

Current Research



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Obesity, Disordered Eating, and Eating Disorders in a Longitudinal Study of Adolescents: How Do Dieters Fare 5 Years Later?

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ABSTRACT

Objective To determine if adolescents who report dieting and different weight-control behaviors are at increased or decreased risk for gains in body mass index, overweight status, binge eating, extreme weight-control behaviors, and eating disorders 5 years later.

Design Population-based 5-year longitudinal study.

Participants Adolescents (N=2,516) from diverse ethnic and socioeconomic backgrounds who completed Project EAT (Eating Among Teens) surveys in 1999 (Time 1) and 2004 (Time 2).

Main outcome measures Weight status, binge eating, extreme weight control, and self-reported eating disorder.

Statistical analysis Multiple linear and logistic regressions.

Results Adolescents using unhealthy weight-control behaviors at Time 1 increased their body mass index by about 1 unit more than adolescents not using any weight-control behaviors and were at approximately three times greater risk for being overweight at Time 2 (odds ratio [OR]=2.7 for girls; OR=3.2 for boys). Adolescents using unhealthy weight-control behaviors were also at in-

creased risk for binge eating with loss of control (OR=6.4 for girls; OR=5.9 for boys) and for extreme weight-control behaviors such as self-induced vomiting and use of diet pills, laxatives, and diuretics (OR=2.5 for girls; OR=4.8 for boys) 5 years later, compared with adolescents not using any weight-control behaviors.

Conclusions Dieting and unhealthy weight-control behaviors predict outcomes related to obesity and eating disorders 5 years later. A shift away from dieting and drastic weight-control measures toward the long-term implementation of healthful eating and physical activity behaviors is needed to prevent obesity and eating disorders in adolescents.

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Obesity, disordered eating, and eating disorders are major public health problems among adolescents because of their high prevalence and their potentially serious physical and psychosocial consequences (1-8). Understanding factors influencing these eating and weight-related problems and identifying effective prevention strategies are critical issues. One important question relates to the role of dieting. Questions about its effectiveness in weight management and its potential for increasing risk for unintentional weight gain, disordered eating, and eating disorders have been raised (9-13).

Longitudinal studies have the capacity to determine if dieting precedes the onset of obesity, disordered eating, and eating disorders. Longitudinal studies exploring these associations are limited and findings are not consistent across studies (14,15). However, the larger studies suggest associations between dieting and the later onset of obesity, disordered eating, and eating disorders (11,13,16,17). In a 3-year longitudinal study on a large sample of adolescent girls and boys, Field and colleagues (13) found that dieters were at increased risk for weight gain compared to nondieters. In two separate 4-year longitudinal studies on middle school girls (18) and on high school girls (16), Stice and colleagues found that dieters were at increased risk for obesity onset. Stice and col-

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leagues (19) also reported that adolescent high school girls engaging in dieting are at increased risk for binge eating 2 years later. Patton and colleagues (11) found that dieting increases risk for the onset of partial and full eating disorders: Adolescent girls who dieted at a severe level were 18 times more likely to develop an eating disorder than those who did not diet, and girls who dieted at a moderate level were five times more likely to develop an eating disorder than those who did not diet. Killen and colleagues (17) found that adolescent girls with the highest level of weight concerns (including past dieting behaviors) were at increased risk for a partial eating disorder at 4-year follow up. The results of these studies suggest that although dieting is common among adolescents (4,5,20), particularly female adolescents, it is not an innocuous behavior.

Our study builds on this body of longitudinal research examining associations between dieting behaviors and the later onset of obesity, disordered eating behaviors, and eating disorders. We examined these associations in a large and diverse study population of female and male adolescents over a 5-year study period. Because adolescents may mean different things when they report that they are dieting (21,22) and because some weight-control behaviors may be appropriate for adolescents trying to lose or maintain weight, in addition to comparing dieters with nondieters, we also compared adolescents engaging in different types and combinations of weight-control behaviors. We addressed the research question: Are adolescents who report dieting and different kinds of weight-control behaviors at increased or decreased risk for gains in body mass index (BMI), overweight status, binge eating, extreme weight-control behaviors, and the onset of an eating disorder 5 years later?

METHODS

Study Design and Population

Project EAT (Eating Among Teens)-II is a longitudinal, follow-up study of Project EAT-I, a study of the socioenvironmental, personal, and behavioral determinants of dietary intake and weight status among a large and ethnically diverse adolescent population (20,23-25). In Project EAT-I, 4,746 junior- and senior-high school students in 31 Minnesota schools completed in-class surveys and anthropometric measures during the 1998-1999 academic year. Project EAT-II aimed to resurvey all original participants to examine changes in their eating patterns and weight status 5 years later (2003-2004) as the younger cohort progressed from early adolescence (junior high school) to middle adolescence (high school), and the older cohort progressed from middle adolescence (high school) to late adolescence (post-high school). Surveys were mailed to the address provided by the participant during Project EAT-I. Internet tracking services were employed to identify correct addresses when mail was returned due to an incorrect address. To enhance participant response, nonresponders were sent two reminder postcards and three additional survey packets. Data collection ran from April 2003 to June 2004 and was conducted by the Data Collection and Support Services in the Division of Epidemiology and Community Health at the University of Minnesota, Minneapolis.

The University of Minnesota's Institutional Review Board Human Subjects Committee approved all study protocols used in Projects EAT-I and II. In Project EAT-I, consent procedures were done in accordance with the requirements of the participating schools' research boards. In some schools, parents were required to return signed consent forms agreeing to have their child participate in the study; in other schools, parents were only required to return signed consent forms if they did not want their child to participate. All participants signed an assent form before survey completion. In Project EAT-II, parents of adolescents younger than age 18 years were sent a consent form before sending out the surveys; surveys were not sent to adolescents whose parents mailed back a signed consent form indicating their refusal to have their child participate. Adolescents were then sent an assent form with the survey and asked to sign and return the form if they were not interested in study participation. Completion of the Project EAT-II survey implied written consent.

Of the original study population, 1,074 (22.6%) were lost to follow-up for various reasons, primarily missing contact information at EAT-I ($n=411$) and no address found at follow-up ($n=591$). Of the remaining 3,672 participants contacted by mail, 2,516 completed surveys, representing 53% of the original cohort and 68.4% of participants who could be contacted for Project EAT-II. The final study population consisted of 1,130 boys (44.9%) and 1,386 girls (55.1%) who completed surveys for both EAT-I (Time 1) and EAT-II (Time 2). One third of participants (32%) were in the younger cohort; at Time 1 their mean age was 12.8 ± 0.8 years and at Time 2 their mean age was 17.2 ± 0.6 years. Two thirds of participants (68%) were in the older cohort; at Time 1 their mean age was 15.8 ± 0.8 years and at Time 2 their mean age was 20.4 ± 0.8 years.

Measures

Dieting and Weight-Control Behaviors (Time 1 Predictor Variables). Dieting was assessed with the question: "How often have you gone on a diet during the last year? By 'diet' we mean changing the way you eat so you can lose weight." Responses included: never, one to four times, five to 10 times, more than 10 times, and I am always dieting. To distinguish dieters from nondieters, responses were dichotomized into no (never) and yes (other responses). Specific types of weight-control behaviors were assessed with the following question: "Have you done any of the following things in order to lose weight or keep from gaining weight during the past year? (yes or no for each method)." Behaviors categorized as healthful included exercised, ate more fruits and vegetables, ate less high-fat foods, and ate fewer sweets. Behaviors categorized as unhealthful included fasted, ate very little food, used a food substitute (powder or a special drink), skipped meals, smoked more cigarettes, took diet pills, made myself vomit, used laxatives, and used diuretics. For the measure of weight-control behaviors, respondents were classified into four groups based on questions assessing dieting and specific types of weight-control behaviors. Categories were chosen a priori, based on previous research with adolescents suggesting differences between dieting and watching what they eat (22,26) and between healthful and unhealthful weight-control behaviors (27).

In addition, the categories were separately confirmed by latent class analysis, which found that a four-class model empirically fit the data well with high probability of responses to the respective items in each class. The four categories included: 1) No behaviors (do not report dieting, and do not use any specific weight-control behaviors); 2) Healthful nondieting behaviors (do not report dieting, and use at least one healthful weight-control behavior but do not use any unhealthful weight-control behaviors); 3) Healthful dieting behaviors (report dieting, but do not use any unhealthful weight-control behaviors); and 4) Unhealthful behaviors (either reported or did not report dieting, and use at least one unhealthful weight-control behavior).

BMI and Weight Status. BMI was calculated as kg/m². BMI was based on self-reported height and weight measures. Although at Time 1 both measured and self-reported height and weight were collected, at Time 2 only self-reported measures were collected. However, at Time 1, BMI values based on measured and self-reported heights and weight were found to be highly correlated ($r=0.85$ for female subjects and 0.89 for male subjects) (28). In cases in which self-reported BMI data at Time 1 were not available, but measured BMI data were available ($n=117$), item imputation was carried out based on measured BMI, age, race, and socioeconomic status, within sex. For weight status, the classification of Must and colleagues (29,30) was used because it provides contiguous values from childhood to adulthood based on the first National Health and Nutrition Survey, and in the current analysis, adolescents are followed through late adolescence/young adulthood. Adolescents with BMI values above the 85th percentile for sex and age were classified as overweight.

Disordered Eating and Reported Presence of an Eating Disorder. Respondents reporting self-induced vomiting, or the use of diet pills, laxatives, and diuretics in the past year were classified as using extreme weight-control behaviors. Binge eating with loss of control was assessed with two 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)? 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 who answered affirmatively to both of these questions were classified as engaging in binge eating with loss of control. Self-reported presence of an eating disorder was assessed with the question: “Has a doctor ever told you that you have an eating disorder such as anorexia nervosa, bulimia nervosa, or binge eating disorder?”

Sociodemographic Characteristics. Sex, age, ethnicity/race, and socioeconomic status were based on self-report at Time 1. The prime determinant of socioeconomic status was parental educational level, defined by the higher level of educational attainment of either parent. An algorithm was developed that also took into account family eligibility for public assistance, eligibility for free or reduced-cost school meals, and employment status of the mother and father (24). Age cohort was based on Time 1 grade in school (junior high vs high school) and subsequent age-appropriate surveys completed at Time 2.

Statistical Analysis

All analyses were stratified by sex. Descriptive summaries (means and proportions) of the dieting and weight-control behaviors at Time 1 and weight status, disordered eating, and reported presence of eating disorder at Time 2 were examined. In addition, simple bivariate relationships between the Time 1 dieting and weight-control behaviors and the Time 2 outcomes were estimated and associations were tested with either F tests for means or χ^2 tests for proportions. To assess longitudinal change, the Time 1 (ie, baseline) weight status, disordered eating, or reported presence of eating disorder were included as covariates along with the predictors of either dieting or weight-control behaviors into multiple or logistic regressions for each of the respective Time 2 outcomes. Age cohort, ethnicity/race, and socioeconomic status were included in all multivariable models. Time 1 BMI was also included as a covariate in the multivariable models predicting disordered eating and a reported eating disorder. Mean differences and standard errors (for BMI change) and odds ratios (ORs) with 95% confidence intervals for the other outcomes were calculated along with associated P values. Differential effects of dieting and weight-control behaviors on outcomes by age cohort were examined by testing interactions between age cohort and the predictors, and findings indicated similar patterns of association between dieting and weight-control behaviors at Time 1 and outcomes at Time 2 across age cohorts. Thus, interactions were not taken into account in further analyses. SAS (version 9.1, 2003, SAS, Inc, Cary, NC) was used for all analyses.

Attrition in the study population was not equal across sociodemographic characteristics. Thus, in all analyses, the data were weighted to adjust for differential response rates using the response propensity method (31), where the inverse of the estimated probability that an individual responded at Time 2 was 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 EAT-II (yes/no) on a large number of predictor variables available from the EAT-I survey (Time 1 survey). The selected response propensity model included main effects for baseline sex, native born, ethnicity/race, socioeconomic status, overweight status, parental marital status, individual’s concern about health, and most common grade in school. The weighting method results in estimates representative of the demographic makeup of the original Project EAT-I sample. The weighted ethnic/racial and socioeconomic status proportions of the study population are as follows: 48.3% white, 18.9% African American, 5.8% Hispanic, 19.6% Asian, 3.6% Native American, and 3.8% mixed or other race; socioeconomic status was low (17.8%), middle-low (18.9%), middle (26.7%), middle-high (23.3%), and high (13.3%).

RESULTS

Prevalence of Dieting and Weight-Control Behaviors at Time 1 and Outcomes at Time 2

At Time 1, 57% of the female subjects and 25.3% of the male subjects reported dieting, and unhealthful weight-control behaviors were reported by 57.8% of the female

Table 1. Dieting and weight-control behaviors at time of first Project EAT (Eating Among Teens) survey (Time 1) and weight status, disordered eating, and reported presence of eating disorder at time of second Project EAT survey (Time 2), in adolescents by sex

Survey item	Girls (n=1,386) ^a		Boys (n=1,130) ^a	
	n	% or mean	n	% or mean
Time 1				
Dieting (% yes)	773	57.0	278	25.3
Weight-control behaviors^b				
No behaviors	163	12.1	311	28.4
Healthful nondieting	257	19.2	363	33.1
Healthful dieting	147	10.9	79	7.2
Unhealthful	776	57.8	343	31.3
Time 2				
Overweight (% body mass index >85 th percentile)	351	27.0	263	24.6
Body mass index (mean±standard deviation)	1,323	23.9±5.1	1,081	24.6±4.8
Binge eating with loss of control (% yes)	133	10.1	29	2.8
Extreme weight control (% yes)	299	22.0	75	6.8
Reported eating disorder (% yes)	38	2.9	6	0.5

^aThe total denominator n for each variable varies slightly due to missing values.
^bWeight control behaviors were defined as: no behaviors (do not report dieting, and don't use any weight control behaviors); healthful nondieting behaviors (do not report dieting, and use at least one healthful weight control behavior but do not use any unhealthful weight control behaviors); healthful dieting behaviors (report dieting, but do not use any unhealthful weight control behaviors); and unhealthful behaviors (either reported or didn't report dieting, use at least one unhealthful weight control behavior).

subjects and 31.3% of the male subjects (Table 1). At Time 2, approximately one fourth of the girls (27.0%) and boys (24.6%) were overweight. About three times more girls than boys reported binge eating and extreme weight-control behaviors. Five times more girls than boys reported having had an eating disorder in the past year; the number of male subjects reporting an eating disorder was small (n=6), limiting further multivariable analyses.

Associations Between Time 1 Dieting/Weight-Control Behaviors and Time 2 Weight Status

Neither dieting nor any of the weight-control behaviors at Time 1 predicted decreases in BMI or decreases in overweight status at Time 2 in either girls or boys. On the contrary, findings indicated that dieting and weight-control behaviors, particularly unhealthful weight-control behaviors, were associated with weight gain (Tables 2 and 3).

Time 1 dieting was associated with higher BMI values and a greater prevalence of overweight status in both girls and boys in unadjusted analyses (Table 2). More importantly, in analyses adjusting for Time 1 outcomes and sociodemographic characteristics (Table 3), Time 1 dieting was predictive of a greater increase in BMI and a greater tendency to become or stay overweight. In adjusted analyses, female dieters had an increase of 1.88 BMI units whereas female nondieters increased only 1.24 units. Likewise, male dieters increased 2.76 BMI units and male nondieters increased only 1.99 units. In summary, for both girls and boys, Time 1 dieters had BMI values that were more than half a unit higher 5 years later than those of nondieters.

Among female subjects, the use of unhealthful weight-control behaviors at Time 1 predicted significant increases in BMI at Time 2. Both healthful dieting (ie,

report dieting but no unhealthful weight-control behaviors) and unhealthful weight-control behaviors at Time 1 predicted overweight status at Time 2 in girls (Table 3). Female subjects engaging in either healthful dieting or unhealthful weight-control behaviors had three times the odds of being overweight 5 years later compared with girls not using any weight-control behaviors. Among male subjects, unhealthful weight-control behaviors at Time 1 also predicted significant increases in BMI and overweight status at Time 2. The odds of being overweight at Time 2 was three times higher for boys who reported unhealthful weight-control behaviors at Time 1 compared with boys not using any weight-control behaviors (Table 3).

Associations Among Time 1 Dieting/Weight-Control Behaviors and Time 2 Disordered Eating/Reported Eating Disorders

Time 1 dieting was significantly associated with Time 2 binge eating with loss of control among female and male subjects in both unadjusted analyses (Table 2) and analyses adjusted for baseline outcomes, baseline BMI, and sociodemographic characteristics (OR=1.87 for girls; OR=3.37 for boys) (Table 4). Among female subjects, Time 1 dieting was also significantly associated with Time 2 extreme weight-control behaviors and a reported eating disorder. Female subjects who reported dieting at Time 1 were at greater than twice the odds for engaging in extreme weight-control behaviors and reporting an eating disorder 5 years later (OR=1.95 and 2.34, respectively) as nondieters (Table 4).

Adolescents reporting unhealthful weight-control behaviors at Time 1 were at greatest risk for disordered eating behaviors (Table 4). In adjusted analyses, girls engaging in unhealthful weight-control behaviors at Time 1 were at increased risk for binge eating (OR=6.42)

Table 2. Weight status, disordered eating, and eating disorders of adolescents at 5-year follow-up (Time 2) by dieting and weight-control behaviors at Time 1 in Project EAT (Eating Among Teens)^a

Response	BMI ^b		Overweight (BMI >85th percentile)			Binge Eat with Loss of Control			Extreme Weight Control			Eating Disorder		
	N	Mean±SD ^c	N	n	%	N	n	%	N	n	%	N	n	%
Girls														
Dieting														
No	563	22.5±3.9	561	94	16.8	552	32	5.9	576	70	12.1	578	9	1.5
Yes	725	25.1±5.6	722	254	35.2	745	100	13.5	766	227	29.6	766	30	3.9
<i>P</i>		<0.001			<0.001			<0.001			<0.001			0.010
Weight-control behaviors														
No behaviors	152	21.3±2.9	152	12	8.1	154	3	1.6	163	14	8.6	162	2	1.0
Healthful nondieting	254	22.3±3.6	253	39	15.2	249	12	5.0	257	21	8.3	252	3	1.0
Healthful dieting	135	24.9±4.5	135	53	39.1	145	16	11.2	147	29	19.7	146	2	1.5
Unhealthful	734	24.9±5.6	730	242	33.2	742	101	13.7	776	232	29.9	769	32	4.2
<i>P</i>		<0.001			<0.001			<0.001			<0.001			0.027 ^d
Boys														
Dieting														
No	790	23.6±3.8	789	134	17.0	787	13	1.7	819	41	5.0	820	3	0.4
Yes	262	27.5±6.2	262	121	46.4	267	15	5.8	277	33	11.9	274	3	0.9
<i>P</i>		<0.001			<0.001			<0.001			<0.001			0.170 ^d
Weight-control behaviors														
No behaviors	301	22.7±3.3	301	29	9.5	295	2	0.7	311	5	1.5	310	0	0
Healthful nondieting	342	24.1±3.6	342	64	18.7	347	6	1.7	363	21	5.9	360	1	0.3
Healthful dieting	75	26.2±5.4	75	26	34.7	77	1	0.9	79	4	5.6	79	2	2.0
Unhealthful	328	26.5±6.2	328	136	41.4	332	20	6.0	343	43	12.4	338	3	0.8
<i>P</i>		<0.001			<0.001			<0.001			<0.001			0.025 ^d

^aUnadjusted means and percents.

^bBMI=body mass index.

^cSD=standard deviation.

^dFisher's exact test used due to low counts.

and extreme weight control (OR=2.48) at Time 2, compared with girls not using any weight-control behaviors. Similarly, boys engaging in unhealthful weight-control behaviors at Time 1 were more likely to report binge eating (OR=5.94) and extreme weight-control behaviors (OR=4.80) at Time 2 compared with boys not using any weight-control behaviors. Associations between weight-control behaviors and eating disorders among female subjects were not statistically significant, and analyses could not be run among the male subjects due to low numbers.

DISCUSSION

This study aimed to determine if adolescents who report dieting and different kinds of weight-control behaviors are at increased or decreased risk for weight gain, overweight status, binge eating, extreme weight-control behaviors, and the onset of an eating disorder 5 years later. Key findings from this study show that dieting predicted weight gain, overweight status, disordered eating, and eating disorders; that unhealthful weight-control behaviors were the strongest and most consistent predictors of these outcomes; and that none of the weight-control behaviors had any benefits in terms of weight status at

5-year follow-up when comparisons were made between adolescents using different weight-control behaviors and those not using any weight-control behaviors. An examination of interactions with age indicated that patterns tended to be consistent among adolescents transitioning from early to middle adolescence and from middle to late adolescence. Thus, dieting—and particularly unhealthful weight-control behaviors—do not appear to be effective for weight loss or weight maintenance, and can be detrimental in terms of leading to weight gain and the onset of disordered eating behaviors and eating disorders in both younger and older adolescents.

Reported dieting at Time 1 was found to be associated with weight gain, overweight status, and binge eating at Time 2 in both girls and boys. Among female subjects, Time 1 dieting also significantly predicted extreme weight-control behaviors and a reported eating disorder at Time 2. These findings were not due to higher levels of outcome measures at baseline (eg, higher BMI levels at Time 1), as analyses were adjusted for baseline outcomes and other potential confounders. These findings, which are consistent with other longitudinal studies (32-37), raise serious concerns about a behavior that is reported

Table 3. Mean changes in body mass index (BMI) and odds ratios (ORs) with 95% confidence intervals (CIs) at 5-year follow-up (Time 2) by dieting and types of weight-control behaviors at Time 1 in adolescents in Project EAT (Eating Among Teens)^a

Response	Change in BMI		Overweight Status (BMI >85th percentile)		
	Mean change±SE ^b	P value	OR	CI	P value
Girls					
Dieting					
No	1.24±0.16	—	1.0	—	—
Yes	1.88±0.14	0.003	1.80	1.29, 2.51	<0.001
Weight-control behaviors					
No behaviors	1.03±0.30	—	1.0	—	—
Healthful nondieting	1.10±0.23	0.996	1.62	0.76, 3.43	0.211
Healthful dieting	1.82±0.31	0.160	3.54	1.63, 7.71	0.001
Unhealthful	1.87±0.14	0.035	2.69	1.36, 5.31	0.004
Boys					
Dieting					
No	1.99±0.12	—	1.0	—	—
Yes	2.76±0.22	0.003	1.83	1.23, 2.75	0.003
Weight-control behaviors					
No behaviors	1.66±0.19	—	1.0	—	—
Healthful nondieting	2.21±0.18	0.090	1.68	0.97, 2.91	0.065
Healthful dieting	2.17±0.38	0.510	1.66	0.78, 3.55	0.190
Unhealthful	2.63±0.19	0.002	3.20	1.86, 5.50	<0.001

^aValues adjusted for Time 1 outcomes (BMI or overweight status), age cohort, socioeconomic status, race, and nonresponse propensity weight. Referent group for dieting: no dieting; referent group for weight-control behaviors: no weight-control behaviors.
^bSE=standard error.

Table 4. Disordered eating and reported eating disorder at 5-year follow-up (Time 2) by dieting and types of weight-control behaviors at Time 1 in adolescents in Project EAT (Eating Among Teens)^a

Response	Binge Eat with Loss of Control			Extreme Weight Control			Reported Eating Disorder		
	OR ^b	CI ^c	P value	OR	CI	P value	OR	CI	P value
Girls									
Dieting									
No	1.00	—	—	1.00	—	—	1.00	—	—
Yes	1.87	1.18, 2.94	0.007	1.95	1.41, 2.69	<0.001	2.34	1.05, 5.24	0.039
Weight-control behaviors									
No behaviors	1.00	—	—	1.00	—	—	1.00	—	—
Healthful nondieting	2.87	0.72, 11.49	0.137	0.78	0.38, 1.59	0.488	0.74	0.10, 5.55	0.766
Healthful dieting	5.97	1.50, 23.75	0.011	1.76	0.86, 3.61	0.122	1.21	0.15, 9.85	0.856
Unhealthful	6.42	1.75, 23.54	0.005	2.48	1.35, 4.54	0.003	3.22	0.61, 16.98	0.168
Boys									
Dieting									
No	1.00	—	—	1.00	—	—	1.00	—	—
Yes	3.37	1.38, 8.21	0.008	1.39	0.74, 2.59	0.305	4.57	0.59, 35.64	0.147
Weight-control behaviors									
No behaviors	1.00	—	—	1.00	—	—	— ^d	—	—
Healthful nondieting	1.52	0.29, 8.01	0.625	3.75	1.36, 10.39	0.011			
Healthful dieting	0.78	0.05, 12.97	0.861	2.28	0.55, 9.40	0.255			
Unhealthful	5.94	1.31, 27.01	0.021	4.80	1.70, 13.51	0.003			

^aValues adjusted for Time 1 outcomes (binge eating, extreme weight control, or eating disorder), Time 1 body mass index, age cohort, socioeconomic status, race, and nonresponse propensity weights. Referent group for dieting: no dieting; referent group for weight-control behaviors: no weight-control behaviors.
^bOR=odds ratio.
^cCI=confidence interval.
^dNumbers too low to give meaningful results.

by more than half of female adolescents and by one quarter of male adolescents. Clearly, dieting is not an innocuous behavior that can be brushed aside as normative for teens. Associations among dieting and the later onset of binge eating, extreme weight-control behaviors, and eating disorders suggest dieting may be the first step in a progression to more severe behaviors—or at the very least an early marker for the later onset of more severe behaviors—and should be addressed as early as possible to prevent a chain of potentially harmful events. Although it may be argued that many adolescents diet and only a few develop clinical eating disorders, dieting was found to be strongly predictive of more prevalent disordered eating behaviors 5 years later. Furthermore, dieting was counterproductive to weight management: Time 1 dieters were at nearly twice the risk for being overweight at Time 2 as nondieters. Thus, the risk–benefit ratio for dieting is just too high not to be addressing dieting seriously in adolescents.

An important question is what adolescents mean when they say they are dieting. Among girls, healthful dieting, but not healthful weight-control behaviors without dieting, was associated with increased odds for overweight status. This pattern was not found in boys. These findings suggest the act of dieting increases girls' risk for becoming overweight and that dieting may mean something different to girls than to boys. A qualitative study designed to gain insight into how the term dieting is understood and used by adolescents revealed that interpretations vary greatly (21). Whereas for some teens dieting involves healthful behaviors such as eating less fat, for other teens unhealthful behaviors such as skipping meals or starvation were also described as dieting behaviors. Interestingly, some teens talked about dieting in nonbehavioral terms including, “trying to lose weight” or a “desire for weight loss,” suggesting that the concept of dieting is more of an attempt toward a temporary behavior change or a mindset than an actual long-term behavior change. In general, female subjects had more to say on the topic than male subjects. In light of the findings from our study, a logical conclusion may be that the short-term nature and mindset of “going on a diet” may be detrimental to developing the meaningful and long-lasting behavior changes that could be more effective in weight management and have fewer undesirable consequences in terms of increasing risk for eating disorders.

Because of the breadth of questions on weight-control behaviors in the current study, we were able to distinguish between associations with different types of weight-control behaviors and outcomes 5 years later. The findings clearly indicate that adolescents employing unhealthful weight-control behaviors are at great risk for undesirable outcomes related to obesity and eating disorders at 5-year follow-up. Adolescents using unhealthful weight-control behaviors at Time 1 were at approximately three times greater risk for overweight status than adolescents not using any weight-control behaviors at Time 1. Both girls and boys using unhealthful weight-control behaviors were at much greater risk for binge eating and extreme weight-control behaviors when compared with adolescents not using any weight-control behaviors. The salience of these findings is strengthened by the fact that all anal-

yses were adjusted for baseline outcomes and potential confounders. In the current study, more than half of female subjects and one third of male subjects reported the use of unhealthful weight-control behaviors. Given the high prevalence of unhealthful weight-control behaviors in adolescents, these findings are of major public health concern.

None of the weight-control behaviors had benefits in terms of weight status at 5-year follow-up, when comparisons were made among adolescents using different weight-control behaviors and those not using any behaviors. Even behaviors commonly recommended for healthful weight management (eg, increasing fruit and vegetable consumption or increasing physical activity) were not associated with greater weight control, strongly suggesting that these behaviors are not being done with adequate frequency, duration, or intensity. It is noteworthy that weight-control behaviors typically viewed as healthful were predictive of fewer undesirable outcomes than dieting or the use of unhealthful weight-control behaviors.

Dietetics professionals and other health care providers have an important role in helping young people understand that dieting, and particularly the use of unhealthful weight-control behaviors, increases risk for weight gain and other eating and weight-related problems.

Strengths of the current study that enhance our ability to draw conclusions from the findings include the large and diverse study population in terms of ethnicity and socioeconomic status, the 5-year follow-up during key transitional periods of adolescence, and a broader assessment of weight-related variables than is typically done in large population-based surveys of youth (38-41). We are unaware of any other studies of this magnitude that have allowed for the assessment of the effect of different types of weight-control behaviors on outcomes of relevance to both obesity and eating disorders in such a large and diverse study population.

Although these strengths contribute to the uniqueness and utility of the findings, study limitations also need to be taken into account in interpreting the findings. First, despite multiple attempts to reach the original study participants, there was study attrition and participants in EAT-II differed from the original cohort (ie, the longitudinal participants were more likely to be female, of higher socioeconomic status, and white than the original participants). To enhance our ability to make extrapolations to the original study population, we included weights correcting for nonresponse bias in all analyses. Second, although the measures of weight-control behaviors and disordered eating are more comprehensive than is typical for large epidemiologic studies, they still are much briefer than those that can be

used in clinical assessments or in smaller studies focusing only on eating disorders. The assessment of binge eating used in our analysis takes into account subjective overeating and loss of control, but does not take into account frequency of binge eating or feelings about binge eating, as would be required for an assessment of binge-eating disorder. The measure used to assess the presence of an eating disorder is brief and for that reason the variable is labeled "reported eating disorder." However, it is noteworthy that although only one question was used to assess the presence of an eating disorder, percentages are within the expected range compared with other studies that employed more comprehensive measures (42-44). Consequently, due to the low prevalence, statistical comparisons are limited. Finally, BMI may not provide an adequate measure of adiposity among adolescents with high levels of muscle mass, although it is a suitable measure of weight status for a large epidemiologic study such as Project EAT. In our study, BMI values were based on self-reported heights and weights; however, the strong correlations found between measured and self-reported measures at Time 1 lessen our concerns about the use of a self-reported measure (28). Furthermore, previous studies examining associations between dieting and weight status using self-reported heights and weights (13) and measured heights and weights (16,18) reported similar trends to those found in our study.

CONCLUSIONS

Findings from this study suggest that dieting, and particularly unhealthful weight control, is either causing weight gain, disordered eating, or eating disorders; serving as an early marker for the development of these later problems; or is associated with some other unknown variable (eg, a personality characteristic like perfectionism or a genetic predisposition to be more influenced by an obesogenic environment) that is leading to these problems. Possible causal mechanisms linking dieting to later problems include behaviors such as the substitution of short-term dieting behaviors for more meaningful, long-term changes in eating and physical activity (21); overestimation of additional kilocalories that can be consumed when using unhealthful weight-control behaviors like self-induced vomiting (45); effects on one's psychological well-being (eg, negative effect) that affect eating or activity patterns; decreased recognition and response to feelings of satiety and hunger due to externally imposed rules for eating; restraint-induced overeating (46); and physiological mechanisms associated with food restrictions (eg, effects on neurotransmitters that could increase risks for either obesity or eating disorders via influences on food regulation processes) (47,48). Further work, using epidemiologic, qualitative, laboratory, and clinical data, is needed to disentangle and identify some of the mediating processes by which dieting and specific weight-control behaviors increase the risk for weight gain/obesity and disordered eating/eating disorders.

Our findings further indicate that a major shift in thinking about weight management is needed to decrease the high prevalence of obesity. None of the behaviors being used by adolescents for weight-control purposes predicted weight loss. Even recommended weight-man-

agement behaviors, although not associated with weight gain, were not associated with weight loss, suggesting that young people need help with their implementation. Of greater concern were the negative outcomes associated with dieting and the use of unhealthful weight-control behaviors, including significant weight gain. These findings demonstrate that these behaviors should not be viewed as innocuous and should be addressed in primary and secondary prevention efforts. Young people engaging in unhealthful weight-control behaviors should be targeted for intervention, and interventions should provide knowledge, skills, and support to avoid unhealthful weight-control behaviors. Findings from this study provide justification for the development and evaluation of interventions that aim to simultaneously prevent the onset of obesity and eating disorders through the prevention of dieting behaviors and the promotion of healthful eating and physical activity as ongoing lifestyle behaviors (9,10).

Dietetics professionals and other health care providers have an important role in helping young people understand that dieting, and particularly the use of unhealthful weight-control behaviors, increases risk for weight gain and other eating and weight-related problems. Further, dietetics professionals should provide young people with the skills and support to implement healthful weight-control behaviors that have enough intensity and duration to be effective for long-term weight management.

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