School-Based Overweight Preventive Intervention Lowers Incidence of Disordered Weight-Control Behaviors in Early Adolescent Girls

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Objective: To determine the effect of a school-based intervention to promote healthful nutrition and physical activity on disordered weight-control behaviors (self-induced vomiting or use of laxatives or diet pills to control weight) in early adolescent girls and boys.

Design: Using a group-randomized, controlled-trial design, we randomly assigned middle schools to an intervention or control condition. Multivariate logistic regression analyses were used to assess the effect of the intervention on the odds of reporting a new case of disordered weight-control behaviors at follow-up, adjusting for sex, school-level prevalence of disordered weight-control behaviors at baseline, and school clusters. Students reporting these behaviors at baseline were excluded from the analyses.

Setting: Thirteen middle schools.

Participants: At baseline, 749 girls and 702 boys in grades 6 and 7.

Intervention: The 5-2-1 Go! intervention (Planet Health obesity prevention curriculum plus School Health Index for Physical Activity and Healthy Eating: A Self-Assessment and Planning Guide, Middle/High School Version) was implemented during 2 school years, from November 2002 through May 2004.

Main Outcome Measure: Self-reported disordered weight-control behaviors in last 30 days at follow-up.

Results: At follow-up in girls, 3.6% (15 of 422) in control schools compared with 1.2% (4 of 327) in intervention schools reported engaging in disordered weight-control behaviors (P = .04). Multivariate analyses indicated that the odds of these behaviors in girls in intervention schools were reduced by two thirds compared with girls in control schools (odds ratio, 0.33; 95% confidence interval, 0.11-0.97). No intervention effect was observed in boys.

Conclusions: Results add compelling support for the effectiveness of an interdisciplinary, school-based obesity prevention intervention to prevent disordered weight-control behaviors in early adolescent girls.

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Eating disorders have substantial negative consequences on the health of affected adolescents, including fluid and electrolyte imbalances, menstrual and gastrointestinal dysfunction, cardiomyopathy, and premature death. Disordered weight-control behaviors, including self-induced vomiting or use of laxatives or diet pills to control weight, often precursors to eating disorders, also have been positively associated with overweight in adolescents as antecedents, correlates, and sequela. The rising obesity epidemic in children and adolescents and its associated health consequences and economic costs to individuals and society add urgency to the need to identify effective strategies for the prevention of maladaptive methods of weight control in youth. Interventions that can prevent both overweight and disordered weight-control behaviors may have the potential to be more efficient and safe.

A recent analysis of the efficacy of the Planet Health obesity preventive intervention in a randomized controlled trial conducted in middle school students found that the interdisciplinary curriculum had an unanticipated but beneficial effect, halving girls’ risk of reporting disordered weight-control behaviors after 2 school years in intervention schools compared with control schools (odds ratio [OR], 0.41; 95% confidence interval [CI], 0.22-0.75). Planet Health had previously been found effective in reducing obesity prevalence in girls. To our knowledge, the Planet Health protective effect on the on-
From November 2002 to May 2004, the Massachusetts Department of Public Health carried out the 5-2-1 Go! study using a 2-arm, group-randomized design in 13 Massachusetts middle schools. The intervention arm was designed to promote healthful nutrition and physical activity and reduce overweight, and included 2 tools, the Planet Health curriculum and the School Health Index for Physical Activity and Healthy Eating: A Self-Assessment and Planning Guide, Middle/High School Version (SHI). The Planet Health curriculum includes health messages focused on physical activity, television viewing, and consumption of fruits, vegetables, and fats that are provided in the major subject area and physical education classes. The SHI is a tool developed by the Centers for Disease Control and Prevention (CDC) and public schools were further stratified by racial/ethnic composition (≥75% or <75% white). Schools within each group were then randomly assigned to the intervention, which included both Planet Health and the SHI, or the control condition. Control schools were asked to work with only module 1 of the SHI, focused on school policies and environment, and to make an action plan and prepare a report on their progress on the plan at the end of year 2 of the study. Subsequent to randomization and before the baseline assessment, 2 intervention schools and 1 control school dropped out, leaving 6 intervention and 7 control schools in the study. Additional details about 5-2-1 Go! methods have been published previously.

All students from the 13 schools who were in the sixth and seventh grades at baseline were eligible to participate. Informed consent was obtained before assessment. A total of 1839 students completed the baseline assessment. Students completed self-report questionnaires on physical activity, sedentary behaviors, diet, and disordered weight-control behaviors at baseline in November 2002 and at follow-up in May 2004. Disordered weight-control items (self-induced vomiting or use of laxatives or diet pills to lose or control weight in the last 30 days) were adapted from the Centers for Disease Control and Prevention Youth Risk Behavioral Surveillance System survey, we created a binary variable representing disordered weight-control behaviors if students reported engaging in at least 1 of the behaviors. A validation study with girls examining a disordered weight-control measure closely adapted from the Youth Risk Behavioral Surveillance System items used in 5-2-1 Go! found that the measure had a sensitivity of 0.93 and a specificity of 0.86. To characterize the social environment, we computed the prevalence of disordered weight-control behaviors in each school at baseline. We used this variable as a school-level covariate to adjust for the social environment relating to disordered weight-control behaviors of students in the school, along with a random effect for school within intervention group to capture any additional unmeasured school-level influences.

From the baseline cohort of 1839 students, 1664 completed the follow-up questionnaire and were included in the longitudinal cohort (90.5% of baseline). From the longitudinal cohort, we excluded respondents if there was missing information on sex or disordered weight-control behaviors at baseline or follow-up (n = 156), leaving 1508 students (90.6% of the longitudinal sample and 82.0% of the baseline sample) (Figure). We further excluded students who reported disordered weight-control behaviors at baseline (n = 57; 3.8% [26 of 775] of girls and 4.3% [31 of 733] of boys; 3.7% from control vs 4.2% from intervention schools with P = .71) from statistical analyses; thus, our total analytic sample was 1451 students (749 girls and 702 boys) who did not report disordered weight-control behaviors at baseline. At baseline, control and intervention schools did not differ by grade (P = .23), race/ethnicity (P = .21), or overweight (defined here as body mass index [calculated as weight in kilograms divided by height in meters squared] ≥85th percentile for age and sex; P = .93) (Table 1), indicating that randomization resulted in a satisfactory balance of student characteristics across the intervention conditions.

We used multivariate logistic regression models with generalized estimating equation methods to estimate ORs and 95% CIs that account for the clustered sampling design. All models contemporaneous with the Massachusetts Department of Public Health Enhanced School Health Services Program. All schools were contacted through letters and telephone calls, and the 16 schools that indicated they wanted to participate were enrolled in 5-2-1 Go! The study used a group-randomized design in which middle schools were the unit of randomization and students were the unit of analysis. The 16 schools were stratified by type (parochial vs public), and public schools were further stratified by racial/ethnic composition (≥75% or <75% white). Schools within each group were then randomly assigned to the intervention, which included both Planet Health and the SHI, or the control condition.
RESULTS

At follow-up, a sizable protective effect of the intervention on disordered weight-control behaviors was observed for girls. After 2 school years, 3.6% (15 of 422) of girls in control schools compared with 1.2% (4 of 327) of girls in intervention schools reported new disordered weight-control behaviors. The multivariate odds of adopting disordered weight-control behaviors were reduced by two thirds in girls in intervention schools compared with girls in control schools (OR, 0.33; 95% CI, 0.11-0.97) (Table 2). In subsequent multivariate models that also controlled for grade, race/ethnicity, and overweight, the magnitude of the effect estimate associated with the intervention for girls remained stable, changing less than 10%, but the CI widened to include the null value of 1.0. No added covariates were statistically significant. No protective effect of the intervention was observed for boys. At follow-up, 2.7% (11 of 415) of boys in control schools compared with 2.4% (7 of 287) of boys in intervention schools reported new disordered weight-control behaviors (Table 2).

COMMENT

The results of the 5-2-1 Go! trial provide encouraging evidence that a middle school–based intervention that has been shown to be effective in reducing obesity in early adolescent girls3 can also prevent adoption of disor-

Table 1. Characteristics of Middle Schools at Baseline and of Analytic Sample of Participants in 5-2-1 Go! Intervention Triala

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All Schools (N = 13)</th>
<th>Control Schools (n = 7)</th>
<th>Intervention Schools (n = 6)</th>
<th>P Valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public, ≥75% white students</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>. . .</td>
</tr>
<tr>
<td>Public, &lt;75% white students</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>. . .</td>
</tr>
<tr>
<td>Parochial</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>. . .</td>
</tr>
<tr>
<td>Disordered weight-control behavior, % at baseline</td>
<td>3.9</td>
<td>3.7</td>
<td>4.2</td>
<td>.71</td>
</tr>
<tr>
<td>Total No. of Studentsc</td>
<td>1451</td>
<td>837</td>
<td>614</td>
<td>. . .</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>702 (48)</td>
<td>415 (50)</td>
<td>287 (47)</td>
<td>.15</td>
</tr>
<tr>
<td>Female</td>
<td>749 (52)</td>
<td>422 (50)</td>
<td>327 (53)</td>
<td>. . .</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>818 (56)</td>
<td>420 (50)</td>
<td>398 (65)</td>
<td>.23</td>
</tr>
<tr>
<td>7</td>
<td>633 (44)</td>
<td>417 (50)</td>
<td>216 (35)</td>
<td>. . .</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1263 (87)</td>
<td>693 (83)</td>
<td>570 (93)</td>
<td>.21</td>
</tr>
<tr>
<td>African American</td>
<td>52 (4)</td>
<td>46 (5)</td>
<td>6 (1)</td>
<td>. . .</td>
</tr>
<tr>
<td>Hispanic</td>
<td>91 (6)</td>
<td>67 (8)</td>
<td>24 (4)</td>
<td>. . .</td>
</tr>
<tr>
<td>Other</td>
<td>45 (3)</td>
<td>31 (4)</td>
<td>14 (2)</td>
<td>. . .</td>
</tr>
<tr>
<td>Overweightd</td>
<td></td>
<td></td>
<td></td>
<td>.93</td>
</tr>
</tbody>
</table>

Abbreviation: ellipses, not applicable.
aValues are given as number (percentage) unless otherwise indicated.
bComparing control and intervention conditions with generalized estimating equations.
cStudents reporting purging or diet pill use at baseline were excluded from follow-up analysis.
dBody mass index (calculated as weight in kilograms divided by height in meters squared) greater than or equal to the 85th percentile for age and sex.

Table 2. Effect of 5-2-1 Go! Intervention on 2-Year Incidence of Disordered Weight-Control Behaviors in Middle School Childrena

<table>
<thead>
<tr>
<th>Covariate Adjustment</th>
<th>Covariate Effectb</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student characteristic</td>
<td>. . .</td>
<td>0.91 (0.27-3.13)</td>
<td>0.33 (0.11-0.97)</td>
</tr>
<tr>
<td>Grade 6 vs grade 7</td>
<td>0.72 (0.32-1.58)</td>
<td>0.68 (0.26-2.88)</td>
<td>0.32 (0.10-1.02)</td>
</tr>
<tr>
<td>Nonwhite vs white</td>
<td>0.65 (0.24-1.80)</td>
<td>1.04 (0.27-4.06)</td>
<td>0.36 (0.11-1.14)</td>
</tr>
<tr>
<td>Overweight at baselinec</td>
<td>1.15 (0.53-2.46)</td>
<td>0.98 (0.26-3.62)</td>
<td>0.33 (0.11-1.01)</td>
</tr>
<tr>
<td>All of the above</td>
<td>. . .</td>
<td>0.97 (0.25-3.75)</td>
<td>0.34 (0.10-1.21)</td>
</tr>
</tbody>
</table>

Abbreviation: ellipses, not applicable.
aValues are given as odds ratio (95% confidence interval). Students reporting disordered weight-control behaviors at baseline were excluded.
bOdds of disordered weight-control behaviors in indicated group vs other, with 95% confidence interval. From logistic regression analysis adjusted for school clustering, individual-level covariates as indicated, school-level prevalence of disordered weight-control behaviors at baseline, sex, and an intervention condition × sex interaction term. The school-level covariate and all individual-level covariate effects (grade, race/ethnicity, and overweight) were nonsignificant (P > .30) in all models. Similar results were obtained when regression was adjusted for all covariates simultaneously.
cAbove or equal to vs less than the body mass index (calculated as weight in kilograms divided by height in meters squared).

included intervention condition, school-level baseline prevalence of disordered weight-control behaviors, sex, and an intervention condition × sex interaction term. Additional models also controlled for grade, race/ethnicity, and overweight. All statistical analyses were performed using SAS software (version 9.1; SAS Institute Inc, Cary, NC).
ndered weight-control behaviors. The risk of reporting self-induced vomiting or use of laxatives or diet pills to control weight at follow-up after 2 school years was reduced by two thirds in girls in the intervention schools compared with the control schools. The present study expands on previous work to evaluate the Planet Health intervention effect by including a larger number of schools (13 vs 10) and girls (749 vs 480) and more recently collected data (2002-2004 vs 1995-1997). In addition, the Massachusetts Department of Public Health oversaw both the implementation protocol and conduct of 5-2-1 Go!; thus, the findings suggest more generalized effectiveness of the intervention model in school settings. The magnitude of risk reduction in the 5-2-1 Go! trial is comparable to that found for girls participating in the first evaluation of Planet Health (OR, 0.41; 95% CI, 0.22-0.75), a robust protective effect that has held up in 2 rigorously designed randomized controlled trials.

Findings from other studies may provide some insight into the protective effect documented in our intervention. In a small randomized controlled trial in 8- to 10-year-old girls that assessed the effect of an intervention to promote dance and reduce television viewing for overweight prevention, Robinson et al. found that girls in the intervention arm experienced a reduction in weight and shape concerns, although 2 other nutrition and physical activity interventions in adolescent girls and boys did not find an intervention effect on body dissatisfaction and weight concerns or body image. In an eating disorders prevention randomized controlled trial conducted in 14- to 19-year-old high school and college female students with moderate body dissatisfaction, an arm of the intervention that focused on healthful nutrition and physical activity was associated with reduced body dissatisfaction and bulimic symptoms compared with the assessment-only arm, and reduced risk of obesity onset in female students who were not obese at baseline. It is possible that our Planet Health and 5-2-1 Go! findings of a protective effect on disordered weight-control behaviors in early adolescent girls may be achieved through a reduction in unhealthful weight concerns and body dissatisfaction, but further research will be needed to identify the mechanism of the observed protective effect.

The present study has several limitations. The 5-2-1 Go! trial may not have been sufficiently powered to detect differences in intervention effect on the addition of multiple covariates to regression models. The observations that grade, race/ethnicity, and overweight did not differ across intervention conditions at baseline after randomization and that the effect estimate associated with the intervention changed little (<10%) on the introduction of these covariates are reassuring and suggest that our results are not likely to be substantially confounded. We could not examine possible race/ethnicity differences in intervention effects, but because eating disorders affect all racial/ethnic groups, further study will be critical. While the measure of disordered weight-control behaviors used in our study has high sensitivity and specificity in girls, it is not known whether measure performance is comparable in boys.

In 2004, the National Institutes of Health called for strategies in school settings that integrate obesity and eating disorders prevention initiatives. New research efforts will need to identify protective strategies for early adolescent boys also and to understand the mechanism of Planet Health and other strategies in school settings that integrate obesity and eating disorders prevention.

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Author Contributions: Dr Austin had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Austin, Wiecha, Troped, and Peterson. Acquisition of data: Wiecha, Troped, and Peterson. Analysis and interpretation of data: Austin, Kim, Wiecha, Troped, Feldman, and Peterson. Drafting of the manuscript: Austin, Kim, Troped, and Feldman. Critical revision of the manuscript for important intellectual content: Austin, Kim, Wiecha, Troped, Feldman, and Peterson. Statistical analysis: Austin, Kim, and Feldman. Obtained funding: Wiecha and Peterson. Administrative, technical, and material support: Kim, Wiecha, Feldman, and Peterson. Study supervision: Austin. Design and implementation of the 5-2-1 Go! intervention trial: Wiecha, Troped, and Peterson.

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Solomon Mezgebu, MSc; Wee Lock Ooi, ScD; and Julie Roberts, MPH, RD, at the MDPH participated in the design and implementation of 5-2-1 Go! and Daniel Finkelstein, PhD, contributed to the data analyses.

REFERENCES


