Prevention of Eating Disorders in At-Risk College-Age Women

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Context: Eating disorders, an important health problem among college-age women, may be preventable, given that modifiable risk factors for eating disorders have been identified and interventions have been evaluated to reduce these risk factors.

Objective: To determine if an Internet-based psychosocial intervention can prevent the onset of eating disorders (EDs) in young women at risk for developing EDs.

Setting: San Diego and the San Francisco Bay Area in California.

Participants: College-age women with high weight and shape concerns were recruited via campus e-mails, posters, and mass media. Six hundred thirty-seven eligible participants were identified, of whom 157 were excluded, for a total sample of 480. Recruitment occurred between November 13, 2000, and October 10, 2003.

Intervention: A randomized controlled trial of an 8-week, Internet-based cognitive-behavioral intervention (Student Bodies) that included a moderated online discussion group. Participants were studied for up to 3 years.

Main Outcome Measures: The main outcome measure was time to onset of a subclinical or clinical ED. Secondary measures included change in scores on the Weight Concerns Scale, Global Eating Disorder Examination Questionnaire, and Eating Disorder Inventory drive for thinness and bulimia subscales and depressed mood. Moderators of outcome were examined.

Results: There was a significant reduction in Weight Concerns Scale scores in the Student Bodies intervention group compared with the control group at postintervention ($P<.001$), 1 year ($P<.001$), and 2 years ($P<.001$). The slope for reducing Weight Concerns Scale score was significantly greater in the treatment compared with the control group ($P=.02$). Over the course of follow-up, 43 participants developed subclinical or clinical EDs. While there was no overall significant difference in onset of EDs between the intervention and control groups, the intervention significantly reduced the onset of EDs in 2 subgroups identified through moderator analyses: (1) participants with an elevated body mass index (BMI) (≥25, calculated as weight in kilograms divided by height in meters squared) at baseline and (2) at 1 site, participants with baseline compensatory behaviors (eg, self-induced vomiting, laxative use, diuretic use, diet pill use, driven exercise). No intervention participant with an elevated baseline BMI developed an ED, while the rates of onset of ED in the comparable BMI control group (based on survival analysis) were 4.7% at 1 year and 11.9% at 2 years. In the subgroup with a BMI of 25 or higher, the cumulative survival incidence was significantly lower at 2 years for the intervention compared with the control group (95% confidence interval, 0% for intervention group; 2.7% to 21.1% for control group). For the San Francisco Bay Area site sample with baseline compensatory behaviors, 4% of participants in the intervention group developed EDs at 1 year and 14.4%, by 2 years. Rates for the comparable control group were 16% and 30.4%, respectively.

Conclusions: Among college-age women with high weight and shape concerns, an 8-week, Internet-based cognitive-behavioral intervention can significantly reduce weight and shape concerns for up to 2 years and decrease risk for the onset of EDs, at least in some high-risk groups. To our knowledge, this is the first study to show that EDs can be prevented in high-risk groups.

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APPROXIMATELY 2% TO 4% of the young adult female population has full-syndrome eating disorders (EDs) (anorexia nervosa [AN], bulimia, or binge-eating disorder [BED]).[1,2] The peak age at onset appears to be around 16 to 20 years of age, about the time when young women begin leaving home and starting college.[2] In addition, rates of subthreshold or partial-syndrome EDs likely exceed those of full-syndrome EDs,[3] suggesting that the combined rates easily exceed 4%. Furthermore, subthreshold or partial-syndrome EDs exist on a continuum with full-syndrome EDs and represent similar levels of functional impairment.[3]

Unhealthful weight regulation methods and body image concerns, which pre-

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dispose people to clinical and subclinical EDs,[4,5] are common among high school and college students. For instance, 9% of high school senior girls in the United States reported self-induced vomiting or laxative use to control their weight in the past month according to a national study by the Centers for Disease Control and Prevention.[6] The number of college women with body image concerns is even more prevalent. Overall, 35% to 45% of adolescent girls report difficulties with weight control, regard themselves as too fat, or aspire to become thinner.[7] Eating disorders are known to be chronic, persistent, and refractory to treatment.[8]

Eating disorder attitudes and behaviors can have serious psychological and physical consequences. These attitudes and behaviors are associated with low confidence and self-esteem, shame, and other psychological problems.[9-11] Self-induced vomiting and laxative use can lead to significant physical consequences, including dental erosion, esophageal tears, and other medical problems,[12] and also are risk factors for the development of EDs.[5]

In recent years, a number of potentially modifiable risk factors for EDs have been identified. Across populations and in longitudinal studies, excessive weight and shape concerns have been consistently associated with the onset of subclinical and clinical level EDs.[4,5] Given their importance as a risk factor, many investigators have attempted to reduce weight and shape concerns.[13] We have shown that Student Bodies, an Internet-based cognitive-behavioral intervention, is effective in reducing weight and shape concerns.[14-17] However, all of these previous studies were short-term with small sample sizes. Thus, the goals of the present study were to (1) replicate these findings in a large sample of college women; (2) evaluate the intervention's long-term impact on reducing weight and shape concerns in college women at risk for developing EDs; (3) determine if the intervention could increase survival as a non-ED case; and (4) examine moderators and mediators of outcome.

METHODS

PARTICIPANTS

Participants were college-age women between 18 and 30 years of age who were at high risk for developing an ED, had a body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) of 18 or higher and less than 32, and resided in the San Diego and the San Francisco Bay areas in California. Potential participants were recruited from flyers posted at local academic institutions, campus mailings, and mass media. Potential participants completed a brief screening questionnaire delivered by telephone or e-mail. Interested and eligible women gave informed consent for their participation, completed several self-report assessments, and underwent a semistructured diagnostic clinical interview. The study was approved by the human subjects committees at each of the participating institutions and by the human subjects committees at Stanford University and San Diego State University. Women who met clinical criteria for a *DSM-IV*–diagnosed ED at baseline were excluded from the study and referred to appropriate mental health professionals. Participant randomization was stratified by school, and random-number sequences were generated by the study coordinator using SPSS (SPSS Inc, Chicago, Ill).

The Weight Concerns Scale (WCS)[18] was used to determine preliminary eligibility for high-risk participants. The WCS consists of 5 questions that assess worry about weight and shape, fear of gaining 3 pounds, last time on a diet, importance of weight, and feelings of fatness. The WCS has test-retest reliability of 0.85 and good predictive validity.[18,19] A receiver operating characteristic analysis found that a WCS score of 47 or higher had a sensitivity of 79%, specificity of 67%, and positive predictive value of 13% for identifying adolescents who developed partial- or full-syndrome EDs.[20] Participants were considered potentially eligible for this study if they scored 50 or higher on the WCS, reported they were moderately or very afraid of gaining 3 pounds, or reported that their weight was the most important thing in their life.

Women were excluded from participation in the study if they had a current diagnosis of a subclinical or clinical ED or had been in treatment for an ED within the past 6 months or if they had acute suicidal ideation and/or evidence of drug or alcohol abuse or dependence. The ED diagnoses and assessment of ED behaviors were made with the Eating Disorder Examination (EDE) interview adapted to include the diagnostic criteria for BED. The EDE[21] is a semistructured interview that generates ED diagnoses based on *DSM-IV* criteria. It has demonstrated high internal consistency,[22] sensitivity to change,[22,23] and interrater reliability.[22,23] The EDE assesses objective bulimic episodes (OBEs) (objective overeating with loss of control); subjective bulimic episodes (SBEs) (loss of control without objective overeating as judged by the interviewer but perceived as excessive by the interviewee); objective overeating (overeating without loss of control); self-induced vomiting; laxative, diuretic, or diet pill use; and driven exercise. At each yearly follow-up, the interviewers retrospectively assessed eating behaviors for each month in the previous year with a structured timeline follow-back approach. Interviewers first identified the most recent, if any, OBEs/SBEs, and these episodes were used as prototypes throughout the interview. A 12-month calendar was used as a reference and the occurrence of OBEs, SBEs, and objective overeating was assessed for each month. The frequency of compensatory behaviors was assessed using the same interview format. At baseline only, participants underwent a structured clinical interview for *DSM-IV* diagnoses[24] conducted by experienced interviewers. Women who reported current prescription medication use for mood or anxiety disorders were included if their medication was stable for at least 2 months and they were not disqualified by other exclusion criteria.

INTERVENTION

The Student Bodies intervention was an 8-week, Internet-based, structured cognitive-behavioral program combined with an online, asynchronous, moderated discussion group. The primary goal of the program was to reduce body dissatisfaction and excessive weight concerns. The program incorporated elements of interventions previously shown in controlled studies to be effective at reducing ED attitudes and behaviors. The core goals of the program were to reduce weight and shape concerns, enhance body image, promote healthy weight regulation, reduce binge eating, and increase knowledge about the risks associated with EDs. Each week, when a participant logged onto the program, she was directed to the updated weekly program content. Participants were expected to read the content and complete accompanying assignments, which included participating in the online discussion group, self-monitoring, and/or writing entries in the Personal Journal or Body Image Journal. Discussion groups were moderated by a clinical psychologist or psychology graduate student who was supervised by a clinical psychologist. Weekly e-mails were sent to participants to

reinforce program participation and encourage participants who failed to comply with study expectations for participation. About 9 months following the 8-week intervention, participants were notified by e-mail that the program would be available for 2 weeks to review material from the initial 8 sessions. The control group was given the opportunity to complete the Student Bodies intervention at the end of follow-up.

MEASURES

Participants reported their age, year in school, ethnicity, and mother's and father's highest level of education. All participant interviews were audiotaped. Audiotapes were periodically reviewed by senior interviewers at each site and interviewers received written and/or verbal feedback. At follow-up, EDE interviews were conducted in person if the participant resided near 1 of the 2 sites. Otherwise, interviews were conducted by telephone, a method shown to be reliable for assessing a number of Axis I psychiatric disorders.[25,26] Interviewers were blind to participant group assignment.

Diagnoses of AN, bulimia nervosa, and BED corresponded with the *DSM-IV* and were consistent with previous studies.[27] Subclinical AN was diagnosed if the participant met all AN criteria except amenorrhea. Subclinical bulimia nervosa was diagnosed if the binge eating and inappropriate compensatory behaviors occurred at a frequency of less than twice a week or for a duration of less than 3 months, 1 OBE or SBE and 1 purge behavior occurred at least once per week on average for 3 months, or purge behavior occurred 2 or more times per week on average for at least 1 month. Subclinical BED was diagnosed if the participant had an OBE at least once per week, on average, for at least 3 months accompanied by marked distress. Participants were considered cases when they first met the criteria for subclinical or clinical EDs, were referred by the research team for ED treatment, or started seeing a mental health professional for an ED. To determine potential cases, a committee of 4 experts who were blind to the participants' group assignment assessed the monthly data, including occurrence of OBE, SBE, and compensatory behaviors, and made independent diagnoses. The research team reviewed diagnoses and disagreement was resolved by consensus. Because diagnostic criteria were predetermined, only cases referred for treatment or referral required review.

Postintervention assessment occurred immediately following the cessation of the intervention. Follow-up assessments were approximately 1, 2, and 3 years after cessation of the intervention.

Eating disorder attitudes and behaviors were assessed using the WCS,[18,19] the Eating Disorder Inventory (EDI) drive for thinness and bulimia subscales, and the EDE Questionnaire (EDE-Q), a self-report version of the EDE. The EDI subscales are widely used and have good internal consistency.[28] The EDE-Q is a 41-item self-report version of the EDE that yields 4 subscales: restraint, weight concern, shape concern, and eating concern. The EDE-Q has good internal and temporal consistency.[29] For these measures, higher scores indicate worse symptom severity.

The Center for Epidemiological Studies Depression Scale, a 20-item self-report questionnaire, was used to assess depressed mood.[30] The Center for Epidemiological Studies Depression Scale has high internal consistency, adequate test-retest reliability, and convergent validity.[31]

Social support was measured with the Multidimensional Scale of Perceived Social Support,[32] a 12-item self-report measure of perceived social support.[33]

Standing height was measured to the nearest millimeter. Weight was determined to the nearest 0.1 kg using a digital stand-on scale with participants wearing light indoor clothing without shoes or coats. Height and weight were converted to BMI.
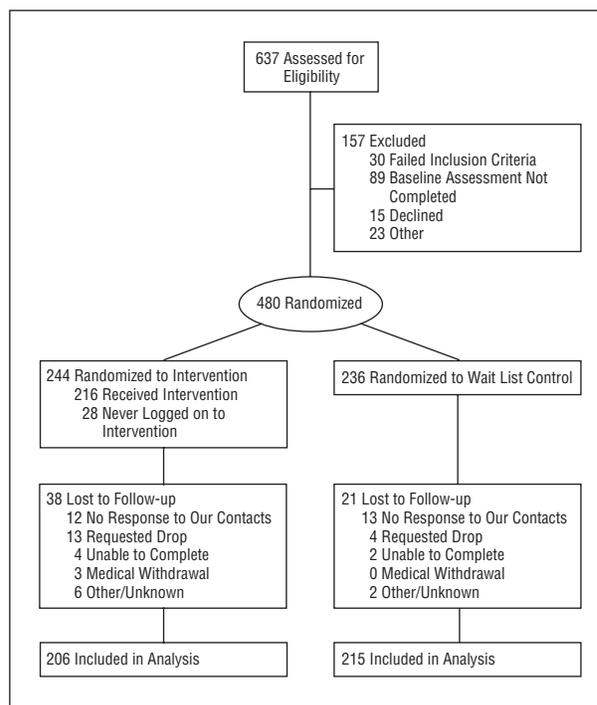

Figure 1. Flowchart for subject recruitment, randomization, and follow-up.

ADHERENCE

Each week, participation in the intervention was monitored for each participant. Adherence was defined as the percentage of assigned "Web pages" accessed each week averaged by the 8 weeks of the intervention period.

STATISTICAL ANALYSIS

The sample size was based on having sufficient power to detect a 5% difference at 2 years, with the assumption that 10% of participants would develop an ED and the intervention would reduce the rate by 50% to 5%. Cox regression models were the primary analysis to predict time to onset of clinical or subclinical EDs. The primary outcome measure was survival as a non-ED case. The model for examining potential moderators follows statistical recommendations by Kraemer and colleagues.[34] Potential moderators were identified a priori and their univariate effect on the intervention outcome was examined. Significant variables were examined in terms of their interaction with outcome. The authors hypothesized that the intervention would lead to significantly reduced weight and shape concerns as a prerequisite to the primary hypothesis, survival as a non-ED case. Secondary measures, including weight and shape concern variables, were examined with an analysis of covariance, controlling for baseline values. All models included site and site interactions. Controlled effect sizes were calculated using the Cohen d statistic.

RESULTS

PARTICIPANT FLOW

Participant flow can be seen in **Figure 1**. Recruitment occurred between November 13, 2000, and October 10, 2003, in 3 waves (wave 1, November 13, 2000-October 14, 2001; wave 2, October 15, 2001-October 11, 2002; wave 3, Oc-

Table 1. Changes in Eating Disorder Attitudes, Mood, and BMI From Baseline to Postintervention and 1-Year Follow-up*

	Sample Size	Baseline	Posttest	12 Months	Posttest Significance	12-Months Significance
WCS[18,19] score					$F_{1,386} = 89.7; P{<}.001; d = 0.81$	$F_{1,386} = 16.1; P{<}.001; d = 0.42$
Control	199	62.7 (12.5)	62.5 (13.4)	56.4 (16.5)		
Treatment	192	60.5 (13.5)	49.7 (15.9)	48.8 (17.9)		
Global EDE-Q[29] score					$F_{1,392} = 76.7; P{<}.001; d = 0.70$	$F_{1,392} = 10.7; P = .001; d = 0.36$
Control	201	2.7 (0.9)	2.6 (1.0)	2.3 (1.0)		
Treatment	196	2.5 (1.0)	1.9 (1.0)	1.9 (1.1)		
EDI[28] drive for thinness subscale score					$F_{1,383} = 54.7; P = .001; d = 0.61$	$F_{1,383} = 17.1; P{<}.001; d = 0.39$
Control	195	8.5 (5.0)	8.7 (5.5)	7.1 (5.8)		
Treatment	193	8.1 (5.3)	5.2 (5.2)	5.0 (5.2)		
EDI bulimia subscale score					$F_{1,386} = 10.0; P = .002; d = 0.22$	$F_{1,386} = 2.5; P = .11; d = 0.11$
Control	197	1.2 (2.0)	1.4 (2.8)	1.2 (2.5)		
Treatment	194	1.3 (2.4)	0.9 (1.5)	0.9 (2.2)		
BMI†					$F_{1,338} = 23; P = .65; d = 0$	$F_{1,338} = 0.04; P = .83; d = -0.04$
Control	171	23.4 (2.6)	23.5 (2.7)	23.4 (2.8)		
Treatment	172	23.5 (2.8)	23.5 (3.1)	23.5 (2.8)		
CES-D[30]					$F_{1,384} = 1.2; P = .27; d = 0.16$	$F_{1,384} = 3.3; P = .07; d = 0.21$
Control	198	14.8 (9.0)	14.8 (9.6)	15.2 (11.7)		
Treatment	191	13.6 (8.9)	13.2 (9.7)	12.9 (9.8)		

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CES-D, Center for Epidemiological Studies Depression Scale; EDE-Q, Eating Disorder Examination Questionnaire; EDI, Eating Disorder Inventory; WCS, Weight Concerns Scale.
*Values are expressed as mean (SD) unless otherwise indicated.
†BMI not collected for participants assessed by telephone at follow-ups.

tober 14, 2002-October 10, 2003). Participants recruited during wave 1 were assessed annually for up to 3 years, participants recruited during wave 2 were assessed annually for up to 2 years, and participants recruited during wave 3 were assessed at 1 year. Overall, 637 eligible participants were identified after screening, of whom 157 were excluded. Four hundred eighty women were eligible, interested, and randomized following diagnostic interviewing. Fifty-nine participants (14%) had no follow-up data and, hence, were not available for the survival analysis. The follow-up response rates by recruitment/intervention waves were as follows: wave 1: postintervention, 91% (145/159), 1 year, 81% (129/159), 2 years, 81% (128/159), and 3 years, 69% (110/159); wave 2: postintervention, 92% (170/185), 1 year, 86% (160/185), and 2 years, 82% (151/185); wave 3: postintervention, 95% (129/136) and 1 year, 90% (122/136). Overall, compliance with follow-up assessments was quite high. Only 38 intervention participants (16%) did not complete any follow-up assessments compared with 21 control participants (9%). There were no dropout differences in demographic, eating psychopathology, or eating behavior variables.

Ethnicity of the final sample was 60% white, 2% African American, 10% Hispanic, 17% Asian, and 11% other/unknown. By year in school, the sample was 31% freshman, 20% sophomore, 22% junior, 18% senior, and 8% graduate student. The mean (SD) age was 20.8 (2.6) years (range, 17-31 years).

Participants randomly assigned to the intervention had significantly lower WCS scores ($F_{1,414} = 3.9; P = .048$) and global EDE-Q scores ($F_{1,417} = 4.9; P = .03$). There were no other significant differences between the intervention and control groups on demographics, baseline measures of psychopathology, or ED behaviors. The Bay Area site had

parents with higher levels of education ($F_{1,275} = 41.0$; $P{<}.001$), fewer negative life events ($F_{1,478} = 8.2; P = .004$), higher prevalence of diuretic use ($F_{1,478} = 6.5; P = .01$), lower prevalence of driven exercise ($F_{1,478} = 10.0; P = .002$) and diet pills ($F_{1,478} = 6.9; P{<}.001$), higher prevalence of objective binges ($F_{1,478} = 4.4; P = .04$), and lower motivation to improve body image ($F_{1,473} = 74.0; P{<}.001$).

INTERVENTION IMPLEMENTATION

The intervention was provided to 13 groups and ranged in size from 14 to 24 members per group. Of the 244 participants who were randomized to the intervention, 28 (11%) never logged onto the program. For the remaining 216, adherence to the intervention protocol was high: the mean (SD) percentage of pages read was 79% (24.2%) (range, 6%-99%). There was a significant difference in adherence between study sites. Adherence was higher for participants with higher scores on the WCS ($t_1 = 2.2; P = .03$), EDI drive for thinness subscale ($t_1 = 3.5; P = .02$), global EDE-Q ($t_1 = 2.8; P = .005$), and EDI bulimia subscale ($t_1 = 2.3; P = .02$). Higher adherence resulted in reduced posttest scores on the WCS ($t_{209} = -2.3; P = .02$), EDE-Q restraint subscale ($t_{211} = -3.0; P = .003$), and EDE-Q weight concerns subscale ($t_{211} = -2.3; P = .02$). Ninety-seven participants (40%) of the treatment group used the booster session at least once following completion of the core 8-week program. Use of the booster sessions was not related to outcome.

CHANGE IN ED ATTITUDES AND BEHAVIORS

As presented in **Table 1**, there were statistically significant baseline to postintervention and baseline to 1-year
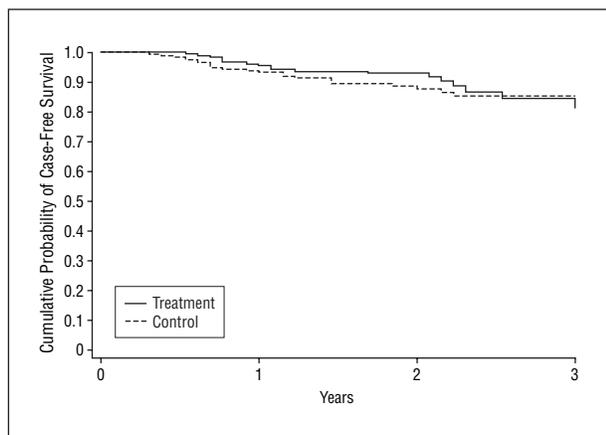
Figure 2. Survival as a non–eating disorder case. Intervention vs control through 3 years.

Figure 3. Survival as a non–eating disorder case for participants with a body mass index (calculated as weight in kilograms divided by height in meters squared) of 25 or higher at baseline. Note that there were no cases in the treatment group.

Figure 4. Survival as a non–eating disorder case for San Francisco Bay Area, California, participants with compensatory behaviors at baseline.

follow-up differences between the intervention and control groups on the scores for the WCS, global EDE-Q, and EDI drive for thinness subscale. In addition, there was a significant reduction in scores for the intervention group on the EDI bulimia subscale from baseline to postintervention. The WCS score slope was significantly steeper for treatment compared with control ($F_{1,450}=5.2$; $P=.02$). There were no significant wave, wave $\times$ center, wave $\times$ treatment, or wave $\times$ treatment $\times$ center effects on slope. Participant BMIs remained remarkably stable for all cohorts across all years. No adverse events were reported.

CLINICAL CASES

Over the course of follow-up, 43 participants were classified as becoming a subclinical or clinical eating disorder case. Ten participants were classified as being cases on the basis of reporting entering therapy for treatment of an eating disorder. Of the remaining 33, the diagnoses were 2 with bulimia nervosa, 27 with subclinical bulimia nervosa, and 14 with subclinical BED. There was no overall significant difference in onset of EDs between intervention and control groups (**Figure 2**).

MODERATORS

The moderator analysis[34] identified a number of nonspecific predictor variables, including year in school ($W_1=5.3$; $P=.02$), with participants further in school being less likely to develop an ED, and, as expected, all ED attitude variables. Baseline BMI and use of compensatory behaviors (San Francisco Bay Area site) both predicted outcome and interacted with treatment. The intervention significantly increased survival as a non-ED case in participants with an elevated baseline BMI ($W_1=11.2$; $P=.001$) and participants with baseline compensatory behaviors (self-induced vomiting, laxative use, diuretic use, diet pill use, driven exercise) at 1 site ($W_1=4.0$; $P=.046$). No participants with a BMI of 25 or higher who received the intervention developed an ED, whereas the rates of onset of EDs were 4.7% at 1 year and 11.9% at 2 years in the comparable BMI control group (95% confidence interval, 2.7% to 21.1%). For the San Francisco Bay Area sample with baseline compensatory behaviors, 4% of par-
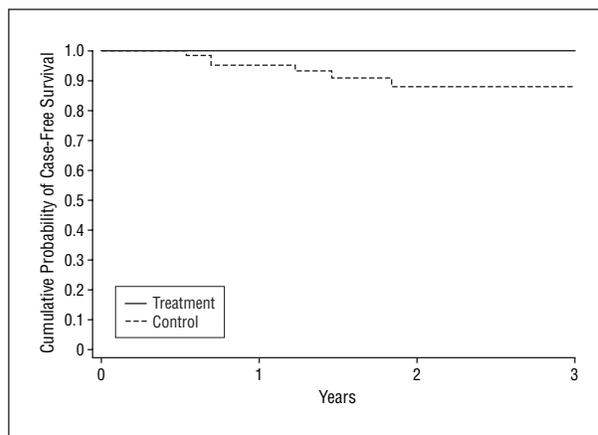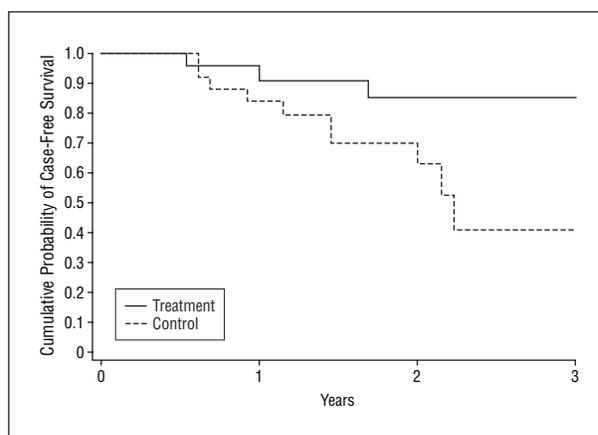
ticipants developed EDs at 1 year and 14.4%, by 2 years. The rates for the comparable control group were 16% and 30.4%. **Figure 3** and **Figure 4** display the survival curves for the moderator subgroups. The numbers of participants in the groups are as follows: BMI lower than 25 and no compensatory behaviors, n=215; BMI of 25 or higher and no compensatory behaviors, n=85; BMI lower than 25 with compensatory behaviors, n=88; and BMI of 25 or higher with compensatory behaviors, n=30. In total, about 49% (203/418) of the overall sample fell into 1 of the groups where the intervention was effective.

The 1- and 2-year incidence rates based on the cumulative survival curves are presented in **Table 2**. The 2-year incidence rates were lower in the intervention compared with the control group in all cohorts at all times. The 1-year overall incidence in the control group was lower than expected, although the 2-year incidence was close to prediction (10% in the control group; 5% in the intervention group). There was a significant difference in the incidence of EDs in the subgroup with a BMI of 25 or higher (95% confidence interval, 0%) compared with 11.9% (95% confidence interval, 2.7%-21.1%) in the group with a BMI lower than 25.

Table 2. 1- and 2-Year Incidence Rates From the Survival Data for Onset of Eating Disorders

	% (95% Confidence Interval)					
	San Francisco Bay Area, California		San Diego, Calif		Total	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Overall						
Control	7.7 (2.8 to 12.5) (n = 107)	12.8 (6.1 to 19.5) (n = 60)	4.1 (0.2 to 8.1) (n = 91)	9.5 (3.1 to 15.9) (n = 57)	6.6 (3.4 to 9.8) (n = 198)	11.3 (6.6 to 16) (n = 117)
Treatment	5.4 (1.2 to 9.6) (n = 104)	10.0 (5.8 to 14.2) (n = 60)	2.2 (–0.8 to 5.3) (n = 89)	3.7 (–0.5 to 7.9) (n = 57)	4.0 (1.3 to 6.7) (n = 193)	7.2 (3.4 to 11) (n = 116)
BMI ≥25 at baseline						
Control	5.6 (–1.9 to 13.0) (n = 32)	10.8 (–1.5 to 23.1) (n = 15)	3.6 (–3.3 to 10.4) (n = 26)	12.5 (–0.9% to 26) (n = 18)	4.7 (–0.5% to 9.9) (n = 58)	11.9 (2.7 to 21.1) (n = 33)
Treatment	0 (0) (n = 26)	0 (0) (n = 14)	0 (0) (n = 22)	0 (0) (n = 11)	0 (0) (n = 48)	0* (0) (n = 25)
Compensatory behaviors at baseline						
Control	16 (1.6 to 30.4) (n = 22)	30.4 (11.3 to 49.4) (n = 12)	2.6 (–2.5 to 7.7) (n = 37)	11.6 (0.9 to 22.3) (n = 27)	8 (1.3 to 14.7) (n = 59)	19 (8.8 to 29.2) (n = 39)
Treatment	4 (–3.7 to 11.7) (n = 22)	14.4 (–0.8 to 29.6) (n = 14)	3.2 (–2.9 to 9.3) (n = 32)	6.9 (–2.4 to 16.2) (n = 22)	3.6 (–1.3 to 8.5) (n = 54)	10.1 (1.6 to 18.5) (n = 36)

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared).
*Significantly different with no overlap of confidence intervals.

At baseline, only 14 participants were taking antidepressants, and 11 of these continued to take medications during the follow-up period. Only 11 subjects started taking medications. Of the 25 who were taking medications, 5 developed EDs: 4 control participants and 1 treatment participants.

COMMENT

The most important finding of this study is that a brief, 8-week, Internet-based cognitive-behavioral intervention led to sustained reductions in weight and shape concerns in college-age women who were at high risk for developing EDs. While there was no overall decrease in the onset of EDs, participation in the intervention was associated with a decrease in the onset of EDs in 2 subgroups constituting about half the sample: those who had baseline compensatory behaviors (self-induced vomiting, laxative use, diuretic use, diet pill use, driven exercise) and those who had elevated baseline BMIs. The data provide further evidence that elevated weight and shape concerns identify college-age women who are at risk of subsequently developing EDs and/or who engage in unhealthy weight-regulation practices. The overall rate of ED onset was at least 9% (43 of 480 participants).

Reductions in weight and shape concerns, the primary risk factor, were impressive. The short-term postintervention effect size on the main risk factor (d=0.81) was similar to those for comparable preintervention to postintervention periods in efficacy studies.[14,15,17] Intervention and control differences on WCS scores remained significant at 1 year with an effect size in the moderate range (d=0.41).

Although the slope of the decline in WCS score was significantly greater in intervention compared with control group participants, both groups continued to improve over time. This improvement may be the result of statistical regression to the mean or normal developmental processes for college women. With experience and maturity, weight and shape concerns may become less important to many women. The sustained improvement in weight and shape concerns, and the improvement in the control group, occurred with no overall changes in BMI, suggesting participants were not feeling better about their weight and shape because of weight loss, which was not advocated in the intervention.

This study provides some evidence that elevated weight and shape concerns are a causal risk factor for the onset of EDs on the basis that reduction of weight and shape concerns was associated with reduced onset of EDs, at least in 1 subgroup—women with elevated baseline BMIs. However, these findings need confirmation in a prospective trial with these subgroups randomized to treatment or control.

While there was a significant reduction in weight and shape concerns, the median WCS scores at 2 years remained higher than the threshold entry criteria for the study. How could the intervention be improved? The overall adherence to the intervention was high (eg, 79% of assigned pages were read); thus, it is unlikely that adherence could be significantly improved. A face-to-face intervention might be more effective, although the effect sizes are comparable with those reported in studies that used face-to-face interventions.[15,35] Another potential modification would be to add a postintervention monitoring feedback component that would monitor weight and shape concerns, binge eating, and compensatory behaviors so participants could receive an additional intervention when they might most need it.

The results for the subgroup with a BMI of 25 or higher are exciting but need to be replicated in a prospective study using a sample selected on this basis. We arbitrarily picked a BMI of lower than 32. We thought a higher BMI cutoff would allow us to include participants with higher weights where weight maintenance and not weight loss would be

acceptable. There were 17 participants (about 4% of the sample) with a BMI in the range of 30 to 31.

The subgroup of participants who at baseline had high weight and shape concerns, a BMI lower than 25, and no compensatory behaviors might have other characteristics that differentiate them from participants in the subgroups in which the intervention was effective. They may have a stronger and more refractory internalization of a thin-body ideal or other characteristics less amenable to change or that were not addressed in Student Bodies. It may also be the case that providing the intervention when women are struggling with weight management, as evidenced by use of inappropriate compensatory behaviors, might make it more immediately relevant to them and thus more effective.

An Internet-based program can provide relatively inexpensive electronic reminders and be made available for "booster sessions" after completion of an intervention such as Student Bodies. In this study, participants were allowed access to the core program about 9 months after completion of the core 8-week program. Fewer than half did so and there was no significant benefit for those who did. Booster or maintenance sessions may be important to prevent relapse and sustain benefits but probably need to be actively incorporated into a program.

Differences in ED attitudes, behaviors, and outcomes were noted between the 2 sites. We do not know if these differences represent different populations reached through recruitment or if regional differences affect the presentation of EDs. Differences between the types of compensatory behaviors used by participants at the 2 sites might also explain why there was a significant effect at the San Francisco Bay Area site but not the San Diego area site for prevention of EDs in participants with baseline compensatory behaviors. Participants in the San Francisco Bay Area were more apt to report using laxatives, diuretics, and vomiting, whereas participants in San Diego reported higher levels of diet pill use and driven exercise.[36]

The criteria for subclinical eating disorders were those we have used in other studies[9,27] and were developed to operationalize "case" criteria that are clinically considered to be eating disorders not otherwise specified. Overall, most studies have found a continuity between subclinical and clinical symptoms.[3,9]

The results of this study should be considered in the context of several limitations. First, although our targeted participant pool was within the typical age at onset[2] and we recruited from both public and private academic institutions that ranged considerably in size, generalizability is restricted to college women in northern and southern California. Our data showed differences between the 2 sites in baseline characteristics and in treatment response. Thus, sampling from different regions, age groups, diverse groups, and/or the general population might have led to different outcomes. Second, participants were highly motivated to participate in the study and enhance their body image, as evidenced by the high rates of adherence to the intervention protocol. Women who are less motivated, have more barriers to participation, or are more diverse might show different outcomes. For example, in this study, participants were required to have Internet access and a minimum level of competency with computers. Restricted computer access and lesser competency might affect adherence to the intervention protocol and subsequent treatment outcome. The use of a self-report measure and a retrospective self-report are other limitations. Although we used the timeline follow-back approach, which has been shown to be reliable for measuring a number of behaviors over the preceding year,[37,38] the method includes data "remembered" from as long as 12 months before. The diagnoses of bulimia and binge eating require the target behaviors occur for at least 3 months, inherently requiring a relatively long-term recollection. Some of the remembered events, such as going into therapy, however, are likely to be accurately recalled. A prospective monthly assessment would be ideal to avoid this problem but might also generate its own bias, such as underreporting, aside from the increased measurement costs incurred. Ravaldi et al[39] gave the EDE to 25 female patients who had previously been assessed a year or more earlier. The test-retest reliability of the subscales was 0.7 or greater, suggesting that the EDE is a reliable interview even when administered retrospectively.

An Internet-based intervention has the advantage of facilitating rapid dissemination. The most significant cost is related to group moderation. Discussion group moderators need to be selected, trained, and, in some cases, supervised. In our studies, about 1 to 2 hours per week were required to moderate groups of 10 to 20 participants. Future studies might examine the benefit of or need for moderation and explore ways that moderation can be provided less expensively. Furthermore, Internet-based programs can be used as a first step in a stepped-care program to screen women for possible ED risk and classify women with high ED risk as early as possible to facilitate further assessment and treatment recommendations.[40] There are a number of research and delivery issues related to a stepped-care program[40] but this study provides an important initial step in that direction. Overall, this research lends support that Internet-based interventions can significantly reduce weight and shape concerns for 2 years among college-age women with high weight and shape concerns. To our knowledge, this is the first study to show that EDs can be prevented in a high-risk group; the intervention significantly reduced the risk of EDs in college-age women who had elevated baseline BMIs and/or low-level baseline compensatory behaviors. The results from this investigation also suggest that reducing risk factors in high-risk groups can lead to reductions in the onset of EDs.

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