Examination of Shared Risk and Protective Factors for Overweight and Disordered Eating Among Adolescents

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Objective: To identify shared risk and protective factors for purging, binge eating, and overweight.

Design: Prospective cohort study.


Participants: Girls (n=6022) and boys (n=4518), aged 11 to 17 years in 1998, in the ongoing Growing Up Today Study.

Main Exposures: Putative risk and protective factors within the psychological, behavioral, and socioenvironmental domains.

Main Outcome Measures: Overweight, use of laxatives or purging (vomiting), and binge eating. Because of the low prevalence of purging, we did not examine shared factors for this behavior among boys.

Results: In 1998, a total of 219 girls (3.7%) and 30 boys (0.7%) reported purging behaviors, 426 girls (7.1%) and 90 boys (2.0%) reported binge eating, and 1019 girls (17.4%) and 1040 boys (24.6%) were overweight. From 1999 through 2001, 331 girls (7.8%) initiated purging behaviors, 503 girls (11.8%) and 132 boys (4.5%) initiated binge eating behaviors, and 424 girls (10.0%) and 382 boys (13.6%) became overweight. Concern for weight was directly associated with all 3 weight-related problems among boys and girls. Among girls, dieting, parental weight-related teasing, and family meal frequency had a shared effect on the weight-related problems examined.

Conclusions: Factors within the psychological, behavioral, and socioenvironmental domains may have a shared effect on purging, binge eating, and overweight. Further research is needed to determine if an intervention designed to address these shared risk and protective factors is effective in simultaneously reducing these weight-related problems.


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comes. Neumark-Sztainer et al examined the association between each risk factor and each weight-related problem in separate models. Thus, the relative contribution of these factors in relation to others explored is unknown. Examining the relative contribution would help identify the most potent factors on which to intervene. In addition, the analyses of Neumark-Sztainer et al did not account for the correlation between these outcomes, possibly causing the standard error estimates of the effects to be too small, which can result in P values that overstate the significance of observed associations.

Our study addresses limitations of previous research by modeling these weight-related outcomes jointly, allowing for appropriate estimation of P values and for assessing whether risk factors are associated differentially with purging, binge eating, and overweight.

We aimed to identify shared risk factors for overweight and disordered eating behaviors that could serve as targets for integrated interventions. To achieve this aim, we examined cross-sectional and prospective associations between a range of psychological, behavioral, and socioenvironmental factors and purging, binge eating, and overweight among a large sample of children and adolescents (aged 11-17 years). We hypothesized that factors within the psychological, socioenvironmental, and behavioral domains would jointly predict purging, binge eating, and overweight.

**THEORETICAL MODEL**

The putative risk factors of weight-related outcomes examined in this study are derived theoretically based on social cognitive theory (Figure).17,18 Many have been examined previously in etiologic studies of overweight or disordered eating.16,19

**STUDY POPULATION**

GUTS is a prospective cohort study of adolescents residing throughout the United States. Participants are offspring of participants in the second Nurses’ Health Study (NHS II). Participants in NHS II provided consent for their child to participate in GUTS. In 1996, we mailed GUTS participants an explanatory letter and a questionnaire. Return of the questionnaire constituted consent. The Human Subjects Committee at Brigham and Women’s Hospital approved this study.

Details of initial recruitment are available elsewhere.20 The baseline 1996 sample included 8843 girls and 7696 boys ages 9 through 14 years. Participants were mailed follow-up questionnaires annually from 1997 through 2001 and biannually since 2003. For the present study, we explored cross-sectional associations between risk factors and purging, binge eating, and overweight in 1998 when participants were aged 11 through 17 years. We examined these associations in 1998 because all predictor variables of interest for 1998. Our final sample for our cross-sectional analyses was 6022 girls and 4518 boys. To identify development of weight-related problems subsequent to the predictors of interest, only participants who were not overweight and were not engaging in any of the relevant disordered eating behaviors in 1998 were eligible for the prospective analysis. Thus, we excluded 1997 girls and 1389 boys who reported purging or binge eating or who were overweight in 1998. We also excluded 163 girls and 219 boys missing data on all 3 outcome variables across the follow-up years. Our final sample for prospective analyses was 4262 girls and 2910 boys.

**OUTCOME MEASURES**

**Purging**

We assessed purging with the following validated questions25-27: “During the past year, how often did you make yourself throw up to keep from gaining weight?” and “How often did you take laxatives to keep from gaining weight?” Response options ranged from “never” to “daily.” We defined purging as reporting vomiting or laxative use in the past year.

**Binge Eating**

We assessed binge eating with validated questions.52,23 Participants first reported the frequency during the past year of eating “so much food in a short period of time that you would be embarrassed if others saw you (binge eating or gorging).” Response options ranged from “never” to “more than once a week.” Respondents who reported any episodes of overeating were directed to a follow-up question asking whether “you felt out of control during these episodes, like you could not stop even if you wanted to”. We defined binge eating as having at least 1 episode of overeating in the past year and feeling out of control during the episode.

**Overweight**

Children and adolescents self-reported their height and weight. Previous studies25-27 report high validity for self-reported heights and weights in adolescents. We classified children and adoles-

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**Figure.** Putative socioenvironmental, behavioral, and psychological risk and protective factors for purging, binge eating, and overweight among adolescents.

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cents as overweight or obese based on the International Obesity Task Force cutoff points,28 which are age- and sex-specific body mass index (calculated as weight in kilograms divided by height in meters squared) values for individuals younger than 18 years that correspond with a body mass index of 25 at 18 years of age. Thus, the International Obesity Task Force cutoff points provide comparability in assessing overweight in adolescents and adults.

PSYCHOLOGICAL AND BEHAVIORAL FACTORS

Weight Concern

We assessed weight concern using items from the McKnight Risk Factor Survey.32 Adolescent boys are more likely than girls to want to increase muscle tone rather than be thin;32 thus, to make the questions appropriate for boys, we replaced the questions on thinness with questions about the importance of not being fat in the surveys sent to male participants.

Dieting

We assessed dieting with the question, “During the past year, how often did you diet to lose weight or to keep from gaining weight?” Response options ranged from “never” to “always on a diet.” For these analyses, participants were considered dieters if they reported any dieting.

Fast-Food Intake

We assessed fast-food intake with the question, “How often do you eat fast food away from home (like French fries)?” Response items ranged from “never/less than once per week” to “daily.” This item is moderately correlated with a question asking about the frequency of eating at a fast-food restaurant.31

Breakfast

We assessed frequency of breakfast with the question, “How many times each week (including weekdays and weekends) do you eat breakfast?” Response options ranged from “never or almost never” to “5 or more times per week.”

Physical Activity

We assessed mean hours of physical activity per week using the 18-item Youth/Adolescent Activity Questionnaire. This tool is based on the validated assessment tool developed for the NHS II questionnaire.34

Television Viewing

We assessed television (TV) viewing with the question, “How many hours per week do you spend watching TV?” Response options ranged from “never” to “31 or more hours per week.” Separate questions were asked for weekends and weekdays, and the values were summed and averaged to create the hours-per-day variable.

SOCIOENVIRONMENTAL FACTORS

Maternal Dieting

We assessed adolescent perception of maternal dieting with the question, “In the past year, how often has your mother tried to lose weight?” Response options ranged from “never” to “always.” For these analyses, mothers were considered dieters if their child reported any maternal dieting.33

Parental Weight-Related Teasing

We assessed parental weight-related teasing with the question, “In the past year, how often has your mother made a comment about your weight or eating that made you feel bad?” (a similar question was given with regard to the father). Response options ranged from “never” to “always.”

Peer Concern With Thinness

We assessed peer concern with the following questions: (1) “How often have your friends talked about wanting to lose weight?” (2) “How important has it been to your friends that they not be fat?” and (3) “How important has it been to your friends that you not be fat?” We used the mean score of these questions to create the peer influence variable.

Desire to Look Like Same-Sex Media Figure

We assessed desire to look like same-sex media figures with the question, “In the past year, how often have you tried to look like the girls or women you see on TV, in movies, or in magazines?” (a similar question was posed to boys). Response options ranged from “not at all” to “totally.”

Family Meal Frequency

We assessed family meal frequency with the question, “How often do you sit down with other members of your family to eat dinner or supper?” Response options ranged from “never” to “every day.”

Other Covariates

The age of the child/adolescent was used as a covariate. We calculated this age from the individual’s birth date and the date each questionnaire was returned.

STATISTICAL ANALYSES

We used generalized estimating equations34,35 to jointly model the effects of the predictors on purging, binge eating, and overweight. These models assume that there is some correlation among the outcomes and adjust standard errors to account for this correlation. We first assessed whether different effects for each predictor were necessary. To do this, we included each predictor as a main effect plus interaction terms between outcome type (ie, purging, binge eating, overweight) and each predictor. Specifically, we included a row for each outcome for each predictor as a main effect plus interaction terms between outcome type (ie, purging, binge eating, overweight) and each predictor. The test to examine whether different odds ratios (ORs) are required for each outcome associated with the predictor. If the interaction terms were statistically significant (P ≤ .05), we retained them in the model and showed the distinct ORs for each outcome associated with the predictor. If the interaction terms were not significant, we removed them from the model and presented the homogenous main effect of the predictor on the outcomes as a single OR, which applies to all of the outcomes. All analyses were stratified by sex and conducted using SAS statistical software, version 9.1 (SAS Institute, Cary, North Carolina).
We conducted sensitivity analyses for the cross-sectional and prospective analyses to examine how our decisions regarding inclusion and exclusion of participants may have influenced our results. We ran our models 2 different ways: (1) excluding any participants who had missing data on any outcome variable of interest and (2) including all participants in the models regardless of how many outcome variables of interest were missing. No substantive differences in results were found for the model options. We chose to use results from the second model, which kept all available data by including all participants in the models regardless of how many outcome variables of interest were missing.

RESULTS

PARTICIPANT CHARACTERISTICS

In 1998, a total of 219 girls (3.6%) and 30 boys (0.7%) reported purging and 426 girls (7.1%) and 90 boys (2.0%) reported binge eating (Table 1). In addition, 1019 girls (17.4%) and 1040 boys (24.6%) were overweight. Given the small number of boys reporting purging behaviors, we did not include purging in our examination of shared factors for boys. During the 3-year follow-up period, 331 girls (7.8%) initiated purging, whereas 503 girls (11.8%) initiated binge eating behaviors. In addition, 24 girls (10.0%) and 382 boys (13.6%) became overweight.

CROSS-SECTIONAL RESULTS

Table 2 presents the cross-sectional multivariable adjusted ORs of purging (girls only), binge eating, and overweight associated with psychological, behavioral, and socioenvironmental factors among girls and boys. In instances when the effect estimates for a predictor were similar for all 3 outcomes (ie, the interaction term of outcome type and the predictor variable of interest was not significant), we present the single homogeneous main effect of the predictor variable on the outcomes. In instances when the effect estimates for a predictor were significantly different for the 3 outcomes (ie, the interaction term was significant), we present the individual effect of the predictor variable and each outcome.

Girls

Among girls, weight concern was directly associated with all 3 weight-related problems and the direction and magnitude of the effect were similar for all 3 outcomes (homogeneous effect OR, 2.45; 95% confidence interval [CI], 2.26–2.67). Of the 5 behavioral factors examined, only dieting was significantly associated with all 3 weight-related problems. The magnitude of the effect differed across the 3 outcomes, with dieting being most strongly associated with purging. Physical activity was significantly associated with purging and overweight; however, the direction of the effect differed; physical activity was directly associated with purging and inversely associated with overweight. Fast-food intake, breakfast, and TV viewing did not have a shared effect on the weight-related problems examined.

Boys

Among boys, concern with weight was directly associated with binge eating and overweight; the magnitude of effect differed across the 2 outcomes, with weight concern being more strongly associated with overweight. Of the 5 behavioral factors examined, only TV viewing was significantly associated with binge eating and overweight. Television viewing was directly associated with both outcomes (homogeneous effect OR, 1.12; 95% CI, 0.98–1.28). None of the socioenvironmental factors were significantly associated with all 3 weight-related problems. However, a number of socioenvironmental factors were associated with 2 of the 3 weight-related problems, suggesting a shared effect. Parental weight-related teasing was directly associated with binge eating and overweight. Family meal frequency was inversely associated with purging and binge eating. The desire to look like same-sex media figures and the importance of thinness to peers were also significantly associated with 2 of the weight-related problems; however, the direction of these associations differed across outcomes. The desire to look like same-sex media figures was directly associated with purging and inversely associated with overweight. The importance of thinness to peers was directly associated with binge eating and inversely associated with overweight. Maternal dieting did not have a shared effect on the weight-related problems examined.

Table 1. Outcomes, Predictors, and Covariates of Growing Up Today Study Participants in 1998

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adolescent Girls (n=4022)</th>
<th>Adolescent Boys (n=4518)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcomes, No. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purging</td>
<td>219 (3.6)</td>
<td>30 (0.7)</td>
</tr>
<tr>
<td>Binge eating</td>
<td>426 (7.1)</td>
<td>90 (2.0)</td>
</tr>
<tr>
<td>Obese or overweight</td>
<td>1019 (17.4)</td>
<td>1040 (24.6)</td>
</tr>
<tr>
<td>Predictors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight concernb</td>
<td>2.4 (1.1)</td>
<td>1.6 (0.8)</td>
</tr>
<tr>
<td>Behavioral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dieting, No. (%) responding yes</td>
<td>2316 (38.5)</td>
<td>719 (15.9)</td>
</tr>
<tr>
<td>Fast-food intake,servings per weekb</td>
<td>1.2 (1.3)</td>
<td>1.5 (1.5)</td>
</tr>
<tr>
<td>Breakfast, times per weekb</td>
<td>4.8 (2.0)</td>
<td>5.2 (1.7)</td>
</tr>
<tr>
<td>Physical activity, h/db</td>
<td>1.8 (1.1)</td>
<td>2.1 (1.2)</td>
</tr>
<tr>
<td>Television viewing, h/db</td>
<td>1.4 (1.1)</td>
<td>1.8 (1.3)</td>
</tr>
<tr>
<td>Socioenvironmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal dieting, No. (%)</td>
<td>4104 (68.2)</td>
<td>2746 (60.8)</td>
</tr>
<tr>
<td>Parental weight-related teasingb</td>
<td>1.3 (0.6)</td>
<td>1.2 (0.6)</td>
</tr>
<tr>
<td>Importance of thinness to peersb</td>
<td>1.9 (0.7)</td>
<td>1.3 (0.5)</td>
</tr>
<tr>
<td>Desire to look like</td>
<td>1.7 (1.0)</td>
<td>1.4 (0.7)</td>
</tr>
<tr>
<td>same-sex media figureb</td>
<td>3.1 (0.8)</td>
<td>3.2 (0.8)</td>
</tr>
<tr>
<td>Family meal frequencyb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity, No. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other than white</td>
<td>375 (6.2)</td>
<td>306 (6.8)</td>
</tr>
<tr>
<td>White</td>
<td>5625 (93.4)</td>
<td>4201 (93.0)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>13.9 (1.6)</td>
<td>13.8 (1.5)</td>
</tr>
</tbody>
</table>

aTotal number may differ slightly owing to missing data.
bData are presented as mean (SD).
Dieting, fast-food intake, breakfast, and physical activity did not have a shared effect on binge eating and overweight among boys.

Parental weight-related teasing was directly associated with binge eating and overweight (homogeneous effect OR, 1.31; 95% CI, 1.15-1.50). Importance of thinness to peers was significantly associated with binge eating and overweight; however, the direction of these associations differed across outcomes. Importance of thinness to peers was directly associated with binge eating and inversely associated with overweight. The desire to look like same-sex media figures was also directly associated with binge eating and inversely associated with overweight. Maternal dieting and family meal frequency did not have a shared effect on binge eating and overweight.

**Prospective Results**

**Table 3** presents the prospective multivariable adjusted ORs of incident cases of purging (girls only), binge eating, and overweight status. These factors are associated with risk factors among girls and boys.

As in our cross-sectional analyses, concern with weight was directly associated with all 3 weight-related problems in our prospective analyses, and the direction and magnitude of the effect were similar for all 3 outcomes (homogeneous effect OR, 1.48; 95% CI, 1.25-1.74). Dieting was also directly associated with those 3 outcomes (homogeneous effect OR, 1.48; 95% CI, 1.25-1.74). Unlike our cross-sectional results, which found that physical activity was directly associated with purging and inversely associated with overweight, our prospective analyses showed that physical activity did not have a shared effect on the weight-related outcomes. Prospectively, fast-food intake, breakfast, and TV viewing did not have a shared effect on weight-related problems, similar to our cross-sectional findings.

As we found in our cross-sectional analyses, parental weight-related teasing was directly associated with binge eating and overweight but not purging prospectively. Also similar to our cross-sectional analyses, the desire to look like same-sex media figures was associated with more than 1 weight-related problem prospectively, but the direction...
of this effect differed across outcomes; it was directly associated with purging and inversely associated with overweight. Prospectively, family meal frequency was inversely associated with all 3 weight-related outcomes (homogeneous effect OR, 0.90; 95% CI, 0.83-0.98). Maternal dieting and the importance of thinness to peers did not have a shared effect on weight-related problems.

Boys

As we found in our cross-sectional analyses, concern with weight was directly associated with binge eating and overweight prospectively; the effect's magnitude differed across the 2 outcomes, with weight concern being more strongly associated with overweight. Unlike our cross-sectional results, which found that TV viewing was directly associated with binge eating and overweight prospectively, TV viewing did not have a shared effect on obesity and binge eating. Dieting, fast-food intake, breakfast, and physical activity also did not have a shared effect on binge eating and overweight among boys. Prospectively, none of the 5 socioenvironmental factors had a shared effect on binge eating and overweight among boys.

Using analytic methods that account for the correlation among the 3 weight-related outcomes, we examined shared risk factors of purging, binge eating, and overweight in a large cohort of adolescents. Identification of shared risk factors for these weight-related problems can inform development of interventions to promote maintenance of healthful weight and decrease risk of disordered eating.

We found that weight concern was the most robust shared risk factor for purging (girls only), binge eating, and overweight among boys and girls. Among girls, dieting was a shared risk factor for purging, binge eating, and overweight. Two socioenvironmental factors, weight-related teasing by parents and family meal frequency, had a shared effect on weight-related problems. Parental weight-related teasing was a risk factor for binge eating and overweight, and family meal frequency was a protective factor for all 3 weight-related outcomes. These findings are consistent with previous research showing that dieting\(^{36,37}\) and weight-related teasing\(^{38,39}\) are associated

<table>
<thead>
<tr>
<th>Factors</th>
<th>Homogeneous Main Effect, OR (95% CI)</th>
<th>Different Effect by Outcome, OR (95% CI)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Purging</td>
<td>Binge Eating</td>
</tr>
<tr>
<td>Adolescent Girls</td>
<td></td>
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</tr>
<tr>
<td>Psychological</td>
<td>Weight concern</td>
<td>1.56 (1.42-1.71)</td>
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<tr>
<td>Behavioral</td>
<td>Dieting</td>
<td>1.48 (1.25-1.74)</td>
</tr>
<tr>
<td></td>
<td>Fast-food intake</td>
<td>1.02 (0.97-1.07)</td>
</tr>
<tr>
<td></td>
<td>Breakfast</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>Physical activity</td>
<td>1.05 (1.00-1.11)</td>
</tr>
<tr>
<td></td>
<td>Television viewing</td>
<td>1.01 (0.95-1.08)</td>
</tr>
<tr>
<td>Socioenvironmental</td>
<td>Maternal dieting</td>
<td>0.89 (0.77-1.02)</td>
</tr>
<tr>
<td></td>
<td>Parental weight-related teasing</td>
<td>...</td>
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<tr>
<td></td>
<td>Importance of thinness to peers</td>
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<tr>
<td></td>
<td>Desire to look like same-sex media figure</td>
<td>...</td>
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<tr>
<td></td>
<td>Family meal frequency</td>
<td>0.90 (0.83-0.98)</td>
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<tr>
<td>Adolescent Boys</td>
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<td>Weight concern</td>
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<td></td>
<td>Breakfast</td>
<td>...</td>
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<td></td>
<td>Physical activity</td>
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<td>Maternal dieting</td>
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<td>Parental weight-related teasing</td>
<td>1.07 (0.88-1.29)</td>
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<td>Importance of thinness to peers</td>
<td>0.92 (0.72-1.17)</td>
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<td></td>
<td>Desire to look like same-sex media figure</td>
<td>0.95 (0.82-1.11)</td>
</tr>
<tr>
<td></td>
<td>Family meal frequency</td>
<td>0.89 (0.78-1.01)</td>
</tr>
</tbody>
</table>

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

\(^{a}\)Multivariable model includes all psychological, behavioral, and socioenvironmental factors. Multivariable model adjusted for age when questionnaire was returned. Bold-faced type represents statistically significant results (\(P \leq .05\)).

\(^{b}\)Purging not included in shared factors for boys owing to the small number of boys reporting those behaviors.
with increased risk of disordered eating and obesity and that family meals\textsuperscript{40-43} may reduce adolescents’ risk of engaging in disordered eating behaviors.

Our finding that girls who reported wanting to look like same-sex media figures were less likely to become overweight but were more likely to initiate purging behaviors underscores the importance of examining the influence of risk factors on a range of weight-related problems. By looking only at the influence of wanting to look like media figures on obesity risk, researchers and public health professionals may inadvertently promote an obesity prevention strategy (ie, emulating media figures) that could increase disordered eating risk among adolescents.\textsuperscript{44}

Among boys, none of the behavioral or socioeconomic factors were consistently associated with binge eating and overweight. Our results are consistent with the finding by Neumark-Sztainer et al\textsuperscript{16} that, compared with girls, substantially fewer risk factors had a shared effect on weight-related problems among boys. It is possible that our relatively null findings among boys may be because our measures of the behavioral or socioeconomic factors do not adequately capture the experiences of boys. For example, we did not assess performance-related (vs appearance-related) pressures to achieve an ideal body weight, which may have a strong influence on weight-related problems among boys.\textsuperscript{45}

Further research is needed to elucidate shared factors of weight-related problems among adolescents.

This study’s strengths include prospective data collection, the breadth of theoretically driven risk factors examined, and the use of analytic methods that account for the correlation among the weight-related outcomes examined. This study also had limitations. Although study participants reside throughout the United States, our cohort is not a representative sample of US adolescents. Participants are children of registered nurses, and the cohort is more than 90% white, which may reduce the generalizability of our findings. However, our findings are similar to those of Neumark-Sztainer et al,\textsuperscript{16} who examined shared risk factors in an ethnically and socioeconomically diverse population. Another limitation was the necessity of collecting data from adolescents by self-report questionnaires. All 3 self-report outcome measures have been previously validated\textsuperscript{22,23,46} and the resulting measurement error should be random.

In conclusion, we found that weight concern was the most robust shared risk factor for overweight and disordered eating among adolescents. Among girls, we found that dieting, parental weight-related teasing, and family meal frequency had a shared effect on these weight-related problems. Interventions that aim to prevent multiple weight-related problems should test strategies that address these factors to determine whether such efforts can reduce the high prevalence of overweight and disordered eating behaviors among adolescents.

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Author Contributions: Drs Field and Austin contributed equally to this study. Drs Haines and Field and Ms Rifas-Shiman had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Haines, Kleinman, and Austin. Acquisition of data: Field and Austin. Analysis and interpretation of data: Haines, Kleinman, Rifas-Shiman, Field, and Austin. Drafting of the manuscript: Haines. Critical revision of the manuscript for important intellectual content: Haines, Kleinman, Rifas-Shiman, Field, and Austin. Statistical analysis: Kleinman and Rifas-Shiman. Obtained funding: Haines, Field, and Austin. Administrative, technical, and material support: Haines. Study supervision: Austin.

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