI)</th>
<th>P Value</th>
<th>Effect Size (Cohen d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>27.17 (5.20)</td>
<td>27.12 (7.00)</td>
<td>–0.43 (–1.15 to 0.30)</td>
<td>0.23</td>
<td>–0.58</td>
<td>–0.48 (–1.46 to 0.49)</td>
<td>0.31</td>
<td>–0.47</td>
</tr>
<tr>
<td>BMI z score</td>
<td>1.21 (2.03)</td>
<td>1.20 (1.92)</td>
<td>0.07 (–0.13 to 0.00)</td>
<td>0.40</td>
<td>0.08</td>
<td>0.08 (–0.16 to 0.00)</td>
<td>0.04</td>
<td>–0.07</td>
</tr>
<tr>
<td>Total activity, 7 am-10 pm, mean, counts/min</td>
<td>641.65 (508.97)</td>
<td>545.41 (412.69)</td>
<td>105.74 (3.24 to 208.24)</td>
<td>0.04</td>
<td>1.22</td>
<td>44.29 (–165.65 to 130.23)</td>
<td>0.29</td>
<td>0.61</td>
</tr>
<tr>
<td>MPA, 7 am-10 pm, 3000-5200 counts/min</td>
<td>22.96 (10.18)</td>
<td>10.12 (9.31)</td>
<td>10.57 (1.42 to 19.73)</td>
<td>0.03</td>
<td>1.22</td>
<td>3.02 (–3.68 to 9.72)</td>
<td>0.36</td>
<td>0.48</td>
</tr>
<tr>
<td>VPA, 7 am-10 pm, &gt;5200 counts/min, min</td>
<td>7.06 (3.33)</td>
<td>4.91 (2.43)</td>
<td>4.37 (0.73 to 8.01)</td>
<td>0.02</td>
<td>1.13</td>
<td>1.25 (–1.48 to 3.99)</td>
<td>0.35</td>
<td>0.43</td>
</tr>
<tr>
<td>Television and other screen time, h/wk</td>
<td>17.14 (15.00)</td>
<td>11.67 (11.40)</td>
<td>3.17 (–3.96 to 10.30)</td>
<td>0.36</td>
<td>0.42</td>
<td>0.96 (–20.51 to 6.71)</td>
<td>0.30</td>
<td>–0.47</td>
</tr>
<tr>
<td>Depressive symptoms, 0 = low to 15 = high</td>
<td>4.44 (2.51)</td>
<td>2.82 (1.24)</td>
<td>1.11 (–1.26 to 3.48)</td>
<td>0.34</td>
<td>0.44</td>
<td>–0.65 (–2.24 to 0.95)</td>
<td>0.40</td>
<td>–0.38</td>
</tr>
<tr>
<td>Overconcerns with weight, 5 = low to 15 = high</td>
<td>58.89 (19.00)</td>
<td>50.00 (23.01)</td>
<td>1.18 (–12.89 to 15.26)</td>
<td>0.86</td>
<td>0.08</td>
<td>–0.17 (–17.90 to 17.55)</td>
<td>0.98</td>
<td>–0.01</td>
</tr>
<tr>
<td>Self-esteem, 10 = low to 40 = high</td>
<td>21.89 (4.65)</td>
<td>19.22 (2.73)</td>
<td>–0.02 (–4.20 to 3.79)</td>
<td>0.92</td>
<td>–0.05</td>
<td>0.55 (–2.88 to 3.97)</td>
<td>0.74</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CI, confidence interval; MPA, moderate physical activity; T−C, treatment minus control; VPA, vigorous physical activity.

a Significant baseline × treatment BMI z score interaction (P=.03 at 3 months and P=.04 at 6 months).

b Significant baseline × treatment BMI z score interaction (P=0.03 at 3 months and P=0.04 at 6 months).
by many of the child and parent responses to the program, may also have enhanced participation; for example, opportunities to interact with peers and young adult coaches and health educators, feelings of competence and confidence around sports or improved health knowledge, and enjoyment of improved physical activity and health knowledge.

We did not find any negative effects of offering a program specifically for overweight children on-site at schools. The soccer program was held in public view. We did not systematically assess whether participants were teased for being on an overweight soccer team, but we did not hear reports of teasing, and child and parent responses suggested that this was not a substantial problem. In contrast, parents reported that participation in a program only for overweight children promoted positive experiences for most children.

We purposefully did not include a nutrition education curriculum in the sports program because we were interested in the isolated effect of team sports participation. Discussions of healthful food and drink choices, however, spontaneously arose through the sports program. In addition, we chose not to offer a snack before or after practices or games to help disconnect food from being associated with sports. We found that despite no snack being offered before or after practices or games, children still actively participated throughout practice and games and continued to attend.

The health education active placebo control intervention was a rigorous comparison. A 25-session weekly health education program is of greater duration and intensity than is available to overweight children in most communities. As a result, it is possible that controls also experienced beneficial effects. The improvements seen in the team sports group may have been even greater if compared with a nonintervention/natural history control group.

As a pilot study, the main limitation was the small sample size. Recruitment strategies were designed to minimize stigmatization. Flyers for parents were sent home with children describing a study of health programs for their child. This referral process necessitated the child's delivery of the flyer to the parent and the parent's initiation of a telephone call to the study coordinator. Children were also recruited through physician referrals. Physicians were introduced to the study and given "prescription pads" for SPORT that served as a referral and as medical clearance. Although physicians were enthusiastic about the study, most referrals came from schools. Because we did not track the number of prescriptions that were written, we do not know whether physicians were referring families that did not follow through with the referral or whether there were limited referrals. Another limitation of this study was its length. Children were followed up for 6 months. Although testimonials suggest that program participants remained active after the conclusion of the study, longer follow-up periods are needed to determine whether team sports is a feasible, acceptable, and efficacious approach for longer periods. A larger study will also allow an expanded research team with masked data collectors to address potential bias from cointerventions or biased assessment of outcomes. Finally, as a pilot study, we limited the team sports to coed soccer. Further studies could help test whether other team sports would produce similar outcomes. The soccer program was designed to highlight what we perceived to be the most highly motivating aspects of being part of a team, and we believe that the team component is more important than the specific sport selected.

To our knowledge, this is the first experimental study to evaluate team sports exclusively for overweight children as an intervention to reduce weight gain. Our experience suggests that children not previously exposed to team sports or with previous negative experiences will enjoy and participate in a program specifically designed for overweight children. Particularly promising was our ability to engage children who previously were uninterested in sports to become excited about sports and to join existing after-school team sports programs at their schools. Unique experiences for overweight children may be addressed through a supervised environment, allowing them to have positive experiences with sports and, as a "side effect," improve their health. Ideally, sports programs designed specifically for overweight children introduce inactive children to the benefits of team sports, leading to continued involvement in sports. Further studies are needed to assess efficacy and effectiveness in other samples, with different sports and for longer periods, but these results support an after-school team sports program designed specifically for overweight children as a promising intervention to reduce weight gain.

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Correspondence: Dana L. Weintraub, MD, Division of General Pediatrics and Stanford Prevention Research Center, Stanford University School of Medicine, 211 Quarry Rd, Hoover Pavilion, Room N032, Stanford, CA 94305-5705 (Dana.Weintraub@Stanford.edu).

Author Contributions: Dr Weintraub had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of data analysis. Study concept and design: Weintraub, Fulton, and Robinson. Acquisition of data: Tirumalai and Fujimoto. Analysis and interpretation of data: Weintraub, Haydel, Fujimoto, and Robinson. Drafting of the manuscript: Weintraub, Tirumalai, and Haydel. Critical revision of the manuscript for important intellectual content: Fujimoto, Fulton, and Robinson. Statistical analysis: Haydel, Fujimoto, and Robinson. Obtained funding: Weintraub and Robinson. Administrative, technical, and material support: Tirumalai and Fujimoto. Study supervision: Weintraub, Fulton, and Robinson.

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A supply of negative opportunities has become part of the enabling environment.
   —From a study by Anne-Marie Ambert, PhD, referencing the rise in number of children and adoles- 