Preventing Eating Disorders among Young Elite Athletes: A Randomized Controlled Trial

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ABSTRACT

MARTINSEN, M., R. BAHR, R. BØRRESEN, I. HOLME, A. M. PENSGAARD, and J. SUNDGOT-BORGEN. Preventing Eating Disorders among Young Elite Athletes: A Randomized Controlled Trial. *Med. Sci. Sports Exerc.*, Vol. 46, No. 3, pp. 435–447, 2014. **Purpose**: To examine the effect of a 1-yr school-based intervention program to prevent the development of new cases of eating disorders (ED) and symptoms associated with ED among adolescent female and male elite athletes. **Methods**: All 16 Norwegian Elite Sport High Schools were included (intervention group [n = 9] and control group [n = 7]). In total, 465 (93.8%) first-year student athletes were followed during high school (2008–2011, three school years). The athletes completed the Eating Disorder Inventory 2 and questions related to ED before (pretest), immediately after (posttest 1), and 9 months after the intervention (posttest 2). Clinical interviews (Eating Disorder Examination) were conducted after the pretest (all with symptoms [n = 115, 97%] and a random sample without symptoms [n = 116, 97%]), and at posttest 2, all athletes were interviewed (n = 463, 99.6%). **Results**: Among females, there were no new cases of ED in the intervention schools, while 13% at the control schools had developed and fulfilled the *DSM-IV* criteria for ED not otherwise specified (n = 7) or bulimia nervosa (n = 1), P = 0.001. The risk of reporting symptoms was lower in the intervention than in the control schools at posttest 1 (odds ratio [OR] = 0.45, 95% confidence interval [CI] = 0.23–0.89). This effect was attenuated by posttest 2 (OR = 0.57, 95% CI = 0.29–1.09). The intervention showed a relative risk reduction for current dieting (OR = 0.10, 95% CI = 0.02–0.54) and three or more weight loss attempts (OR = 0.47, 95% CI = 0.25–0.90). Among males, there was one new case of ED at posttest 2 (control school) and no difference in the risk of reporting symptoms between groups at posttest 1 or 2. **Conclusion**: A 1-yr intervention program can prevent new cases of ED and symptoms associated with ED in adolescent female elite athletes. **Key Words:** ADOLESCENT, INTERVENTION, DISORDERED EATING, CLINICAL INTERVIEW

Being an athlete produces not only an array of health benefits, but it may also entail substantial health risks, such as low energy availability, disordered eating (DE) behaviors, and eating disorders (ED) (9). For female athletes, this is a particular concern because it increases the risk for the female athlete triad, referring to three interrelated health threats consisting of inadequate energy availability, menstrual disorders, and decreased bone mineral density (9,20). Untreated, an ED can have persistent psychological and physiological effects and may even be fatal. The prevalence of ED is higher among elite athletes than nonathletes, particularly among athletes competing in weight-sensitive sports (35,37), and higher in female than male athletes (19,35). Furthermore, adult elite athletes diagnosed with ED report having started dieting and developing ED during puberty or adolescence (33), and the peak onset of ED is adolescence, when females especially experience a rapid change in body composition and shape (6).

The International Olympic Committee has established a task force to study ED among female athletes, and it has been recommended that national and international sports governing bodies put policies in place to prevent DE and ED (17,36). In addition, the National Collegiate Athletic Association (NCAA) has made substantial efforts to decrease ED among athletes by developing written and audiovisual materials for athletes, coaches, and trainers concerning ED and the triad (36), while UK Sport has produced a guideline entitled "Eating disorders in sport: a guideline framework for practitioners working with high performance athletes" (38). Apart from this, efforts aimed at preventing the development of ED in sports remain limited (36), and there are no large randomized studies on the prevention of ED among female and male elite athletes or adolescents available.

In general, substantial advances have been made over the last decade with regard to the development of efficacious ED prevention programs (32). However, only six studies, all in nonathletes (32), have reportedly reduced ED symptoms

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through 6-month follow-up and two studies (28,29) have documented a reduced risk for future onset of ED (32). Furthermore, most of these studies have been conducted on females, and male and female athletes may not respond to interventions in the same way. Owing to the high prevalence of DE (18,26) and ED (19) in adolescent elite athletes, and the increased difficulty in treating them the longer they progress (36), early intervention is important. Therefore, we developed the first intervention study to examine the effectiveness of an intervention to prevent the development of new cases of ED among adolescent male and female elite athletes during high school. We conducted a randomized controlled trial to examine the effect of an intervention program on clinical ED and symptoms associated with ED. To minimize contamination bias within schools, we used a cluster randomized design.

METHODS

We invited the total population of first-year students attending Elite Sport High Schools ($n = 16$) in Norway. The different schools were stratified (by size) and randomized to the intervention ($n = 9$) or control group ($n = 7$); all athletes from each school were randomized to the same treatment arm (intervention or control). The statistician (I.H.) who conducted the randomization did not take part in the intervention.

The Norwegian Elite Sport High Schools are private and public high schools with programs designed for talented athletes. The schools were told that those allocated to the intervention group would receive a 1-yr intervention program aiming at preventing the development of ED and reducing symptoms associated with ED among young elite athletes.

Participants

We invited 711 student elite athletes to participate during the 2008–2009 school year. Of these, 34 were excluded (due to age: $n = 29$; did not obtain parental consent: $n = 5$). Of the remaining 677 athletes, 66 did not participate because they did not attend school on the test day. Reasons reported were training camps, competition, and illness. This resulted in a sample of 611 athletes attending the pretest screening. Among these, 115 left the Elite Sport High School program during the study (7 of them were diagnosed with an ED before the intervention started). This resulted in a final sample of 465 athletes representing 50 different sports/disciplines attending the pretest, posttest 1, and posttest 2. For part of the analysis and in accordance to recent research (19), the sports/disciplines were classified into weight-sensitive (e.g., gymnastics, high jump, and cycling) and less weight-sensitive (e.g., basketball, alpine skiing, and sprint) sports.

Athletes ($n = 27$) meeting the criteria for ED before the start of the intervention program were excluded from all analyses on the effect of the intervention. The flow of participants through the study can be seen in Figure 1.

The Regional Committee for Medical and Health Sciences Research Ethics in Southern Norway and the Norwegian Social Science Data Services approved the study. The respondents and their parents provided written consent to participate. We also obtained permission to collect data from each school principal before randomization.

Intervention

On the basis of the current knowledge about possible risk factors and the conditions, theory, and results from existing studies aiming to prevent DE and ED in the general (5,27, 30,40) and athletic population (9,25,33,37), we devised a 1-yr intervention program. The intervention was based on the social–cognitive framework (2), and the primary focus was to enhance self-esteem by strengthening their self-efficacy. Further, motivational aspects such as the meaning of intrinsic versus extrinsic motivation (8) and mastery versus performance goals (22) were included to underpin the importance of building as strong self-less contingent on performance issues and significant others. The participants in the intervention schools were presented various mental training techniques to enhance self-esteem and renown Norwegian elite athletes were used as models (in line with the recommendations from Bandura [2] and Bandura et al. [3]) through Facebook posts. We also included an educational program in nutrition and psychological and physiological development in adolescence.

We focused on systematic changes within the intervention schools and aimed at intervening at the social system level and the individual level (25). The intervention was also influenced by the elaboration–likelihood model (24) and the cognitive–dissonance theory (12). In addition, we tried to find the optimal point of exposure (through lectures, assignments, etc.) based on the assumption that repeated exposure facilitates cognitive elaboration of the message, which, in turn, leads to more lasting changes in attitudes (24). For maximal reinforcement, we used a 1-yr implementation period over two school years (May 2009 to May 2010), repeating many of the messages. An overview of the study design and the components of the intervention program are given in Figure 2 and Table 1.

On the basis of the importance athletes tend to ascribe to coaches (23), successful prevention programs in the athletic setting may be particularly dependent on the commitment and support from their coaches and "significant others" (34). Therefore, to create supportive environments, coaches (employees of the Elite Sport High Schools) were also included in the intervention. In addition, dialogs at different levels with administration, teaching staff, and parents were established to inform and guide during the prevention program. Moreover, parents and club coaches (outside the school system) received a booklet, focusing on facts related to dieting and ED among athletes and guidelines on the identification and management of DE and ED problems. Finally, each school had one staff member available for student athletes who had questions or special needs related to the issues investigated.

The intervention program was piloted at two different regular high schools by students in the same age range with sports and physical education as a major.

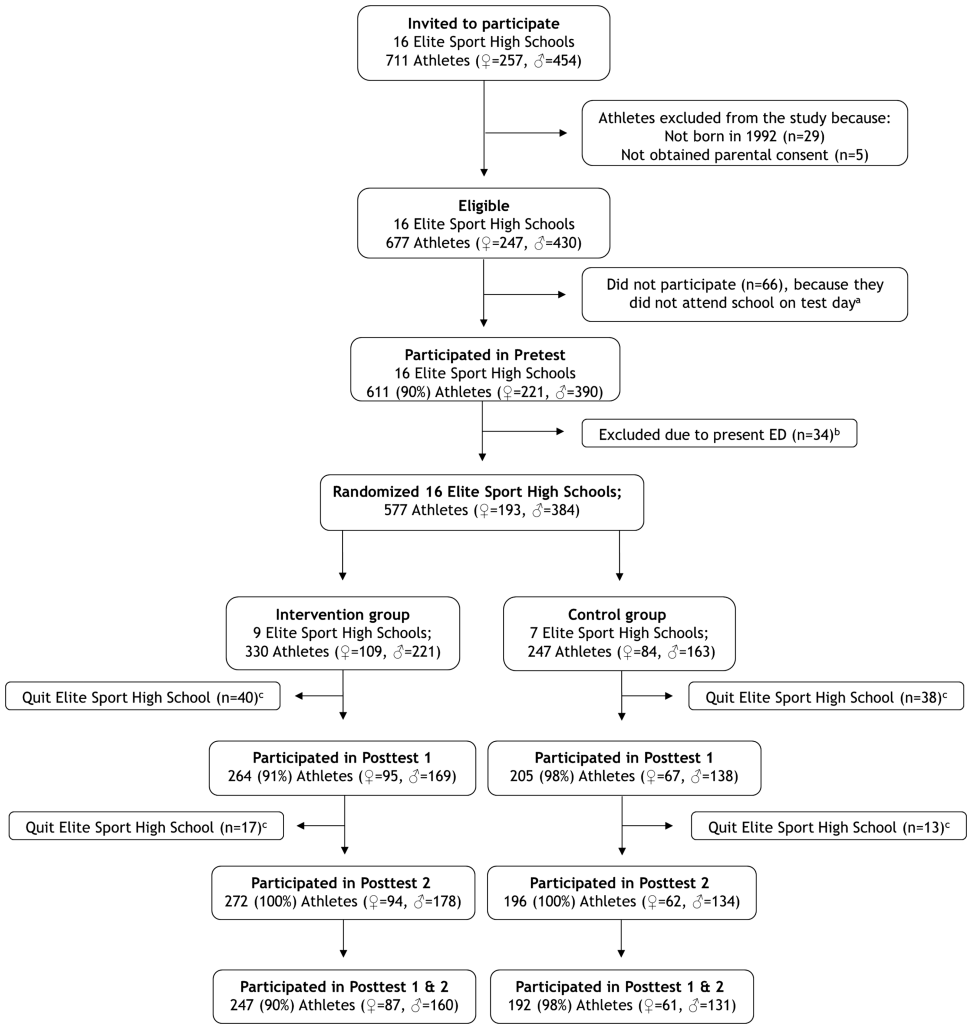

FIGURE 1—Flowchart of the study and participants' movement through high school. a, reasons reported were training camps, competition, and illness. b, six of these changed to regular high school during the study, and one was too ill to continue school. c, changed to regular high school.

Athletes. In addition to educating the student athletes, we wanted to challenge myths, correct possible misinformation, and encourage critical thinking. The school-based program was organized as lectures, teamwork exercises, and practical and theoretical assignments (during lectures and as homework) (Table 1). The lectures consisted of four 90-min sessions conducted at school during school hours by the first author and one other research member. In addition, our communication with athletes was based on e-mail, a closed Facebook group, and different electronic communication tools used by the school (e.g., Fronter/its learning).

Facebook was used during the final 6 months of the intervention when the main focus was on self-esteem (through enhancing self-efficacy and practice mental training). Every week, different renowned Norwegian athletes ("athlete of the week") wrote about their own experiences related to self-esteem, self-efficacy, and mental training. Since behavior change most likely occurs if those who act as models are perceived as models (3), we used both male and female elite athletes representing different sports. We also added videos, tips, and links on the topics, and subjects had the opportunity to ask questions and add their own comments. Finally, the athletes were introduced to and encouraged to use a self-reflection diary ("I am good") to write down three positive events, not related to sports performance, happening each day for a specific period in their lives.

Coaches. The intervention program developed for coaches aimed to present factual information and educate coaches about self-esteem, self-efficacy, mental training, sports nutrition, body composition, weight issues, and how to identify and manage DE and ED problems among athletes (Table 1). We organized two seminars and provided a coaches' guide to increase knowledge about nutrition and how to identify and manage ED in the sport environment. In addition to the seminar lectures, clinical and subclinical cases were also discussed. Moreover, coaches were informed about

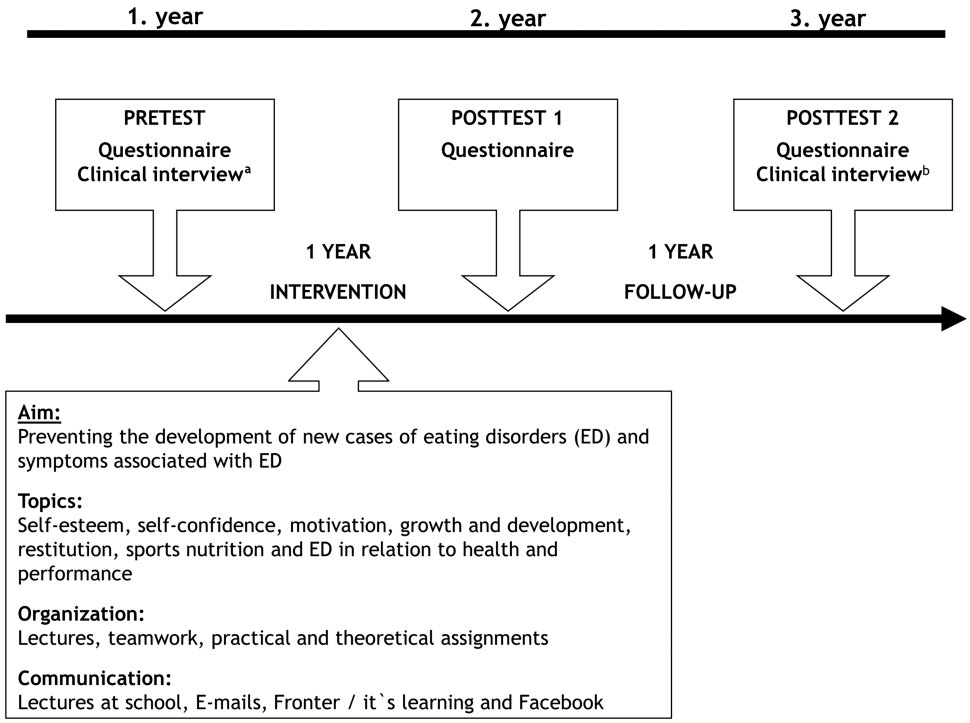

FIGURE 2—Flow of the project design. a, conducted 14.2 ± 5.0 months from finishing the questionnaire screening at baseline (intervention 14.6 ± 4.6 vs control 15.5 ± 4.6, $P = 0.229$). b, conducted 1.8 ± 0.7 months from finishing the data collection (intervention 1.8 ± 0.7 vs 1.8 ± 0.8, $P = 0.343$).

the program provided for the athletes, encouraged to attend at their lectures, and presented with ideas on how to include and follow up some of the mental training assignments in training.

Assessment Procedures

Screening. At pretest, posttest 1 (after the intervention), and posttest 2 (9 months after the intervention), the athletes were asked to complete a questionnaire including questions regarding training history, nutritional patterns, menstrual history, oral contraceptive use, dieting and weight fluctuation history, use of pathogenic weight control methods, injuries, self-report of previous and/or current ED, and standardized questionnaires such as the Eating Disorders Inventory-2 (EDI-2) and the Contingent Self-Esteem Scale (CSE). Except for the CSE measuring general contingent self-esteem, the questionnaire has been described in detail previously (18). The CSE is a 15-item scale designed to measure self-esteem contingencies, in domains such as living up to expectations, successful performance, and acceptance from others (16). Each item is rated on a 5-point scale ranging from 1= "not at all like me" to 5= "very much like me." The item score is calculated by dividing the total score of the number of items answered (ranging between 1 and 5), and higher scores reflect stronger contingencies.

The athletes completed the questionnaire at school during school hours in the presence of members of the research group.

Symptoms associated with ED were assessed at baseline, posttest 1, and posttest 2 based on the self-reported questionnaire. To be classified as "at risk" for ED, athletes had to meet at least one of the following criteria: a) drive for thinness (DT) score ≥15 for girls and ≥10 for boys, b) body dissatisfaction (BD) score ≥14 for girls and ≥10 for boys, c) body mass index (BMI) corresponding to the underweight values (7), d) trying to lose weight now, e) tried to lose weight before three or more times, e) current and/or previous use of pathogenic weight control methods (use of diet pills, laxatives, diuretics, or vomiting to reduce weight), or f) self-reported menstrual dysfunction (primary amenorrhea or secondary amenorrhea; previous 6 months).

Eating disorders were determined by using the clinical interview Eating Disorder Examination (EDE) (11) including sport-specific questions regarding suggested predisposing, precipitating, and perpetuating factors related to ED risk. For being diagnosed with an ED, the criteria for anorexia nervosa (AN), bulimia nervosa (BN), or ED not otherwise specified (EDNOS) from the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*) had to be met (1). The EDE has been described in detail previously (19). Briefly, EDE is an investigator-based interview that assesses ED psychopathology and key ED behaviors. It is generally considered the best established instrument for assessing ED and is used for diagnostic purposes (10).

The clinical interview was conducted after questionnaire screening, at pretest, and at posttest 2 (1-yr follow-up; Fig. 2). After the pretest, all athletes with symptoms (attended: $n = 115$, 97%) and a random sample without symptoms (attended: $n = 116$, 97%) were invited to attend the clinical interview (19). After questionnaire screening at posttest 2, all athletes

TABLE 1. The health, body, and sports performance intervention program.

Athletes **Time Point** **Arena** **Organization**	**Themes**	**Purpose**
Spring 2009 Classroom Lecture 1[a]	*Motivation I*: goal setting, intrinsic and extrinsic	• Increasing knowledge and awareness of the relation between physical skills, physical fitness, and mental skills on sport performance
	Self-esteem I: role of self-confidence, stress management I	• Be familiar with psychological and physiological changes during puberty and how this may affect, e.g., sport performance and become possible stress factors
	Nutrition I: health, physical training, performance	• Increase knowledge about nutrition and the association to health and sport performance
	Physiology I: growth and development, energy metabolism	• Understand the principles of specificity, overload, recovery, adaptation, and reversibility in addition to training and performance
	Sports sciences I: training principles	• Understand that ED is a medical, nutritional, and psychological problem and know how to show concern for a classmate with ED behavior without making accusations
	Prevention I: injury (e.g., energy availability, overtraining), illness (e.g., nature and course of ED, what to do when worried (yourself/classmate)	
Fall 2009 *Classroom* *Lecture 2*[a]	*Motivation II*: process goals, mastery orientation, reduce/avoid risk factors	• Understand the concepts of motivation
	Self-esteem II: body image, stress management II	• Be aware of possible stress factors and how to handle them/cope with it
	Nutrition II: sports nutrition I (e.g., intake before, during, and after training/competition), dieting (energy balance, DE, and ED)	• Improve recovery routines (e.g., by stress management, sufficient nutrition)
	Physiology II: growth and development II	• Obtain adequate nutrition to optimize health and sports performance
	Sports sciences II: developing athlete	• Encourage critical evaluation of "hot" topics and supplements
Assignments • Group	*Mental training I*: requirements and expectations, stress regulation, self-esteem	• Be familiar with psychological and physiological changes during puberty and the association with performance and perceived stress factors
	Nutrition/sport sciences: plan and facilitate fluid and fuel intake before, during, and after training/competition?	• Be aware of own fluid and fuel intake during and after training/competition and how it can be optimized
	Prevention: illness (what to do if worried of DE and ED (yourself/classmate))	• Increase awareness by discussing how to show concern for a classmate without making accusations and who to contact about your concern
Home	*Motivation*: goal setting	
Assignments • Theoretical • Practical	*Self-esteem*: self-confidence	
	Nutrition: habits, register fluid, and fuel intake before, during, and after training/competition (30 min) for a week; attitude to dieting/weight loss	
Fall–winter 2009 Classroom Lecture 3[a]	*Motivation III*: goal setting (long and short term)	• Examples of content and how goal setting can enhance motivation
	Nutrition III: sports nutrition II (e.g., carbohydrate, protein, fat and antioxidant and mineral needs, smart nutritional planning)	• Increase knowledge of the 24-h athlete

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TABLE 1. *(Continued)*

Time Point Arena Organization	Themes	Purpose
Athletes		
	Sports sciences III: training principals (overtraining, restitution, healthy activity habits); dieting and weight loss (sport performance, dispel myths)	• Encourage critical thinking
	Prevention II: injury II (e.g., overtraining, fatigue, recovery); illness II (what to do if you worried one of your classmates who is struggling with DE)	
Assignments • Individual	*Nutrition*: fluid and fuel intake during a normal day	• Improve recovery routines
	Sports sciences: training diary for the last week	• Increase awareness of training load and what, how, and why you train the way you do
Winter 2010 Classroom Lecture 4[a]	*Motivation IV*: self-efficacy and self-esteem, goal setting strategies, intrinsic and extrinsic motivation (pregame, participation, long-term)	• Be aware of how own thinking may affect behavior and performance
	Mental training II: relaxation, self-talk; visualization	• Be introduced to some practical skills to enable development of own mental abilities
	Initiated activities: Facebook page, athlete of the week, self-reflection diary	• Enhance self-esteem and underpin the importance of building a strong self-less contingent on performance issues and significant others
Winter/spring 2010 Home/leisure time/training sessions Facebook page Self-reflection diary	*Motivation, mental training, and self-esteem*: athlete of the week; clips, tips, and the assignments in relation to self-efficacy, self-esteem, and mental training were published on the page	• Enhance self-esteem, self-efficacy, and mental skills such a s self-talk and visualization
	Self-esteem: write three positive events, not related to sports performance, happening each day for a specific period	• Enhance physical skills during training, competition, and in the athletes preparation
Assignments[b]	*Motivation*: self-esteem, goal setting	
	Mental training: self-talk, visualization	
Coaches at the School		
Winter 2009 Outside school Seminar	*Nutrition*: sports nutrition; fluid and fuel intake before, during, and after training/competition; health and performance-enhancing nutrition	• Be aware of challenges related to puberty • Increase knowledge, challenge myths, and correct possible misinformation
	Physiology: growth and development, adolescent athletes health	• Understand how athletes experience pressure to lose weight from coaches and peers
	Prevention: detecting and managing ED	• Increase confidence on how to identify and manage DE and ED among athletes
Winter 2010 Coaches guide (self-study book)	*Prevention*: detecting ED (how to identify in the sport environment); managing ED (how to prepare and plan the first consultation/meeting and follow up athletes who might be suffering)	• Be able to recognize signs, symptoms associated with ED, and ED in athletes • Know how to show concern without making accusations • Understand the behavior of an athlete with an ED
Test	Questions from the coaches guide about ED, nutrition, dieting, how to identify and manage ED in the sport environment.	• Reading the coaches guide • Individual feedback to all coaches

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TABLE 1. *(Continued)*

Time Point Arena Organization	Themes	Purpose
Coaches at the School		
School-wide Seminar	*Mental training*: relaxation, self-talk, visualization, present the program for the athletes and how to follow up the mental training assignments *Self-esteem*: role of self-confidence, stress management *Prevention*: detecting ED (symptoms and signs, understand the nature and course, discussing cases), managing ED (difficulties, guidelines (e.g., training), responsibility (as coach, the school, etc.), management protocol, team infrastructure	• Increase ability to implement mental training • Increase confidence in identifying and managing ED problems among athletes • Discuss cases from their own school/from own school environment • Ability to handle issues concerning body weight, puberty, and performance • Encourage to initiate the development of policies for early detection and management of DE and ED
Parents		
Winter 2009 Home Brochure	*Facts for parents related to*: dieting, ED among athletes, identification and management of DE and ED	• Introducing guidelines on identification and management of DE and ED • Informing about the study
Coaches outside the School		
Winter 2010 Home Brochure	*Facts for coaches related to*: dieting, ED among athletes, identification and management of DE and ED	• Introducing guidelines on identification and management of DE and ED • Informing about the study

[a]Two school hours (45 min × 2 with a break).
[b]Mostly practical assignments every second week from January to May.
ED, eating disorder; DE, disordered eating.

(with and without symptoms) were invited (attended: n = 463, 99.6%). Furthermore, for reliability assessments, a random selection of 28 athletes (12 who fulfilled and 16 who did not meet the ED criteria after the first clinical interview) was reinterviewed. We also reinterviewed 13 athletes (5 who fulfilled and 8 who did not meet the ED criteria) after the second clinical interview. In all cases, there was complete agreement between the two interviewers concerning the diagnostic classification.

Outcome Measures

We defined the primary outcome as fulfilling the *DSM-IV* criteria for AN, BN, or EDNOS (1), and the secondary outcome was reported as symptoms associated with ED.

Statistical Analysis and Data Presentation

Statistical analyses were carried out using Stata, version 12.0 (StataCorp, College Station, TX) and PASW Statistics

TABLE 2. Baseline characteristics of athletes in the intervention and control groups.

	Females			Males		
	Intervention (n = 87)	Control (n = 61)	P	Intervention (n = 160)	Control (n = 131)	P
Age (yr)	16.5 (0.3)	16.4 (0.3)	0.04	16.5 (0.3)	16.5 (0.3)	0.20
BMI ($kg \cdot m^{-2}$)[a]	21.1 (1.9)	21.2 (2.0)	0.68	21.5 (2.0)	21.6 (1.7)	0.94
BMI categories						
Underweight	4 (4.8)	3 (5.5)	0.86	2 (1.3)	1 (0.8)	0.67
Normal weight	77 (91.7)	50 (90.9)	1.0	134 (86.5)	115 (89.1)	0.49
Overweight	3 (3.6)	2 (3.6)	1.0	19 (12.3)	13 (10.1)	0.56
Weight-sensitive sports	27 (31.0)	13 (21.3)	0.19	53 (33.1)	39 (29.8)	0.54
Training volume ($h \cdot wk^{-1}$)	14.9 (4.3)	14.0 (3.5)	0.16	14.3 (3.8)	14.2 (4.0)	0.85
Age at sport specialization (yr)	13.2 (1.9)	13.6 (1.5)	0.17	12.7 (2.3)	12.8 (2.0)	0.62
Symptoms associated with ED[b]	33 (37.9)	26 (42.6)	0.57	21 (13.1)	10 (7.6)	0.13

Results are given as means (SD) for continuous or numbers with percentages for categorical variables.
Only cases without missing values are considered.
[a]Body mass index.
[b]Eating disorders.

18 for Windows (IBM Corporation, Route, Somers, NY). Results are expressed as absolute numbers (n) and percentages (%) for categorical data and mean values with their standard deviations (SD) for continuous data. Fisher exact test was used to calculate the P value in cases where the expected number of cases per cell was five or less. To compare mean differences, an independent-sample t-test was used, while we used χ^2 tests to compare categorical frequencies. To compare differences in reported symptoms at posttest 1 or 2, multiple logistic regression was used, with intervention as exposure variable, taking the cluster randomization by school into account (robust method for estimation of SE) adjusted for baseline. A pretest of interaction between reported symptoms associated with ED at baseline and intervention on ED assessment was done by creating a cross-product term between the two variables and was tested by the Wald method. When an interaction was found, separate logistic regressions per group were performed (e.g., present dieting and not present dieting at pretest). Similar analyses were done when continuous variables were tested per treatment (e.g., BD and DT) using linear regression models accounting for the cluster effects by the robust method.

Odds ratio (OR) and scores are presented with 95% confidence intervals (CI) and P values. The significance level was set to 0.05.

RESULTS

Subject Characteristics

Among females, controls were slightly younger (but all were born in 1992); otherwise, there were no other differences in age, training background, or body composition between the intervention and control groups at baseline (Table 2). Furthermore, a dropout analysis (with the same variables) were conducted between male and female athletes who completed the study compared to those who had to be excluded because of change of school (n = 115) or did not participate in the posttests for reasons unknown (n = 31). The dropout analysis revealed no difference between the female athletes, but among the male athletes, we found a higher BMI value among those who did not complete the study compared to those who did (22.4 ± 2.9 vs 21.5 ± 1.9 $kg \cdot m^{-2}$, $P < 0.001$). Furthermore, 8.6% of the male athletes who dropped out competed in weight-sensitive sports (19), as compared to 31.6% of those completing the study ($P < 0.001$). Finally, at pretest, there was no difference in the prevalence of symptoms associated with ED between male and female athletes in the intervention group compared to the control group (Table 2) or between the male and female athletes who participated in the study compared to those who dropped out for different reasons (males: 10.7% vs 16.1%, P = 0.20; females: 39.9% vs 42.2%, P = 0.78).

Cases of ED. Of the 231 athletes attending the clinical interview at pretest, 34 already had an ED. Among these, 26 completed the study (13 in the intervention and 13 in the control group). At the final clinical interview, which was conducted 1.8 ± 0.7 months after posttest 2 and 11.1 ± 0.8 months after the intervention ended, 16 of these 26 no longer fulfilled the criteria for an ED (12 in the intervention and 4 in the control group), while 9 athletes from the control schools 2 males and 7 females and 1 athlete from an intervention school (female) still met the criteria for an ED.

Among the athletes who were healthy at the pretest and completed the study (n = 439), 8 of 61 female athletes representing the control schools were diagnosed with an ED at posttest 2 compared to none of 87 female athletes from the intervention schools (P = 0.001, Fisher exact test). Among males, one athlete from a control school was diagnosed with an ED.

Thus, the total prevalence of female athletes with ED at posttest 2 (including those with an ED at baseline) was 20.8% (15 of 72) in the control schools compared to 1.0% (1 of 97) in the intervention schools ($P < 0.001$). There were no male athletes attending intervention schools with an ED, while 2.3% (3 of 133) from control schools met the ED criteria. In comparison, 15.3% (11 of 72) in the control schools compared to 10.3% (10 of 97) from the intervention schools among the female athletes had an ED at pretest (P = 0.333). Among the male athletes, 2 of 133 in the control schools were diagnosed with an ED at pretest versus 3 of 163 in the intervention schools (P = 1.00, Fisher exact test).

Symptoms associated with ED. For female athletes free of clinical ED at baseline, the risk of reporting any symptoms associated with ED was lower in the intervention schools than control schools at posttest 1 (Table 3). This effect was attenuated at posttest 2. Among male athletes, there was no difference in the risk of reporting symptoms associated with ED between the intervention and control schools at posttest 1 or posttest 2 (Table 4).

When athletes with preexisting ED were included in the analysis, the risk of reporting symptoms associated with ED was lower for female athletes in the intervention schools than in the control schools at posttest 1 (OR = 0.41, 95% CI = 0.24–0.71, $P < 0.001$) as well as posttest 2 (OR = 0.54, 95% CI = 0.29–0.99, P = 0.045), while there was still no significant difference for males at posttest 1 (OR = 0.81, 95% CI = 0.36–1.82, P = 0.60) or posttest 2 (OR = 0.91, 95% CI = 0.53–1.56, P = 0.72).

Change in ED Attitudes and Behaviors

Dieting. As seen in Table 3, a significant reduction in dieting behavior was observed for females representing the intervention schools. Among male athletes, we observed no significant change in dieting behavior (Table 4).

EDI, BD, and DT. Because of an interaction between intervention and baseline total EDI score and EDI DT subscale, separate analyses per treatment group were conducted (Table 3). We found a weaker association between the total EDI score and EDI DT among female athletes in the intervention schools from pretest to posttest 1 and from pretest to posttest 2 compared to control schools. On the

TABLE 3. Pretest values, delta (Δ)[a] values in absolute numbers (%) and in difference-in-Δ values for the various symptoms among female athletes representing intervention and control schools.

	Intervention (n = 87)			Control (n = 61)			Intervention vs Control			
							Pre − Post 1		Pre − Post 2	
Females	**Pretest**	**Δ Pre − Post 1**	**Δ Pre − Post 2**	**Pretest**	**Δ Pre − Post 1**	**Δ Pre − Post 2**	**OR (95% CI)[b]**	***P***	**OR (95% CI)[b]**	***P***
Symptoms, *n* (%)	33 (37.9)	−3 (−3.4)	−1 (−1.1)	26 (42.6)	6 (9.8)	5 (8.2)	0.45 (0.23 to 0.89)	0.021	0.57 (0.29 to 1.09)	0.090
BD[c] ≥ cutoff, *n* (%)	7 (8.0)	2 (2.3)	−3 (−3.4)	5 (8.2)	3 (4.9)	3 (4.9)	0.73 (0.28 to 1.94)	0.53	0.76 (0.27 to 2.14)	0.61
Present dieting, *n* (%)	12 (13.8)	8 (9.2)	6 (6.9)	11 (18.0)	16 (26.2)	13 (21.3)	0.4 (0.15 to 1.03)	0.056		
Present dieting (pretest)									0.10 (0.02 to 0.54)	0.007
Not present dieting (pretest)									0.60 (0.28 to 1.28)	0.18
Dieting[d]	6 (6.9)	8 (9.2)	7 (8.0)	5 (8.2)	14 (23.0)	15 (24.6)	0.39 (0.17 to 0.91)	0.029	0.35 (0.17 to 0.70)	0.003
Tried before ≥ 3 times, *n* (%)	9 (10.3)	8 (9.2)	−1 (−1.1)	11 (18.0)	11 (18.0)	15 (24.6)	0.53 (0.19 to 1.45)	0.22	0.47 (0.25 to 0.90)	0.022
PWCM,[e] *n* (%)	2 (2.3)	5 (5.7)	2 (−2.3)	6 (9.8)	−4 (−6.6)	−1 (−1.6)	4.2 (0.76 to 23.2)	0.099	[f]	
Amenorrhea, *n* (%)	10 (11.5)	−6 (−6.9)	−6 (−6.9)	4 (6.6)	−3 (−4.9)	−3 (−4.9)	2.6 (0.26 to 25.7)	0.42		
Amenorrhea (pretest)									0.76 (0.17 to 3.31)	0.71
Regular menstruation (pretest)									428 (116 to 1587)	<0.001
							Score (95% CI)[g]	***P***	**Score (95% CI)[g]**	***P***
Number of symptoms, mean (SD)	0.5 (0.8)	0.2 (1.2)	0.23 (1.3)	0.7 (1.1)	0.4 (1.3)	0.44 (1.3)	−0.33 (−0.70 to 0.04)	0.084	−0.28 (−0.70 to 0.14)	0.19
DT,[h] mean (SD)[i]	1.5 (2.9)	0.5 (3.6)	1.9 (3.1)	2.2 (3.7)	1.4 (3.6)	3.7 (5.3				
Intervention							0.42 (0.21 to 0.63)	<0.001	0.37 (0.048 to 0.69)	0.024
Control							1.1 (0.90 to 1.22)	<0.001	1.06 (0.79 to 1.32)	<0.001
BD, mean (SD)	4.9 (5.1)	0.4 (6.0)	5.6 (5.8)	6.3 (5.9)	0.8 (5.6)	7.0 (5.9)	−1.02 (−2.76 to 0.72)	0.25	−0.70 (−2.44 to 1.05)	0.44
Contingent self-esteem	3.3 (0.4)	0.04 (0.4)	0.04 (0.5)	3.2 (0.4)	0.08 (0.4)	0.11 (0.45)	0.014 (−0.12 to 0.14)	0.83	−0.01 (−0.12 to 0.10)	0.85
EDI,[j] mean (SD)[i]	20.9 (15.3)	0.3 (14.9)	−0.06 (14.6)	23.1 (12.4)	1.3 (11.0)	1.51 (11.6)				
Intervention							0.50 (0.22 to 0.77)	<0.001	0.49 (0.33 to 0.64)	<0.001
Control							0.82 (0.64 to 0.10)	<0.001	0.84 (0.56 to 1.11)	<0.001
EDI-2, mean (SD)	43.8 (27.0)	−1.43 (27.2)	−0.3 (28.3)	55.3 (27.2)	−4.55 (26.6)	−2.5 (25.2)	−4.21 (−10.1 to 1.65)	0.16	−3.19 (−12.3 to 5.88)	0.49

[a]Δ is the posttest 1 or 2 value minus the pretest value. Difference-in-Δ between intervention and control schools is the net effect of the intervention. Pretest, posttest, and Δ (given as means [SD] or n [%], as appropriate) for the intervention and control schools are crude values (not adjusted).
[b]Multiple logistic regression analysis taken the cluster randomization for school into account by robust estimation of SE.
[c]Body dissatisfaction.
[d]Dieting (athletes who report both present dieting and repeated attempts at weight loss (≥3).
[e]Total pathogenic weight control methods (diuretics, laxatives, vomiting, and diet pills).
[f]Because of small numbers, no analysis was done.
[g]Multiple linear regression analysis taken the cluster randomization for school into account by robust estimation of SE.
[h]Drive for thinness.
[i]Test of interaction (between intervention and baseline level) was significant, so separate analyses were made per group for categorical (e.g., present dieting and not present dieting at pretest) and per treatment group for continuous data (e.g., DT mean and BD mean).
[j]The Eating Disorder Inventory.

TABLE 4. Pretest values, delta (Δ)[a] values in absolute and in percent and in difference-in-Δ values for the various symptoms among male athletes representing intervention and control schools.

	Intervention (n = 160)			Control (n = 131)			Intervention vs Control			
							Pre − Post 1		Pre − Post 2	
Males	**Pretest**	**Δ Pre − Post 1**	**Δ Pre − Post 2**	**Pretest**	**Δ Pre − Post 1**	**Δ Pre − Post 2**	**OR (95% CI)[b]**	***P***	**OR (95% CI)[b]**	***P***
Symptoms, n (%)	21 (13.1)	3 (1.9)	−1 (−0.6)	10 (7.6)	5 (3.8)	3 (2.3)	0.80 (0.34 to 1.86)	0.60	0.79 (0.41 to 1.53)	0.49
DT[c] ≥ cutoff, n (%)	1 (0.6)	—	−1 (—)	1 (0.8)	—	—	[d]		[d]	
BD[e] ≥ cutoff, n (%)	7 (4.4)	−4 (−2.5)	−3 (−1.9)	2 (1.5)	—	−1 (−0.8)	[d]		[d]	
Present dieting, n (%)	6 (3.8)	8 (5.0)	6 (3.8)	5 (3.8)	4 (3.1)	5 (3.1)	1.3 (0.70 to 2.26)	0.44	[d]	
Tried before ≥ 3 times, n (%)	10 (6.3)	−5 (−3.1)	−1 (−0.6)	2 (1.5)	3 (2.3)	3 (2.3)	0.80 (0.37 to 1.71)	0.56	0.72 (0.28 to 1.82)	0.49
Dieting[f]	4 (2.5)	—	1 (0.6)	1 (0.8)	1 (0.8)	2 (1.5)	[d]		[d]	
PWCM,[g] n (%)	2 (1.3)	−1 (0.6)	−2 (—)	1 (0.8)	—	−1 (−)	[d]		[d]	
							Score (95% CI)[h]	***P***	**Score (95% CI)[h]**	***P***
Number of symptoms, mean (SD)[i]	0.2 (0.5)	−0.02 (0.57)	0.00 (0.55)	0.1 (0.4)	0.05 (0.46)	0.03 (0.55)	−0.003 (−0.06 to 0.06)	0.92		
Intervention									0.47 (0.30 to 0.64)	<0.001
Control									0.08 (−0.16 to 0.32)	0.49
DT, mean (SD)[i]	0.8 (1.9)	−0.14 (2.1)	−0.29 (1.8)	0.5 (1.5)	0.15 (1.4)	−0.07 (2.1)	−0.09 (−0.44 to 0.260)	0.62		
Intervention									0.28 (0.08 to 0.48)	0.006
Control									0.04 (−0.02 to 0.11)	0.17
BD, mean (SD)[i]	2.3 (3.2)	−0.5 (3.5)	−0.57 (3.6)	2.1 (2.9)	−0.19 (2.7)	−0.64 (3.1)			0.29 (−0.30 to 0.88)	0.34
Intervention							0.26 (0.13 to 0.40)	<0.001		
Control							0.48 (0.31 to 0.65)	<0.001		
Contingent self-esteem	3.2 (0.5)	−0.22 (0.48)	−0.09 (0.49)	3.1 (0.4)	0.07 (0.46)	0.06 (0.50)	−0.05 (−0.14 to 0.03)	0.22	−0.09 (−0.16 to 0.02)	0.010
EDI,[j] mean (SD)[i]	18.1 (9.8)	−2.07 (10.8)	−2.66 (11.0)	17.1 (8.2)	−0.41 (8.2)	−1.78 (10.5)	−1.22 (−2.91 to 0.47)	0.16		
Intervention									0.32 (0.25 to 0.38)	<0.001
Control									0.75 (0.46 to 1.04)	<0.001
EDI-2, mean (SD)	41.4 (23.3)	−6.49 (24.9)	−6.62 (27.07)	39.7 (22.2)	−2.75 (24.2)	−6.92 (24.4)	−2.35 (−8.87 to 4.17)	0.48	0.10 (−0.96 to 2.95)	0.32

[a]Δ is the posttest 1 or 2 value minus the pretest value. Difference-in-Δ between intervention and control schools is the net effect of the intervention. Pretest, posttest, and Δ (given as means [SD] or n [%], as appropriate) for the intervention and control schools are crude values (not adjusted).
[b]Multiple logistic regression analysis taken the cluster randomization for school into account by robust estimation of SE.
[c]Drive for thinness.
[d]Because of small numbers, no analysis was done.
[e]Body dissatisfaction.
[f]Dieting (athletes who report both present dieting and repeated attempts at weight loss ≥3).
[g]Total pathogenic weight control methods (diuretics, laxatives, vomiting, and diet pills).
[h]Multiple linear regression analysis taken the cluster randomization for school into account by robust estimation of SE.
[i]Test of interaction (between intervention and baseline level) was significant, so separate analyses were made per treatment group.
[j]The Eating Disorder Inventory.

EDI BD scale, no interaction was found and there was no difference in scores between the female athletes in the intervention schools and control schools. However, among male athletes, we found a weaker association on the EDI body dissatisfaction in the intervention schools from pretest to posttest 1 compared to control schools, after separate regressions per treatment group was performed. A weaker association on the total EDI scores from pretest to posttest 2 among the male athletes in the intervention schools compared to that in the control schools was also found (Table 4).

Contingent self-esteem. Among the female athletes from intervention schools, we found no difference on the contingent self-esteem scale from pretest to posttest 1 and from pretest to posttest 2 compared to control schools. However, at posttest 2, there was a lower score compared to pretest, indicating a lower degree of contingent self-esteem at both intervention and control schools (Table 3). Between the male athletes, this lower degree was found at posttest 1 and 2, and at posttest 2, the degree of contingent self-esteem was lower at the intervention schools compared to the control schools.

Compliance. As many as 222 (89.9%) of 247 athletes from the intervention schools attended at least three of four lectures during the intervention (55.5% attended all 4). Furthermore, 94.3% of the athletes joined the Facebook page. All the athletes reported to have done the practical assignment, while 80.2% completed the theoretical assignments. Since the assignments during the last part of the intervention (mental training, self-esteem, and self-confidence) were practical, we were not able to assess how many who actually completed them. However, 24.7% reported the mental training assignments to be useful, 15.8% a little useful, 24.7% neutral, and 21.1% not useful (13.7% did not respond). Finally, 28.3% of the athletes reported having used the "I am good" diary during the intervention and 17.3% reported having used it the year after the intervention.

Among the 53 coaches working with the athletes throughout high school, 92.5% (49 of 53) completed the pretest and posttest. Furthermore, 69.4% of them attended the seminar and completed the test in addition to the coaches' guide. Reasons reported for not attending were training camps, competition, teaching/working outside the school that day, and illness.

DISCUSSION

This randomized controlled trial shows that it is possible to prevent new cases of ED among adolescent female elite athletes through a school-based 1-yr intervention program. The intervention also showed positive effects on the risk of reporting symptoms associated with ED.

Preventing ED

Our intervention was sport-specific in the sense that the intervention program was developed for elite athletes. Focus on health-promoting factors and multiple risk and potentiating factors and on increasing possible protective factors has been highlighted as essential when preventing ED (5). In addition, Piran (25) reported benefits by implementing a multicomponent intervention program involving systematic changes as well as direct interventions with students attending a residential ballet school. In addition, the inclusion of the coaches may therefore have been important for our positive findings at the intervention schools compared to the control schools.

Among the elite athletes in the control schools, the proportion of new cases of ED and the female-to-male ratio of ED at posttest is higher than expected in the general population. In comparison, an international review (2006) concluded with a prevalence of AN of 0.1% and BN of 1.3% for young females (14), and for all ED, the point and lifetime prevalence in young women is 2.6% and 7.8%, respectively (13). Likewise, the female-to-male ratio for ED in general is usually reported to be approximately 10:1 (15).

In our study, the total prevalence of female elite athletes fulfilling the *DSM-IV* criteria for an ED diagnosis was 15.3% at pretest and 20.8% at posttest 2. This is in accordance with the prevalence reported among adult elite athletes (35). In contrast, the total prevalence of ED among the female elite athletes in the intervention decreased by 90% from the pretest to posttest 2 (10% vs 1%). Thus, in addition to the positive intervention effect, our study indicates that there is possibly a trend with increasing prevalence of ED from the first year through the third year of high school for elite athletes when no intervention is offered. An increase in the prevalence of ED during puberty is expected (26).

Among the adolescent female elite athletes in the intervention group, we found that the lower risk of reporting symptoms associated with ED at posttest 1 was attenuated at the 1-yr follow-up. In addition, the pilot study of Becker et al. (4) among female athletes (NCAA Division III) reported a decrease in all the depended variables at 6 wk, but only the negative affect, bulimic pathology, and shape concern remained at the 1-yr follow-up. It has been suggested that a fade over time may be unavoidable given the ubiquitous sociocultural pressure for thinness in our culture (30). Consequently, an important limitation in ED prevention research is that few studies have a long-term follow-up (average follow-up is 4 months) (31).

In our study, it seems reasonable to suggest that the lack of significant difference in the reported risk of symptoms at posttest 2 regarding the female athletes is more due to a power problem than a lack of long-lasting effect. By including the athletes with an ED at pretest in the analysis, we found that the risk was significantly reduced at posttest 1 as well as at posttest 2 among the female elite athletes at the intervention schools compared to those at the control schools. Interestingly, although the effect on the risk for reporting any symptoms associated with ED was greatest at posttest 1, the effects were stronger at posttest 2 for some of the symptoms (e.g., present dieting). This is in accordance with the study of Stice et al. (28) involving nonathletes, where the prophylactic effects were stronger at the later

follow-ups. In agreement with their finding, our study supports the importance of conducting long-term follow-up in prevention studies to fully describe the effects (28).

As expected, the positive changes when it came to reported symptoms associated with ED were somewhat different between the male and female elite athletes at the intervention schools. Among the male athletes, there was no difference in the risk of reporting symptoms associated with ED between the intervention and control schools at posttest 1 or posttest 2. Furthermore, the male athletes in general had much lower scores on symptoms such as BD, DT, and dieting compared to the female athletes. This might be explained by the fact that the EDI subscale for BD is either sport- or gender-specific (meaning assesses dissatisfaction with areas well-trained athletes and especially male athletes most likely are generally not dissatisfied with, e.g., hips, stomach). Moreover, for the adolescent elite male athletes in particular, high BD score does not necessarily mean a desire to lose weight but rather to gain muscle mass and body weight (19). In general, it is suggested that BD is a risk factor for dieting, negative affect, and eating pathology and a maintenance factor for bulimic pathology (27). We therefore find the weaker association on the BD subscale from pretest to posttest 1 and the lower degree of contingent self-esteem from pretest to posttest 2 among the male athletes attending the intervention schools compared to the control schools of special interest.

Strengths and Limitations of the Study

Strengths of the trial include cluster randomization of schools to avoid contamination between the intervention and the control group, using a theory-based intervention, the long follow-up period, and the two-tiered follow-up (questionnaire and clinical interview).

The trial has also some limitations. First, the sample size estimation was not based on a conventional calculation for cluster-randomized controlled trial because valid data for rates of ED in adolescent male and female elite athletes were not available. On the other hand, we included the total population of male and female first-year students (n = 611) attending all Elite Sport High Schools in Norway. Still, we acknowledge that a larger sample would have added further strength to our study. A *post hoc* calculation with a power of 0.80 at the 5% significance level showed that 322 females would have been necessary in each group to be able to detect a 50% reduction of ED in the intervention group compared to the control (6.5% vs 13%). For an 80% reduction (2.6% vs 13%), we would have needed 101 females in each group. Thus, the study was underpowered to demonstrate even gross intervention effects on ED in females.

There might be a risk of increasing the prevalence of symptoms associated with ED by focusing on topics such as sport nutrition, growth, and development. However, we believe our finding of reduced risk of reporting symptoms associated with ED among the female elite athletes from the intervention schools at the 1-yr follow-up, as well as the fact that none of the athletes in the intervention group developed an ED during the study, indicates that the intervention did not lead to any increased risk.

Implications and Applicability

This school-based intervention package indicates that the development of ED can be prevented among adolescent female elite athletes. Therefore, the intervention program should be implemented in high schools focusing on competitive sports. For athletes in another age ranges or nonathletes attending regular high schools, some of the topics will need adjustments.

Although dieting is probably not sufficient for the development of an ED (39), frequent weight fluctuations have been suggested as an important trigger factor for the development of ED in athletes (33). The significant reduction in dieting behavior observed for the female elite athletes attending the intervention schools with the most pronounced changes at the 1-yr follow-up is therefore especially encouraging, particularly, since in most societies, the group most concerned with dieting and weight loss is young females (9), and an early start of dieting is likely to set the stage for ongoing use (21). Furthermore, in one of our previous studies, most of the adult elite athletes who met the criteria for an ED reported having started dieting and developing an ED during puberty or adolescence (33).

Finally, the results from our study indicate that the adolescent elite athletes attending the intervention have found the themes included in the program relevant. It is interesting to note that as many as 12 of 13 athletes from the intervention group and only 4 of 13 control athletes with an ED at pretest have recovered at posttest 2. This indicates that the intervention most likely also had an effect on athletes fulfilling the criteria for an ED.

CONCLUSION

This study is the first to report that the development of ED can be prevented among adolescent female elite athletes through a 1-yr intervention program.

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