Objective: To examine 5-year longitudinal associations between family meal frequency and disordered eating behaviors in adolescents.

Design: Longitudinal study.

Setting: Participants from 31 Minnesota schools completed in-class assessments in 1999 (time 1) and mailed surveys in 2004 (time 2).

Participants: Adolescents (N=2516) who completed Project EAT (Eating Among Teens)—I (time 1) and –II (time 2) assessments.

Main Outcome Measures: Time 1 family meal frequency and time 2 disordered eating behaviors, including extreme weight control behaviors (self-induced vomiting and use of laxatives, diet pills, or diuretics), less extreme unhealthy weight control behaviors (eating very little, fasting, using food substitutes, skipping meals, or smoking), binge eating, and chronic dieting.

Results: Among adolescent girls, time 1 regular family meals (≥ 5 meals/wk) were associated with lower prevalences of time 2 extreme weight control behaviors (odds ratio, 0.71; 95% confidence interval, 0.52-0.97), even after adjusting for sociodemographic characteristics, body mass index, family connectedness, parental encouragement to diet, and extreme weight control behaviors at time 1. Associations with other disordered eating behaviors were also suggestive of a protective effect of family meals in unadjusted analyses but were not statistically significant in adjusted analyses. Among adolescent boys, regular family meals did not predict lower levels of disordered eating behaviors.

Conclusions: The high prevalence of disordered eating behaviors among adolescent girls and the protective role of family meals suggest a need for interventions aimed at promoting family meals. Further exploration of predictors of disordered eating behaviors in adolescent boys and the role of family meals is warranted.

ics. Furthermore, in interviews conducted with adolescent girls with type 1 diabetes mellitus and their parents, regular family meals emerged as one of the major protective factors against unhealthy weight control practices. Although these findings suggest that family meals may play a role in preventing the onset of disordered eating behaviors, they are limited by cross-sectional study designs or by recall of past mealtime experiences.

The present study builds on this body of research by examining longitudinal associations between family meals and disordered eating behaviors in a large and diverse population of adolescent boys and girls. Specifically, this study addressed the following research question: Is family meal frequency associated with unhealthy weight control behaviors, binge eating, and chronic dieting among adolescent boys and girls 5 years later? Based on previous cross-sectional findings from Project EAT-I, we hypothesized that more frequent family meals would predict fewer disordered eating behaviors in girls but not in boys.

METHODS

STUDY DESIGN AND POPULATION

Project EAT-II is a longitudinal, follow-up study of Project EAT-I, a study of eating patterns and weight-related issues in adolescents. The study population includes 2516 adolescents (1386 girls and 1130 boys) who participated in Project EAT-I and Project EAT-II. In Project EAT-I, middle and high school students from 31 Minnesota schools completed in-class surveys and anthropometric measures during the 1998-1999 academic year. Schools serving ethnically and socioeconomically diverse populations were invited to participate in the study. Project EAT-II aimed to survey all of the original participants by mail 5 years later (2003-2004 academic year). The University of Minnesota’s Institutional Review Board Human Subjects Committee approved all study protocols.

Of the original Project EAT-I study population (N=4746), 1074 (22.6%) were lost to follow-up for various reasons, primarily owing to missing contact information at the EAT-I survey (411 participants) and no address found at follow-up (591). Of the remaining 3672 participants contacted by mail, 2516 completed surveys, representing 53.0% of the original cohort and 68.5% of participants who could be contacted for Project EAT-II. A third of the participants were in middle school in Project EAT-I, 5 years later (2003-2004 academic year). The University of Minnesota’s Institutional Review Board Human Subjects Committee approved all study protocols.

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SURVEY TOOL DEVELOPMENT AND MEASURES

The development of the Project EAT survey was guided by focus groups with adolescents,22 a theoretical framework (social cognitive theory) for understanding factors influencing eating and weight-related behaviors,2324 a review of existing instruments,2728 reviews by experts in the area, and several pilot tests of the survey. Social cognitive theory places great importance on learning through observations of and interactions with one’s social environment. Family meals emerged as an important element of the social environment influencing eating patterns in focus group discussions with adolescents. The following paragraphs describe measures used in the present analysis.

Frequency of family meals was assessed with the question “During the past 7 days, how many times did all, or most, of your family living in your house eat a meal together?” Response categories included (1) never, (2) 1 to 2 times, (3) 3 to 4 times, (4) 5 to 6 times, (5) 7 times, and (6) more than 7 times. To compare adolescents according to whether they were eating meals with their families on a regular basis (ie, most days per week), responses were dichotomized into “less than 5 meals/wk” and “5 or more meals/wk” for analyses.

Disordered eating behaviors assessed included unhealthy weight control behaviors (extreme and less extreme), binge eating with loss of control, and chronic dieting. Unhealthy weight control behaviors during the past year were assessed with the question “Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?” (yes/no for each method). Responses classified as extreme weight control behaviors included (1) took diet pills, (2) made myself vomit, (3) used laxatives, and (4) used diuretics. Responses classified as unhealthy (less extreme) weight control behaviors included (1) fasted, (2) ate very little food, (3) used food substitute (powder/special drink), (4) skipped meals, and (5) smoked more cigarettes.

Binge eating with loss of control was assessed with the following 2 questions (yes/no for each question): “In the past year, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge eating)” and “During the times when you ate this way, did you feel you couldn't stop eating or control what or how much you were eating?” Respondents needed to answer affirmatively to both questions to be classified as engaging in binge eating with loss of control.

Chronic dieting was assessed with the question “How often have you gone on a diet during the past year (by ‘diet’ we mean changing the way you eat so you can lose weight)?” Responses included (1) never, (2) 1 to 4 times, (3) 5 to 10 times, (4) more than 10 times, or (5) “I am always dieting.” Respondents reporting that they had dieted 5 or more times in the past year were categorized as chronic dieters.

Weight-specific pressures within the home included measures of maternal and paternal encouragement to diet. Respondents were asked to indicate how strongly they agreed with the following statement for each parent separately: “My mother (father) encourages me to diet to control my weight.” Responses were based on a 4-point Likert scale ranging from “not at all” to “very much.”

Family connectedness was assessed with the following 2 questions for each parent: “How much do you feel you can talk to your mother (father) about your problems?” and “How much do you feel your mother (father) cares about you?” Each question had 5 response categories ranging from “not at all” to “very much.”

Body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) was based on height and weight measurements taken at baseline by trained research assistants. Where these measured values were missing (8.7%), self-reported height and weight were substituted in the calculation of BMI to reduce the percentage of respondents missing this variable to 1.9%. Correlations between reported and measured BMI at time 1 were r=0.85 for adolescent girls and r=0.89 for adolescent boys, and the mean BMI value (23.0) was the same with and without this substitution.

Sociodemographic variables included sex, grade level in school, ethnicity/race, and socioeconomic status (SES). All variables were assessed via self-report as previously described.

STATISTICAL ANALYSIS

We used χ² tests to examine associations between time 1 family meal frequency and time 2 disordered eating behaviors (extreme weight control behaviors, unhealthy weight control beh-
haviors, binge eating, and chronic dieting). Logistic regression was used to estimate the odds of engaging in each disordered eating behavior for those with 5 or more vs those with fewer than 5 family meals. Models were run adjusting for sociodemographic characteristics and BMI (model 1), with additional adjustment for family connectedness and pressures to diet from parents (model 2) and further adjustment for time 1 disordered eating behaviors (model 3). Models 1 and 2 adjust for variables that could confound the associations between family meals and disordered eating behaviors because of their associations with both family meal frequency and disordered eating behaviors. The adjustment for family connectedness in model 2 is particularly important because it allows for the detection of an association between family meals and disordered eating behaviors above and beyond overall familial relationships. Model 3 examines how family meal frequency at time 1 predicts disordered eating behaviors at time 2 above and beyond any cross-sectional associations between these variables at time 1 and thus allows for a look at the change in disordered eating behaviors during the 5-year study period. All analyses were stratified by sex and conducted using SAS statistical software (version 9.1; SAS Institute Inc, Cary, North Carolina).

Only individuals responding at times 1 and 2 were included in the analysis. Attrition from time 1 to time 2 was not equal across sociodemographic characteristics. Thus, data were weighted to adjust for differential response rates using the response propensity method,24 in which the inverse of the estimated probability that an individual responded at time 2 is used as the weight. Response propensities (ie, the probability of responding to the EAT-II survey) were estimated using a logistic regression of response to the EAT-II survey (yes/no) on a large number of predictor variables available from the EAT-I survey. The selected response propensity model included main effects for baseline sex, place of birth, ethnicity/race, SES, overweight status, parental marital status, individual’s concern about health, and most common letter grade in school. The weighted ethnic/racial and SES proportions were 48.5% white, 19.2% Asian, 19.0% African American, 5.8% Hispanic, 3.5% Native American, and 3.9% mixed or other race. Approximately one-third of the sample (37%) was of low or low-middle SES.

Table 1. Adolescent Girls and Boys Engaging in Disordered Eating Behaviors at Time 2 by Family Meal Frequency at Time 1

<table>
<thead>
<tr>
<th>Time 1 Family Meal Frequency, No./wk</th>
<th>Time 2 Behaviorsa</th>
<th>Extreme WCBs b</th>
<th>Unhealthy WCBs c</th>
<th>Binge Eating</th>
<th>Chronic Dieting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls (n = 1363)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 (n = 772)</td>
<td></td>
<td>199 (26.0)</td>
<td>493 (64.4)</td>
<td>95 (12.7)</td>
<td>142 (18.5)</td>
</tr>
<tr>
<td>≥5 (n = 591)</td>
<td></td>
<td>102 (17.4)</td>
<td>338 (57.4)</td>
<td>54 (9.2)</td>
<td>82 (13.9)</td>
</tr>
<tr>
<td>Tests of significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>χ² value</td>
<td></td>
<td>14.3</td>
<td>6.96</td>
<td>3.99</td>
<td>5.04</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>&lt;.001</td>
<td>.008</td>
<td>.046</td>
<td>.02</td>
</tr>
<tr>
<td>Boys (n = 1115)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 (n = 606)</td>
<td></td>
<td>44 (7.3)</td>
<td>174 (29.0)</td>
<td>20 (3.4)</td>
<td>35 (5.9)</td>
</tr>
<tr>
<td>≥5 (n = 509)</td>
<td></td>
<td>30 (6.0)</td>
<td>178 (35.4)</td>
<td>19 (3.8)</td>
<td>34 (6.7)</td>
</tr>
<tr>
<td>Tests of significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>χ² value</td>
<td></td>
<td>0.73</td>
<td>5.09</td>
<td>0.16</td>
<td>0.34</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>.39</td>
<td>.02</td>
<td>.69</td>
<td>.56</td>
</tr>
</tbody>
</table>

Abbreviation: WCB, weight control behavior.

a Small numbers of respondents had missing data for the different disordered eating behaviors; therefore, the numbers used in each cell’s calculation are slightly smaller than the total number for that category.

b Includes self-induced vomiting and use of laxatives, diet pills, or diuretics.

c Includes fasting, eating very little food, using food substitutes, skipping meals, and smoking more cigarettes.

RESULTS

UNADJUSTED PERCENTAGES OF TIME 2 DISORDERED EATING BEHAVIORS

The percentages of adolescent girls and boys engaging in disordered eating behaviors at time 2 by family meal frequency at time 1 are shown in Table 1. Prevalences of disordered eating behaviors were considerably higher among girls than boys, regardless of family meal patterns. For example, extreme weight control behaviors were about 3 times higher in girls than boys. Among girls, regular family meals were significantly associated with lower prevalences of all of the disordered eating behaviors (extreme weight control behaviors, unhealthy weight control behaviors, binge eating, and chronic dieting). Among boys, the only significant finding was that regular family meals were associated with greater likelihood for unhealthy (less extreme) weight control behaviors.

ADJUSTED ODDS RATIOS OF TIME 2 DISORDERED EATING BEHAVIORS

As shown in Table 2, among girls, time 1 regular family meals (≥5 meals/wk) were significantly associated with lower odds of time 2 extreme weight control behaviors after adjustment for sociodemographic characteristics and BMI (model 1 odds ratio [OR], 0.66; 95% confidence interval [CI], 0.49-0.88); after additional adjustment for family connectedness and parental encouragement to diet (model 2 OR, 0.69; 95% CI, 0.51-0.94); and after a final additional adjustment for extreme weight control behaviors at time 1 (model 3 OR, 0.71; 95% CI, 0.52-0.97). Thus, adolescent girls who participated in regular family meals had approximately two-thirds the odds of extreme weight control behaviors 5 years later, compared with adolescent girls who did not have regular family meals at time 1, even af-
ter adjusting for potential confounders. Associations with other disordered eating behaviors were not statistically significant in any of the 3 models examined, although all trends were in a direction suggestive of a protective effect of family meals, with some of the associations showing marginal statistical significance.

Among adolescent boys, a different picture emerged. Associations between family meal frequency at time 1 and extreme weight control behaviors, binge eating, and chronic dieting at time 2 were not statistically significant or consistent in their direction. However, in all 3 models, regular family meals at time 1 were significantly associated with greater risk for unhealthy (less extreme) weight control behaviors at time 2. To further explore the unexpected positive association between regular family meals and subsequent unhealthy weight control behaviors, we ran separate fully adjusted models for each of the 5 unhealthy weight control behaviors at time 2. To further explore the unexpected positive association between regular family meals and subsequent unhealthy weight control behaviors, we ran separate fully adjusted models for each of the 5 unhealthy weight control behaviors at time 2. To further explore the unexpected positive association between regular family meals and subsequent unhealthy weight control behaviors, we ran separate fully adjusted models for each of the 5 unhealthy weight control behaviors (fasting, eating very little food, using food substitutes, skipping meals, and smoking more cigarettes). Family meal frequency was positively associated with skipping meals (OR, 1.81; 95% CI, 1.24-2.63) and eating very little food at time 2 (OR, 1.84; 95% CI, 1.23-2.69), but had no association with the other 3 behaviors. The observed association with unhealthy weight control behaviors, therefore, appears to reflect differences specifically in skipping meals and eating very little food.

The present study explored the 5-year longitudinal associations between family meal frequency and disordered eating behaviors in adolescent girls and boys. The findings suggest that regular family meals during adolescence play a protective role for extreme weight control behaviors in adolescent girls but not boys. Among girls, regular family meals predicted lower prevalences of extreme weight control behaviors, including self-induced vomiting and use of diet pills, laxatives, and diuretics, at the 5-year follow-up, even after adjustment for potential confounding variables and extreme weight control behaviors at time 1. In contrast, among boys, the findings do not suggest a protective role of family meals for disordered eating behaviors.

Findings from the present study add to the growing body of literature suggesting that family meals may contribute to the health and well-being of adolescent girls. The present study findings build on the cross-sectional, retrospective, and qualitative studies that have shown strong inverse associations between family meals and disordered eating behaviors among adolescent girls. Fewer studies have examined associations between family meals and disordered eating behaviors in boys. In a cross-sectional analysis of Project EAT-I data, the association between family meal frequency and disordered eating behaviors was not significant in boys, after adjusting for family connectedness and parental encouragement to diet. In another cross-sectional analysis from Project EAT-I, associations between family meals and psychological well-being measures (eg, suicide attempts) were positive for both sexes but were stronger and more consistent among girls than among boys.

We can only speculate about possible reasons for the large sex differences in associations between family meals and disordered eating behaviors. Perhaps boys who engage in regular family meals are different in some way that increases their risk for disordered eating behaviors. There is also the possibility that adolescent boys and girls have different experiences at family meals. For example, girls may have more involvement in food preparation and other food-related tasks, which may play a protective role in the development of disordered eating behaviors. Finally, family meals may offer more benefits to adolescent girls, who may be more sensitive to and likely to be influenced by interpersonal and familial relationships than are adolescent boys.

The present study is the first longitudinal study of which we are aware that has examined associations be-

### Table 2. Odds of Time 2 Disordered Eating Among Those Reporting 5 or More Family Meals at Time 1

<table>
<thead>
<tr>
<th>Time 2 Disordered Eating Behaviors</th>
<th>Model 1a</th>
<th></th>
<th></th>
<th>Model 2b</th>
<th></th>
<th></th>
<th>Model 3c</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P Value</td>
<td>OR (95% CI)</td>
<td>P Value</td>
<td>OR (95% CI)</td>
<td>P Value</td>
<td></td>
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<tr>
<td><strong>Girls</strong></td>
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<tr>
<td>Extreme WCBs</td>
<td>0.66 (0.49-0.88)</td>
<td>.005</td>
<td>0.69 (0.51-0.94)</td>
<td>.02</td>
<td>0.71 (0.52-0.97)</td>
<td>.03</td>
<td></td>
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</tr>
<tr>
<td>Unhealthy WCBs</td>
<td>0.80 (0.63-1.02)</td>
<td>.07</td>
<td>0.77 (0.59-1.00)</td>
<td>.051</td>
<td>0.85 (0.64-1.11)</td>
<td>.23</td>
<td></td>
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</tr>
<tr>
<td>Binge eating</td>
<td>0.76 (0.52-1.11)</td>
<td>.15</td>
<td>0.68 (0.45-1.03)</td>
<td>.07</td>
<td>0.69 (0.45-1.05)</td>
<td>.09</td>
<td></td>
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<tr>
<td>Chronic dieting</td>
<td>0.75 (0.55-1.03)</td>
<td>.07</td>
<td>0.74 (0.52-1.04)</td>
<td>.83</td>
<td>0.76 (0.53-1.08)</td>
<td>.13</td>
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<tr>
<td><strong>Boys</strong></td>
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<tr>
<td>Extreme WCBs</td>
<td>0.84 (0.50-1.43)</td>
<td>.53</td>
<td>0.78 (0.45-1.37)</td>
<td>.40</td>
<td>0.80 (0.45-1.40)</td>
<td>.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unhealthy WCBs</td>
<td>1.55 (1.16-2.07)</td>
<td>.003</td>
<td>1.62 (1.18-2.23)</td>
<td>.003</td>
<td>1.73 (1.24-2.40)</td>
<td>.001</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Binge eating</td>
<td>1.08 (0.56-2.09)</td>
<td>.83</td>
<td>1.22 (0.59-2.50)</td>
<td>.60</td>
<td>1.16 (0.55-2.44)</td>
<td>.69</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Chronic dieting</td>
<td>1.18 (0.69-2.00)</td>
<td>.55</td>
<td>1.65 (0.90-3.04)</td>
<td>.11</td>
<td>1.63 (0.88-3.01)</td>
<td>.12</td>
<td></td>
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</tbody>
</table>

Abbreviations: CI, confidence interval; OR, odds ratio; WCB, weight control behavior.

- **a** Adjusted for sociodemographic characteristics and body mass index at time 1.
- **b** Adjusted for sociodemographic characteristics, body mass index, family connectedness, and parental encouragement to diet at time 1.
- **c** Adjusted for sociodemographic characteristics, body mass index, family connectedness, parental encouragement to diet, and specific behavior being examined at time 1.
- **d** Includes self-induced vomiting and use of laxatives, diet pills, or diuretics.
- **e** Includes fasting, eating very little food, using food substitutes, skipping meals, and smoking more cigarettes.
tween family meals and disordered eating behaviors in adolescents. Longitudinal studies have the advantage of being able to examine the temporality of associations and can address questions such as whether fewer regular family meals increase the risk for subsequent disordered eating behaviors or, conversely, whether the use of disordered eating behaviors increases the likelihood of an adolescent not participating in family meals. Other study strengths include the large and diverse study population, the inclusion of boys and girls in the analysis, the 5-year follow-up period that captured major transitional stages during adolescence, the assessment of different disordered eating behaviors, and the adjustment for potential confounders such as family connectedness and weight-related pressures at home and for disordered eating behaviors at time 1.

Study limitations also need to be taken into account in interpreting the findings. Although the study population was large and diverse, allowing for an analysis by sex, we did not conduct analyses examining associations between family meals and disordered eating behaviors by ethnicity or SES because of the small numbers of youth from within specific subgroups engaging in the more extreme disordered eating behaviors. Furthermore, there was attrition from the original study population. To help address this limitation, analyses were weighted such that the analytic sample reflects the baseline study population. It is encouraging that there were no significant differences between time 2 responders and nonresponders on the 4 main outcome variables reported at time 1, after adjusting for sociodemographic characteristics. Finally, because of the comprehensive nature of Project EAT, many of the measures of disordered eating behaviors were brief, and clinical measures of eating disorders were not included.

It is important to help families find more ways to increase the frequency of family meals given the high prevalence of unhealthy weight control practices and other disordered eating behaviors among adolescent girls.1,4 The associations found between more frequent family meals and lower prevalences of disordered eating behaviors in the present study and other studies,16,18,23 and the findings from other studies suggesting additional benefits of family meals including improved dietary intake,37-40 lower levels of substance use,18,36,41 and higher levels of psychosocial well-being.18,36 Given that other studies have found that familial interactions around food and weight issues at mealtimes are also associated with disordered eating behaviors,16,19,20,42 it is similarly important to help families improve the atmosphere of family meals. Health care professionals have an important role to play in reinforcing the benefits of family meals, helping families set realistic goals for increasing family meal frequency given schedules of adolescents and their parents, exploring ways to enhance the atmosphere at family meals with adolescents, and discussing strategies for creating healthful and easy-to-prepare family meals. Schools and community organizations should also be encouraged to make it easier for families to have shared mealtimes on a regular basis.

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Author Contributions: Dr Eisenberg 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: Neumark-Sztainer, Eisenberg, Fulker son, and Story. Acquisition of data: Neumark-Sztainer. Analysis and interpretation of data: Eisenberg, Fulker son, and Larson. Drafting of the manuscript: Neumark-Sztainer. Critical revision of the manuscript for important intellectual content: Neumark-Sztainer, Eisenberg, Fulker son, Story, and Larson. Statistical analysis: Eisenberg and Fulkerson. Obtained funding: Neumark-Sztainer. Administrative, technical, and material support: Story. Study supervision: Neumark-Sztainer.

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REFERENCES


