The Impact of a School-Based Obesity Prevention Trial on Disordered Weight-Control Behaviors in Early Adolescent Girls

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Objective: To assess the impact of an obesity prevention intervention on use of self-induced vomiting/laxatives (purging) and diet pills to control weight in girls in early adolescence.

Design: We matched and randomly assigned 10 middle schools to an intervention or a control condition in a randomized controlled trial. Longitudinal multivariable analyses using generalized estimating equations were conducted with data from 480 girls to examine the effects of the intervention on the risk of reporting a new case of purging or diet pill use to control weight at follow-up 21 months later, while controlling for ethnicity and school matched pairs. Girls who reported purging or using diet pills at baseline were excluded from analyses.

Setting: Middle schools.

Participants: Four hundred eighty girls in early adolescence aged 10 to 14 years (mean age, 11.5 years).

Intervention: The Planet Health obesity prevention program was implemented during 2 school years and was designed to promote healthful nutrition and physical activity and to reduce television viewing.

Outcome: Reduced risk of using self-induced vomiting/laxatives or diet pills to control weight in the past 30 days.

Results: After the intervention, we found 14 (6.2%) of 226 girls in control schools and 7 (2.8%) of 254 girls in intervention schools reported purging or using diet pills to control their weight ($P = .003$). In a multivariable generalized estimating equation model, girls in intervention schools were less than half as likely to report purging or using diet pills at follow-up compared with girls in control schools (odds ratio, 0.41; 95% confidence interval, 0.22-0.75).

Conclusion: These findings provide promising evidence that school-based interventions may effectively integrate prevention of both obesity and disordered weight-control behaviors.


EATING DISORDERS and disordered weight-control behaviors, such as vomiting and using laxatives and diet pills, are a major public health concern in adolescent girls. Eating disorder symptoms and behaviors in girls have their peak onset from the ages of 14 to 19 years and are estimated to be 10 times more common in girls than in boys. Eight percent of high school girls in the United States reported vomiting or taking laxatives to control their weight in the past month in a national study by the Centers for Disease Control and Prevention. In middle schools, a study conducted in California and Arizona found that 8% of girls reported vomiting and 6% reported using laxatives to control their weight in the past year. Self-induced vomiting and use of laxatives and diet pills are associated with significant morbidity.

The prevalence of overweight among children and adolescents has been increasing in the past several decades and 15% of children and adolescents aged 6 to 19 years are now reported to have a body mass index at the 95th percentile or greater for age and sex. With the obesity epidemic a high priority for the nation’s health, more attention has been drawn to links between eating disorders and overweight. In cross-sectional analyses, overweight adolescents have been found to have a higher risk than their thinner peers of engaging in self-induced vomiting and use of laxatives to control their weight. In addition, overweight is prospectively associated with an increased risk for development of bulimia nervosa.

For editorial comment see pages 290 and 292
and binge eating, and binge eating can lead to weight gain and obesity.\textsuperscript{15-18}

Dieting to control weight is very common among adolescent girls, with an estimated one third of girls aged 9 to 14 years reporting dieting in the past year.\textsuperscript{10} Dieting has been associated with depressed mood, anxiety, irritability, low self-esteem, and heightened weight concerns\textsuperscript{20} and has been prospectively associated with onset of eating disorder symptoms and behaviors, including vomiting and laxative use, in adolescent girls.\textsuperscript{15,21-24} Successive dieting failures and the associated negative psychological and physiological experiences may render dieters more vulnerable to adoption of disordered weight-control behaviors and development of an eating disorder.\textsuperscript{25-29}

Given these important linkages between eating disorders and overweight, researchers have begun calling for new alliances between the 2 fields for prevention research.\textsuperscript{30-32} Irving and Neumark-Sztainer\textsuperscript{30} recently proposed that interventions designed to prevent eating disorders and overweight in young people should be integrated. Empirical evidence, however, is needed to test the effectiveness of this type of integration. We are aware of 1 randomized controlled trial (RCT) designed to prevent overweight in preadolescent girls that found a reduction in weight and body shape concerns associated with the intervention.\textsuperscript{31} High concern with weight is an important risk indicator in early adolescent girls because it has been shown to be prospectively associated with development of an eating disorder.\textsuperscript{32} It is not known whether overweight preventive interventions can also reduce risk of disordered weight-control behaviors, such as self-induced vomiting and use of laxatives and diet pills. With the present study, we used data from Planet Health, a school-based, obesity prevention RCT that has been shown in previous research to effectively reduce the risk of obesity in early adolescent girls, to examine the impact of the intervention on risk of engaging in disordered weight-control behaviors after 21 months of follow-up.\textsuperscript{35}

### METHODS

#### THE PLANET HEALTH STUDY

The Planet Health intervention was designed to promote healthful nutrition and physical activity and reduce television viewing. A full description of the Planet Health study methods and primary results is available in Gortmaker et al.\textsuperscript{33} In brief, 10 middle schools were matched and then randomized to the intervention or the control condition. The study enrolled 1960 sixth- and seventh-grade girls and boys, representing 65% of the eligible students in participating schools. Self-reported survey data were collected on diet, physical activity, television viewing, dieting, self-induced vomiting, and use of laxatives and diet pills. Anthropometry data were collected by trained staff. Data were collected at baseline in the fall of 1995 and after the intervention in the spring of 1997. Data were provided at both time points by 1295 children, representing 83.0% of the study participants at baseline.

Planet Health was found to have a strong obesity prevention effect with girls than with boys. Safety monitoring and were taken from the Centers for Disease Control and Prevention Youth Risk Behavioral Surveillance System survey.\textsuperscript{36} In a 2-week test-retest reliability study of the Youth Risk Behavioral Surveillance System with almost 1700 students in grades 7 through 12, the dieting question had a moderately high χ statistic (0.79).\textsuperscript{37} We combined responses to the items on use of vomiting, laxatives, and diet pills to create a single disordered weight-control behavior variable for analyses. Height and weight were used to calculate body mass index. Participants were considered obese if they had a body mass index and triceps skinfold thickness at or above the 85th percentile for age and sex\textsuperscript{38} based on National Health and Nutrition Examination Survey I reference growth curves available in 1997.\textsuperscript{39}

#### STATISTICAL ANALYSIS

We used the generalized estimating equation (GEE) method with the SAS PROC GENMOD procedure in the SAS statistical package to account for design effects due to clustered sampling by school.\textsuperscript{30,40} We accounted for matching of schools before randomization with school matched pair indicator variables. Using multivariable GEE models, we estimated the odds of reporting disordered weight-control behavior in the past 30 days at follow-up among girls who did not report use of purging or diet pills at baseline. The primary predictor was intervention status. We tested baseline dieting, age, obesity, and ethnicity as covariates in multivariable models. We used the change-in-estimate method\textsuperscript{41} to evaluate confounding, with a criterion for inclusion defined as a greater than 10% change in the β coefficient associated with intervention status on addition of a covariate to multivariable models. The presence of effect modification was assessed by testing interaction terms and stratified models.

In addition to odds ratios, we calculated the preventive fraction (PF) for our findings. The PF estimates the magnitude of preventive effect associated with a beneficial exposure.\textsuperscript{41-43} For our purposes, the exposure was the Planet Health intervention. The PF is interpreted as the proportion of new cases in a population that could be prevented by a beneficial exposure. The PF is based on the following standard formula for attributable risk percentage:

\[
\text{PF} = \frac{\text{Odds}_{\text{intervention}} - \text{Odds}_{\text{control}}}{\text{Odds}_{\text{control}}} \times \frac{\text{prevalence}_{\text{control}}}{1 - \text{prevalence}_{\text{control}}}
\]
Table 1. Baseline Characteristics of 480 Middle School Girls in the Planet Health Intervention Triala

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention (n = 254)</th>
<th>Control (n = 226)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD, y)</td>
<td>11.5 (0.7)</td>
<td>11.5 (0.7)</td>
</tr>
<tr>
<td>Ethnicity, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>72.1</td>
<td>64.2</td>
</tr>
<tr>
<td>African American</td>
<td>9.1</td>
<td>15.9†</td>
</tr>
<tr>
<td>Hispanic</td>
<td>9.5</td>
<td>11.1</td>
</tr>
<tr>
<td>Other</td>
<td>9.5</td>
<td>8.9</td>
</tr>
<tr>
<td>Overweight, %‡</td>
<td>22.1</td>
<td>19.0</td>
</tr>
<tr>
<td>Dieting, %§</td>
<td>26.8</td>
<td>28.3</td>
</tr>
</tbody>
</table>

*aGirls who reported use of purging or diet pills at baseline were excluded.
†P = .02 comparing intervention and control groups.
‡Obesity was defined as body mass index and triceps skinfold at or above the 85th percentile for age and sex.
§Dieting in the past 30 days to control weight.

Table 2. Multivariable Odds of Initiating Purging or Use of Diet Pills Associated With Intervention Status in the Planet Health Intervention Trial With Middle School Girls After 21 Months of Follow-upa

<table>
<thead>
<tr>
<th>Model</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 (all girls; N = 480)</td>
<td>Reference</td>
</tr>
<tr>
<td>Control</td>
<td>Reference</td>
</tr>
<tr>
<td>Intervention</td>
<td>0.41 (0.22-0.75)</td>
</tr>
<tr>
<td>Model 2 (all girls; N = 480)</td>
<td>Reference</td>
</tr>
<tr>
<td>Control</td>
<td>Reference</td>
</tr>
<tr>
<td>Intervention</td>
<td>0.43 (0.22-0.82)</td>
</tr>
<tr>
<td>Model 3 (baseline dieters only; n = 132)</td>
<td>Reference</td>
</tr>
<tr>
<td>Control</td>
<td>Reference</td>
</tr>
<tr>
<td>Intervention</td>
<td>1.23 (0.66-2.32)</td>
</tr>
<tr>
<td>Model 4 (baseline nondieters only; n = 348)</td>
<td>Reference</td>
</tr>
<tr>
<td>Control</td>
<td>Reference</td>
</tr>
<tr>
<td>Intervention</td>
<td>0.08 (0.01-0.85)</td>
</tr>
</tbody>
</table>

*Girls who reported the use of purging or diet pills at baseline were excluded. All models include ethnicity and school matched pairs.

Abbreviations: CI, confidence interval; OR, odds ratio.

RESULTS

Table 1 presents the baseline characteristics of the sample. Control and intervention participants did not differ significantly in the distribution of age or prevalence of overweight or dieting in the past month. At baseline, the mean age in the control and intervention schools was 11.5 years (SD, 0.7 year; age range, 10-14 years). Dieting in the past month was reported by 64 girls (28.3%) in control schools and 68 girls (26.8%) in intervention schools. Compared with girls in intervention schools, a greater proportion of girls in control schools were African American (9.1% vs 15.9%; P = .02) at baseline; therefore, ethnicity was included in all multivariable models.

After the 21-month intervention, we found 14 (6.2%) of 226 girls in control schools and 7 (2.8%) of 254 girls in intervention schools reported purging or use of diet pills to control their weight (P = .003). In a multivariable GEE model controlling for ethnicity and school matched pairs, girls in intervention schools were less than half as likely to report use of purging or diet pills at follow-up compared with girls in control schools (OR, 0.41; 95% confidence interval [CI], 0.22-0.75) (Table 2, model 1). We observed no evidence of confounding by baseline age or obesity, so these covariates were not included in final models.

To explore whether the intervention may have had a different effect depending on whether a girl reported dieting at the beginning of the study, we stratified the sample by baseline dieting status. The intervention appeared to protect baseline nondieters, but not dieters, from disordered weight-control behaviors. By the end of the study, 5 (7.7%) of 65 baseline dieters in control schools and 6 (8.8%) of 68 in intervention schools reported purging or taking diet pills in the past 30 days (P = .45). In contrast, among the girls who did not diet at baseline, only 1 (0.5%) of 186 in intervention schools compared with 9 (5.6%) of 162 in control schools reported these behaviors at follow-up (P = .03).

In a multivariable GEE model predicting the odds of reporting use of purging or diet pills at follow-up, baseline dieting was not found to be significant (P = .13) (Table 2, model 2), and when an interaction between baseline dieting and intervention status was tested, the interaction term was not significant (P = .06). Finally, we tested separate models stratified by baseline dieting status. As shown in Table 2 (model 3), among girls who reported dieting in the past 30 days at baseline, there was no difference between control and intervention girls in the odds of reporting disordered weight-control behaviors at follow-up (OR, 1.23; 95% CI, 0.66-2.32). Among baseline nondieters, however, girls in intervention schools were 12 times less likely than girls in control schools to report the use of purging or diet pills to control their weight at follow-up (OR, 0.08; 95% CI, 0.01-0.85) (Table 2, model 4).

To estimate the proportion of new cases of disordered weight-control behaviors that may potentially be prevented by the Planet Health intervention, we used the odds ratio associated with intervention status as an estimate of relative risk, controlling for ethnicity and school matched pairs, in model 1 of Table 2 (odds ratio, 0.41). We performed the following calculation:

\[
PF = \left\{ \frac{1}{0.41} - 1 \right\} \times \frac{100}{1/0.41} = 59%.
\]

Based on our findings, an estimated 59% of new cases of disordered weight-control behavior among girls in control schools might have been prevented had they received the intervention.
To our knowledge, Planet Health may be the first RCT designed for overweight prevention to show a protective effect against both obesity and disordered weight-control behaviors in early adolescent girls. In previous analyses, Planet Health was shown to reduce the odds of obesity in girls through prevention and remission during 2 school years. In the present study, we have found the Planet Health intervention also to protect against the use of purging and diet pills for weight control. On the basis of our calculations of the preventive fraction, we estimate that more than half of the expected new cases of disordered weight-control behavior among girls in intervention schools may have been prevented by Planet Health. Although there have been concerns that obesity prevention intervention programs might exacerbate the risk of development of eating disorder symptoms, we found no evidence that this potential iatrogenic effect might be associated with the Planet Health program.

The Planet Health program was designed to promote healthful nutrition and physical activity and to reduce obesity, not eating disorders, so we were not able to test what specific aspects of the program may have been beneficial for preventing disordered weight-control behaviors. The Planet Health program has several important strengths, however, that may have contributed to the positive findings. The study was implemented in 10 middle schools and used an RCT design, which is the strongest research design available to test intervention effects and reduce the threat of confounding. There were no differences between the control and intervention schools at baseline, except in the proportion of African American girls, suggesting that the randomized design of the study was successful in minimizing the threat of confounding across the 2 experimental conditions. The Planet Health intervention was well-grounded theoretically by drawing on social cognitive and behavioral choice theories, both of which have served as the basis for effective behavioral interventions relating to eating and physical activity. In addition, the number of participants in Planet Health was larger than in many eating disorder prevention studies, which allowed us the statistical power to assess the intervention effect on disordered weight-control behavior. The Planet Health study involved a long-term integration of the program across the school and throughout the school curriculum during 2 school years. With 32 classroom lessons and 30 physical education lessons, the Planet Health intervention was more extensive than most preventive interventions for eating disorders in schools to date. It is possible that the infusion of the Planet Health intervention throughout the curriculum and the fact that the program reached both boys and girls may have resulted in a change in the school environment in terms of pressure experienced by girls to take on disordered weight-control strategies. Many studies intended to prevent eating disorders in adolescents address the topics of dieting, body image, and/or eating disorders directly; however, the Planet Health intervention was different in that it focused exclusively on healthful nutrition and physical activity and reduced television viewing and did not explicitly mention eating disorders, weight control, dieting, body image, or overweight. Weight status and obesity were not explicitly addressed in the curriculum in an effort to avoid stigmatizing overweight youth. It is plausible that the nutrition and physical activity focus of the Planet Health program, which promotes healthful behaviors appropriate for all youth and not just those who are overweight, was a strength of the intervention, particularly for nondieting girls.

Our findings are consistent with the results of a 12-week overweight-prevention RCT designed to promote dance and reduction in television viewing that was performed with 61 African American girls aged 8 to 10 years in California. The trial by Robinson and colleagues found a reduction in concern with weight and shape associated with the intervention. Our study extends the findings of Robinson et al in that we found that the Planet Health intervention prevented self-induced vomiting and use of laxatives and diet pills.

In stratified analyses, we found that the intervention effect on the onset of disordered weight-control behaviors was significantly modified by baseline dieting status. Our finding of no intervention impact with dieting girls on disordered weight-control behaviors suggests that a health promotion program like Planet Health that is focused on nutrition and physical activity may not be adequate in the subset of girls who have begun dieting by early adolescence. Furthermore, our findings suggest that girls who have begun dieting by sixth or seventh grade may need intervention at a younger age. Girls who reported no dieting in the past month at the start of the study made up almost three quarters of the sample, and for them, the Planet Health intervention appears to have had a sizable protective effect. This result is consistent with research by Paxton et al, who found in a study with seventh- and eighth-grade girls that dieting and body dissatisfaction were associated with reduced receptivity to persuasive messages intended to prevent dieting and eating disorder symptoms. In the Planet Health study, girls who were not dieting at baseline, compared with their dieting peers, may have been more receptive to the healthful behavioral messages.

Our study has several limitations. The small number of cases reduced the stability of estimates, leading to wide CIs around ORs; therefore, our results should be interpreted with caution. The moderate reliability of self-reported survey data from early adolescents may lead to misclassification and weakened associations. We were not able to test some possible confounding variables, such as pubertal stage, depression, and low self-esteem. Since the study was an RCT, however, we expect that unmeasured factors were likely to be evenly distributed in control and intervention conditions at baseline. Because our study is apparently the first obesity prevention trial to demonstrate protection against the use of purging and diet pills in early adolescent girls, more research will be needed to further evaluate Planet Health or similar interventions in other populations to determine whether findings can be replicated. If the protective effect can be reproduced, more work will be needed to better understand which facets of the program have the greatest impact.
Irving and Neumark-Sztainer\(^{30}\) provide strong conceptual and practical arguments for integrating efforts to prevent overweight and eating disorders. Missing from the literature to date, however, has been empirical evidence of the effectiveness of integrated interventions. The success of the Planet Health intervention in reducing obesity and the onset of disordered weight-control behaviors in early adolescent girls, coupled with the finding by Robinson et al\(^{13}\) of decreased weight concerns in their overweight prevention trial, provides the first evidence that integrating the prevention efforts of the 2 fields may be effective. It is important to note that although Planet Health was found to be safe and protective against disordered weight-control behaviors, many other obesity prevention programs with unknown effects on eating disorder symptoms are being used in schools and communities or are in development. For safety monitoring and to assess their potential impact on disordered weight-control behaviors, it is essential that all obesity prevention interventions with children and adolescents include age-appropriate measures of weight-control practices and eating disorder symptoms.

The Planet Health intervention has been shown to be a cost-effective and cost-saving intervention for schools and communities in terms of its obesity prevention effect.\(^{53}\) For health promotion work to be feasible and sustainable, intervention efforts must be as cost-effective and resource and time efficient as possible.\(^{30,31}\) An integrated approach to overweight and eating disorders prevention with adolescents has the potential to maximize resources and reduce burdens on schools where health promotion programs are implemented. Findings from the Planet Health intervention provide promising evidence that school-based interventions for early adolescent girls can effectively integrate primary prevention of both obesity and eating disorders.

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