Oslo Sports Trauma
RESEARCH CENTER

Marianne Martinsen

Preventing eating disorders among young male and female elite athletes

DISSERTATION FROM THE NORWEGIAN SCHOOL OF SPORT SCIENCES • 2015

ISBN 978-82-502-0508-6

"Talent wins games, but teamwork and intelligence wins championships"

Michael Jordan

Summary

Background: Many athletes struggle with disordered eating or eating disorders (ED) as they attempt to conform to demands or competition regulations that might be ill-suited to their physique. In this situation, participation in sports may lead to an array of health concerns that may adversely affect the athlete's short and long-term health at a variety of performance levels and sports. The peak onset of ED is adolescence, when most athletic participation and competition takes place and athletes begin to focus on a particularly sport. For athletes, the biological changes occurring during adolescence might affect not only attitudes toward weight and shape, but also performance. To prevent the medical and psychological consequences related to ED, early intervention and identification is important.

Aims: The overall aim of this thesis was to examine the effect of a one-year school-based intervention program to prevent the development of new cases of ED and symptoms associated with ED among adolescent male and female elite athletes (Paper II). An educational program was developed for coaches and included as a separate part of the intervention program. In Paper III, we examine the effect of the education program on the coaches' knowledge about nutrition, weight regulation, and ED. In Paper I, we investigate the prevalence of ED among adolescent elite athletes compared to non-athletic controls. Finally, we wanted to design and validate a brief screening questionnaire with the ability to discriminate between athletes with and without an ED (Paper IV).

Methods: First-year students (athletes) and their coaches at all the Norwegian Elite Sport High Schools (n=16) and first-year students (controls) at two randomly selected regular high schools participated in the three school year project period (2008 to 2011). In phase I (pretest) of the study all the schools were included and the students were screened for symptoms associated with ED and ED. In phase II, the Elite Sport High Schools were stratified (by size) and randomized to the intervention (n=9) or control group (n=7). The intervention group received the intervention program. Data from the athletes and their coaches at phase I and II, and data from the controls at phase I are included in this thesis.

Paper I: In this cross-sectional study we used a two-tiered approach: self-reported questionnaire (part I) and clinical interview (part II). The questionnaire, including the Eating Disorder Inventory 2 (EDI-2) and questions related to ED, was completed by 611 athletes (90%) and 355 controls (84%). Subjects reporting symptoms associated with ED were classified as "at risk" for ED. In part II, all at-risk athletes (n=153), a random sample not at risk for ED (n=153), and a

random sample of 50% of the controls classified as at risk (n=91) and not at risk (n=88) were invited to the clinical interview (Eating Disorder Examination) to screen for ED. Paper II: The 611 athletes participating in Paper I formed the basis of this randomized controlled trial (RCT). After the pretest (Paper I) all athletes (and coaches, Paper III) from each school were randomized to the same treatment arm (intervention or control). A final sample of 465 (93.8%) athletes was followed during high school. The athletes completed the questionnaire screening at pretest (Paper I), pottest 1 (after the intervention) and posttest 2 (9-months after intervention). Clinical interviews were conducted after pretest and at posttest 2 (one-year after intervention).

Paper III: In this part of the RCT 76 coaches (93.8%) employed at and working with the first-year students at the Elite Sport High Schools were followed during the project period. At pretest and posttest (9-months after intervention) the coaches completed a questionnaire including questions concerning nutrition, weight-regulation, and ED.

Paper IV: We conducted this prospective cross-sectional study in three phases. Phase I consist of data from the screening at pretest among the female athletes (Paper I). Based on the questionnaire screening we extracted items with good predictive abilities for an ED-diagnosis to the Brief ED in Athletes Questionnaire (BEDA-Q) version 1 and version 2. Version 1 consisted of 7-items from the EDI-Body dissatisfaction, EDI-Drive for thinness, and questions regarding dieting. In version 2, two items from the EDI-Perfectionism subscale were added. In phase II, the external predictive validity of version 1 was tested involving 54 age-matched elite athletes from an external dataset. In phase III, the predictive ability of posttest assessments was determined among athletes with no ED at pretest (n=53, 100%).

Main results: 1) No new cases of ED in athletes at the intervention schools one-year after the intervention program, while 13% of the females and one male at the control schools developed ED. 2) Coaches at the intervention schools had higher scores on total knowledge, weight-regulation and ED compared to coaches at the control schools after intervention. The intervention also showed positive effects on the coaches' subjective evaluation of their ED knowledge. 3) Higher prevalence of ED in adolescent elite athletes than controls (although more controls than athletes reported symptoms associated with ED. 4) BEDA-Q version 2 showed higher discriminative accuracy than version 1 in distinguishing athletes with and without an ED, and higher diagnostic accuracy in predicting new cases of ED than version 1.

Conclusions: A one-year school-based intervention program can prevent new cases of ED and symptoms associated with ED in adolescent female elite athletes. The intervention part targeting the coaches with strategies of identification, management and prevention of ED produced

significant effect of at least 9-months. It is confirmed that the prevalence of ED is higher among adolescent elite athletes than controls and higher in female than male adolescent elite athletes. Finally, BEDA-Q containing 9-items reveal promising psychometric and predictive features to distinguish between adolescent female elite athletes with and without ED.

Key words: athletes, coaches, eating disorders, prevalence, prevention, screening, instrument, intervention

Acknowledgements

I would like to express my innermost gratitude and appreciation to all of you who have helped and supported me along the way making this thesis possible.

I would especially like to thank:

The participating coaches, athletes and students, school administrators and contact-persons for supporting and facilitating our research. It has been a true pleasure to travel all over the country and visit you. I am especially grateful to all the athletes for "letting me in". Thank you for sharing your experiences and inner thoughts. To my contact-persons, thank you for always being helpful and taking good care of me on my many visits.

Professor Jorunn Sundgot-Borgen, my main supervisor. There is no doubt that this project would never have seen daylight if it was not for you. I am sincerely grateful for the opportunity you gave me to work with this marvelous research project from its very first beginning. We started out planning a master project and ended out with a PhD project. Thank you for believing in me from the very first day. Through all these years, first as your master student and then as your PhD student, I have been given a lot of responsibility and learned a lot as a scientist and person. When it comes to eating disorders and athletes am I convinced that I have been under the wings of the person with the best knowledge. You have inspired me with all your visions. Your enthusiasm, optimism, ability to keep updated and endurance are admirable. I particularly like your great sense of humor. We have survived "askeskyer", several weeks with almost no sleep, many miles on the road, and interviews 24/7. I have especially enjoyed our many talks whether it has been on science or life. You are a warm and caring person with high ambitions for your candidates. Hope you are proud of what we have achieved. You have my deepest gratitude, and you will always have a special place in my hearth.

Professor Anne Marte Pensgaard, my co-supervisor. Although I have not used your skills in sport psychology as much as initially planned, you have always been positive and helpful whenever I was in need for your help. I would like to express my innermost gratitude for your enthusiasm, faith in me, word of wisdom and for always being able to reach. I am grateful for your input at different stages throughout this project. Your experiences and high-level-knowledge in mental training was of particular importance and for me reassuring when developing the mental training part of the intervention program. Thank you for all your kindness. I am proud of having you as my supervisor.

Professor Roald Bahr, co-founder of the Oslo Sports Trauma Research Center. You are outstanding. I am truly grateful for being part of the OSTRC and given the opportunity to work under your direction. I admire not only your skills as a researcher, but also your personal skills which are reflected in the way you lead the center together with Professor Lars Engebretsen. Thank you for all support and inspiration throughout these years. I greatly appreciate your precise responses to my manuscripts and different questions during these years. I am proud of having you as one of my co-authors of Paper II. You have a great honor in this thesis, and have my deepest respect.

Ingar Holme, statistical professor and co-author of Paper II and IV. We are lucky to have such an experienced and skilled statistician available. Thank you for always being helpful with statistical advice, and especially for your help and contribution on Paper II where we dived into the world of STATA.

Runi Børresen, co-author of Paper II and member of the research team. I still remember the first time I met you as a master student. I was so impressed with all your knowledge and your enthusiasm. I think I could have listened for hours. Thanks for sharing your passion for preventing eating disorders, and for valuable and constructive comments and input on Paper II. Your contribution to the development of the intervention and part of the data collection has been invaluable. I wish we had seen each other more these years so I could have absorbed even more of your knowledge and way of thinking.

Monica Klungland-Torstveit, PhD and co-author of Paper IV. Thank you for your collaboration and excellent input on our paper. Even though we haven't had that much contact during these years, I will like to express my appreciation to you for good advices and always being helpful whenever I was in need for it along the way.

I would also like to show my gratitude towards two persons overseas - Roberta Sherman, PhD and Ron Thompson, PhD and co-authors of Paper III. Thank you for your willingness to share your knowledge, your kindness and for excellent input on our paper. Your insight into all issues related to eating disorders in sport is unquestionable. I have read your papers and books with great passion and feel privileged of having you as my co-authors.

Anders Meland, thank you for joining Jorunn and me on the coaches' seminars. I appreciate your warm and easygoing personality. Thank you for interesting discussions and joyful rides all over the country.

A special hug goes to Audun Eriksson, Guro Røen, and Kristin Lundestad for your contribution towards this project.

Laila Sundgot Schneider, I do not think this would have been possible without your help with part of the interviews. Thank you! I will also thank you for allowing me to attend and follow some of your patients with an eating disorder during your consultations. I only wish we would have had more time so I could have attended many more and learned even more from such a fantastic therapist. I understand why all the athletes want to get help from you.

To Rebekka Bahr, Ingeborg Barth Vedøy, Birgitte Blitzner, Ida Boldermo, Kjersti Karoline Danielsen, Julie Dønnestad, Monique Johansen, Hege Mohagen, Emi Murakami, Lasse Nettum, Merethe Nilsson, Ola Nyeggen, Mari Ourum, Solfrid Sanda-Bratland, Karoline Steinbekken, Johanne Støren Stokke, Christine Sundgot-Borgen, Harald Sundgot-Borgen, Kristin Telneset, Erlend Vaade, Nicoline Viker, Ida Vingelsgaard, Arnlaug Wangensteen and Guro Øglund Pauck for help in different ways with the project. Your contribution was highly appreciated and I am much obligated to you all.

I am also grateful to our fantastic present and former elite athletes for their contribution during our intervention. Else-Marthe Sørlie Lybeck, Anne Margrethe Hausken, Hege Riise, Martin Thiblin, Cecilie Skofterud, Cecilia Brækhus, Mathias Trygg, Alexander Tettey, Lise Birgitte Fredriksen, Vebjørn Berg, Øystein Pettersen and Mette Solli thank you for being such great role models.

Else-Marthe Sørlie Lybeck, leader for Sunn jenteidrett. I used to admire and cheer for you as a handball player at the Norwegian handball team. Now I am impressed over the work you and your team are doing for Sunn jenteidrett. I have appreciated our talks and "update meetings" around Sognsvann. Hope for many more good talks in the future. Keep up the good work!

Through these years at the Norwegian School of Sport Sciences and particularly at the Department of Sports Medicine I have met amazing people and made good friends. Thank you for all support, inspiration, interesting discussions, laughter and good advices. Professor Sigmund Alfred Anderssen, head of our department. A special thought goes to you. Thank you for always smiling, good talks and advices. You take really good care of us PhD students. Your positivity is contagious. Tone and Solveig thanks for always being helpful and for showing such great interest in how we PhD students are doing. To all PhD students at SIM 3, thank you for such an inspiring environment, and for bringing laughter and joy into the days at work. Long days at the office are so much more fun with you nearby.

To my wonderful colleagues and friends Elin Kolle, Elisabeth Edvardsen and Tone Bere, I am so glad I met you. Thank you for all support, help, good talks, training sessions, fun and laughter. Elin and Elisabeth, Baltimore, Denver, San Francisco, Indianapolis and Orlando would not have

been the same without you. I will also like to give a warm hug to May Grydeland, Lene Annette Hagen Haakstad, Johanne Støren Stokke and Kathrin Steffen.

To my special friend Knut, I am so grateful for meeting you and having you in my life. You are one of a kind.

Lisbeth Stockseth, thank you for your support and understanding. Through these last years you have not only been a fantastic leader for me at SATS Lillestrøm, but also a great friend. Olav Strømhylden and Brit Bækkevold, thank you for giving me the opportunity to continue my studies. I will also thank all former colleagues for support and showing such interest in my studies and PhD-stuff.

To my dear friends from way back, I do not know how many times I have had to cancel our plans or say no to your invitations these last years. Thank you for being patient and supportive.

Finally, to my beloved family, my warmest thank you goes to you. The ones I love most. Your help and support during these years have been crucial. To my big brother Tom-Arild and little sister Hilde-Marie, thank you for fruitful discussions and advices during this process. I also appreciated that you "forced" me to come out of my bobble now and then. Sander, thank you for showing me what life is really about. Your aunt is back – get ready to be spoiled.

Mum and dad, for always being there for me and for encouraging me and my siblings thirst for knowledge and education. Your help and cheering all my life have made it possible for me to follow any of my dreams. I love you all!

Oslo, July, 2014
Marianne Martinsen

The research reported in this thesis was supported by the Oslo Sports Trauma Research Center and through a grant from the Norwegian Olympic Sports Center (Olympiatoppen) and Sunn jenteidrett. The Oslo Sports Trauma Research Center has been established through generous grants from the Eastern Norway Regional Health Authority, the International Olympic Committee, The Royal Norwegian Ministry of Culture, Norsk Tipping AS and the Norwegian Olympic Committee & Confederation of Sport.

List of papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals:

I. Martinsen M, Sundgot-Borgen J. Higher prevalence of eating disorders among adolescent elite athletes than controls. Medicine & Science in Sports & Exercise 2013: 45(6):1188-1197.

II. Martinsen M, Bahr R, Børresen R, Holme I, Pensgaard AM, Sundgot-Borgen J. Preventing eating disorders among young elite athletes: A randomized controlled trial. Medicine & Science in Sports & Exercise 2014: 46(3):435-447.

III. Martinsen M, Sherman RT, Thompson RA, Sundgot-Borgen J. Coaches' knowledge and management of eating disorders: A randomized controlled trial. On request, revised and resubmitted with minor changes to Medicine & Science in Sports & Exercise.

IV. Martinsen M, Holme I, Pensgaard AM, Torstveit KM, Sundgot-Borgen J. The development of the brief eating disorder in athletes questionnaire. Medicine & Science in Sports & Exercise 2014: 46(8):1666-1675.

Abbreviations

AA:	Anorexia athletica
ACSM:	American College of Sports Medicine
AN:	Anorexia nervosa
APA:	American Psychiatric Association
ATHENA:	Athletes Targeting Healthy Exercise and Nutrition Alternatives
BED:	Binge eating disorder
BEDA-Q:	Brief Eating Disorder in Athletes Questionnaire
BD:	Body dissatisfaction
BN:	Bulimia nervosa
BMI:	Body mass index
CI:	Confidence interval
DE:	Disordered eating
DSED:	Diagnostic Survey for Eating Disorders
DSM:	Diagnostic and Statistical Manual of Mental Disorders
DT:	Drive for thinness
EAT:	Eating Attitudes Test
ED:	Eating disorder(s)
EDE:	Eating Disorder Examination
EDE-Q:	Eating Disorder Examination Questionnaire
EDI:	Eating Disorder Inventory
EDI-B:	Eating Disorder Inventory-Bulimia
EDI-BD:	Eating Disorder Inventory-Body dissatisfaction
EDI-DT:	Eating Disorder Inventory-Drive for thinness
EDI-P:	Eating Disorder Inventory-Perfectionism
EDNOS:	Eating disorders not otherwise specified

IOC:	International Olympic Committee
NCAA:	National Collegiate Athletic Association
OR:	Odds ratio
PE:	Physical education
PL:	Project leader
PWCM:	Pathogenic weight control methods
Q-EDD:	Questionnaire for Eating Disorder Diagnoses
RCT:	Randomized controlled trial
ROC:	Receiver operating characteristics

Table of contents

Introduction

Although there is no doubt that a physically active lifestyle is important (Pate et al., 1995; Fletcher et al., 1996; Surgeon General's report on physical activity and health, 1996), being an athlete also carries substantial risk for injuries and health risks, such as low energy availability, disordered eating (DE) behaviors, and eating disorders (ED) with sometimes fatal consequences (Drinkwater et al., 2005; Nattiv et al., 2007). In various sports, body weight and body composition are crucial performance variables, and many athletes use extreme methods to reduce mass rapidly or maintain a low body mass in order to gain a competitive advantage (Ackland et al., 2012). Research indicates that the prevalence of ED is higher among adult elite athletes than non-athletes, particularly among those competing in weight-sensitive sports (Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008). It is also well-documented that the prevalence of ED is higher among female elite athletes than male athletes (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004). For female athletes, this is a particular concern because deliberately induced underweight or short-term mass reduction may increase 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 (Drinkwater et al., 2005).

ED has a peak of onset in adolescence, which also is when most athletic participation and competition takes place and athletes begin to focus on a particular sport (Byrne & McLean, 2001). Additionally, it has been reported that young athletes are at substantial risk for ED (Smolak et al., 2000; Sigman, 2003), and in a previous study by Sundgot-Borgen (1994) most of the adult elite athletes diagnosed with ED reported having started dieting and developing ED during puberty or adolescence.

Concerning the medical and psychological consequences related to ED and the increased difficulty in treating them the longer they progress, early intervention and identification is important (Nattiv et al., 2007; Thompson & Sherman, 2010a). Consequently, the importance of early detection of ED behavior has been stressed by the National Collegiate Athletic Association (NCAA) (Johnson et al., 1999), the American Psychiatric Association (APA) (American Psychiatric Association., 2000), the Society for Adolescent Medicine (Golden et al., 2003), the International Olympic Committee (IOC) (Drinkwater et al., 2005), the American College of Sports Medicine (ACSM) (Nattiv et al., 2007) and the National Athletic Trainers Association (Bonci et al., 2008). In addition, The IOC has established a task force to study ED among female athletes, and it has been recommended that national and international sports governing bodies

establish policies to prevent DE and ED (Thompson & Sherman, 2010a; Loucks et al., 2011). In fact, the IOC and international sports governing bodies acknowledge a mandated duty of care to protect the physical and psychological health and safety of all athletes, including adolescent elite athletes (Federation Internationale de Gymnastique, 2001; International Olympic Committee, 2009). One example of a prevention tool for athletes, parents, coaches and support staff developed by the IOC is the Healthy Body Image videos series, "Hungry for Gold". The videos introduce the topic of the female athlete triad through four varying athlete scenarios that may serve as a catalyst for more in-depth discussion and education (The International Olympic Comittee, 2014). Besides, the 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 (Thompson & Sherman, 2010a), whereas UK Sport has produced a guideline entitled "Eating disorders in sport – a guideline framework for practitioners working with high performance athletes" (UK Sport., 2013). Apart from this, efforts aimed at prevent the development of ED in sports remain limited (Thompson & Sherman, 2010a), and there are no large randomized controlled trials (RCT) on the prevention of ED among male and female elite athletes available prior to this project. Moreover, there are no previous studies that have examined the prevalence of ED among adolescent male and female elite athletes. Therefore, the overall aim of this thesis was to examine the effect of a one-year school-based intervention program to prevent the development of new cases of ED and symptoms associated with ED among adolescent male and female elite athletes (Paper II). Specific aims were to examine the prevalence of clinical ED in adolescent male and female elite athletes and age-matched controls at pretest by using a two-tiered approach, including a questionnaire screening followed by clinical interviews (Paper I). We also wanted to examine the effect of the separate education program included in the intervention program targeting the coaches at the Elite Sport High Schools on their knowledge of nutrition, weight regulation, and ED (including recognition and management) (Paper III). Finally, in Paper IV the aim was to design an accurate, yet less comprehensive screening questionnaire with the ability to discriminate between adolescent female elite athletes with ED from those without an ED.

Youth sport

Physical activity and organized sports

Personal growth, new skills and a feeling of belonging in a social setting are some of the suggested benefits from being a member of an organized youth sport (Larson, 2000; Hansen et

al., 2003). Participation in sports may also contribute to the development of lifelong physical activity. Hence, for a child or adolescent in Norway joining a sport club means taking part in regular physical activity and exercise in a social setting shared by most children.

Adolescent elite athletes

Adolescent elite athletes represent a group that most closely embodies an "ideal" of physical perfection. However, adolescence is a period of rapid physical, emotional and social changes, and is known as a time of both great risk and opportunity. For instance, the many rapid changes during puberty can be stressful for young individuals, who are at risk of experience a decline in positive self-perception and mental health (Baldwin & Hoffmann, 2002; Robins & Trzesniewski, 2005). Thus, adolescents may be especially vulnerable to reduced mental health or compromised well-being, including the development of depression (Graber & Sontag, 2009), feelings of loneliness (Hawkley & Cacioppo, 2010), body dissatisfaction (BD) (Cash & Pruzinsky, 2002), low self-esteem (Trzesniewski et al., 2003) and ED (Byrne & McLean, 2001). Typically, it is also during adolescence athletes involvement in sport start to get more serious and they begin to focus on a particular sport (Byrne & McLean, 2002). In accordance to the Developmental Model of Sport Participation there are three distinct stages young people may progress through during their sporting lives: sampling, specialising and investment (Cote, 1999; Cote & Hay, 2002; Cote et al., 2007). During the sampling stage (approximately 8-12 years) children try out a range of sport, through support by their parents. The sporting involvement focuses on fun, play-based activities with usually limited competition. At early- to mid-adolescence the athletes enter the specialising stage as they progress. During this stage the focus increases upon developing technical and tactical skills and the athletes are often heavily involved in competition. In this stage the adolescent athletes usually commit to one or two sports. Finally, during mid- to late-adolescence the athletes enter the investment stage. It is at this stage the adolescent athletes usually fully commit to one sport with the desire of becoming elite athletes. As the athletes attempt to become the best they can be in their chosen sport during this stage, it is characterised by intensive training and competition (Cote et al., 2007). Obviously, some children and adolescents may "fast track" through the sampling stage and enter the specialising and investment stages earlier than the traditional rout (termed early specialisation). Such a pathway provides the athletes to specialise in one sport at an earlier age in the hopes of becoming an elite athlete (Cote, 2009). Though, this appears to have become more common in recent years, an early specialisation pathway has been associated with high rates of injuries, a lack of enjoyment and dropout (Cote et al., 2007; Law et al., 2007).

The performance of adolescent athletes is to a large extent determined by their physical maturity. In contrast to age, growth and maturation are not linear factors (Malina et al., 2004), and the onset and rate of growth and maturation varies widely between individuals during adolescence. Consequently, the maturational status of adolescent in the same age also differs. Additionally, the preponderance of early and on-time maturers in adolescent elite sports such as swimming, football and tennis, in which greater strength, power and speed give a competitive advantage, is well-known (Baxterjones et al., 1995; Malina et al., 2000; Malina et al., 2004; Le Gall et al., 2007). Likewise, short stature and leanness favor relative immaturity, which probably accounts for the preponderance of late maturers in for instance gymnastics and diving (Baxterjones et al., 1995; Georgopoulos et al., 1999). Accordingly, not all athletes have a body that fits, or have a subjective feeling that their body fits, into the sport-specific "ideal" – and those athletes often experience pressure to achieve this "idealistic" body type (Sundgot-Borgen, 1994; Drinkwater et al., 2005). Thus, beginning training for a targeted sport before the body matures might hinder these athletes from choosing a suitable sport for their adult body type. This might provoke a conflict in which the athlete struggles to prevent or counter the natural physical changes precipitated by growth and maturity. In fact, it has been suggested that the demands of a sport to meet a particular body requirement alone, even without a high level of BD, may be enough to lead to the development of an ED (Byrne & McLean, 2002). Thus, it is important to remember that the body of a growing athlete often develops in a direction against the sport specific "ideal", although many aspects of sport performance improve with biological maturity (e.g. physiological parameters including strength, aerobic and anaerobic power). This may especially be at issue for pubertal female athletes who typically experience a rapid change in body composition and shape. These possible changes might affect not only their attitudes toward weight and shape, but also their athletic performance (Byrne & McLean, 2001).

Disordered eating and eating disorders

The continuum model

There is a continuum of DE ranging from normal energy balance and healthy body image to clinical ED such as anorexia nervosa (AN), bulimia nervosa (BN) and ED not otherwise specified (EDNOS) (Shisslak et al., 1995). Meaning, the continuum starts with appropriate eating and exercise behaviors, including healthy dieting (e.g. lowering energy intake and gradual weight loss) or occasional use of more extreme weight-loss methods (e.g. short-term restrictive diets <30 kcal/kg fat-free mas per day). These behaviors may then progress to chronic dieting and frequent

weight fluctuation, fasting, active dehydration (e.g. exercise with sweat suits) or passive dehydration (e.g. sauna), and purging (e.g. use of laxatives, diuretics, self-induced vomiting, diet pills with or without excessive training). The continuum ends with clinical ED, where the male or female athlete struggles with extreme dieting, distorted body image, weight fluctuations, abnormal eating behaviors and variable performance (Sundgot-Borgen & Torstveit, 2010; Sundgot-Borgen et al., 2013). At this point the athlete can be underweight, normal weight or overweight, irrespective of the presence of extreme dieting periods or ED (Sundgot-Borgen & Torstveit, 2010).

For the purpose of this review, relevant terms are defined as follows: **Dieting** may be included on the continuum from excessive energy intake via energy balance to energy deficiency, including healthy dieting (e.g. lowering caloric intake by a modest number of calories per day to achieve slow and steady weight loss), destructive dieting, and DE (various abnormal eating behaviors such as restrictive eating, fasting, skipping meals, enemas, binge eating, and purging) (Nattiv et al., 2007; Sundgot-Borgen & Torstveit, 2010). **The female athlete triad** refers to the interrelationship between energy availability, menstrual function, and bone mineral density. The triad may have ED as an early clinical manifestation and includes energy deficiency, functional hypothalamic amenorrhea, and osteoporosis (Nattiv et al., 2007). A male athlete triad also exists, but because the reproductive effects are not perceived by men, it rarely comes to attention (DeSouza et al., 1994a; DeSouza et al., 1994b; Dolan et al., 2012). It should be noted that the syndrome originally known as the female athlete triad has recently been expanded to recognize that Relative Energy Deficiency in Sport has a broader range of negative effects on body systems with functional impairment in both males and females (Mountjoy et al., 2014). **Energy availability** can be defined as the amount of 'unused' dietary energy remaining for all other metabolic processes after the energy cost of exercise is subtracted from the daily energy intake (e.g. dietary energy intake minus exercise energy expenditure) (Nattiv et al., 2007). Thus, **a negative energy balance** is experienced if fewer calories are consumed than needed to meet the energy costs of daily living, plus those expended in exercise. Adolescence must also meet the energy costs of growth (Manore, 2002). Accordingly, athletes may induce a negative energy balance in an attempt to lose weight or body fat by restricting the caloric intake using abnormal eating behaviors without meeting the criteria for a clinical ED (Drinkwater et al., 2005).

Classification and diagnostic criteria for eating disorders

The diagnostic category ED consisting of the three diagnostic subcategories AN, BN and EDNOS are in this dissertation defined in accordance to the criteria in the Diagnostic and

Statistical Manual of Mental Disorders, 4th edition (DSM-IV) by APA (American Psychiatric Association., 1994). The AN category comprises four specific criteria: marked weight loss, fear of gaining weight, body image distortion, and for the females, amenorrhea. In addition, AN is divided into two subcategories, restricting subtype and binge-purge subtype (Table 1). An athlete with AN believes he/she is overweight even though being 15% or more below ideal body weight.

Table 1. Diagnostic criteria for AN (DSM-IV) (American Psychiatric Association., 1994).

A	Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g. weight loss leading to maintenance of body weight less than 85% of what expected; or failure to make expected weight gain during period of growth, leading to body weight of less than 85% of what expected).
B	Intense fear of gaining weight or becoming fat, even when underweight.
C	Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight.
D	In postmenarcheal females, amenorrhea i.e. the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone, e.g. estrogen administration).
Specific type:	
Restrictive type: during the current episode of AN, the person has not regularly engaged in binge-eating or purging behaviour (i.e. self-induced vomiting or the misuse of laxatives, diuretics or enemas)	
Binge eating/purging type: during the current episode of AN, the person has regularly engaged in binge eating or purging behaviour (i.e. self-induced vomiting or the misuse of laxatives, diuretics or enemas)	

BN is defined by binge eating in addition to the use of inappropriate compensatory behaviors (e.g. vomiting, fasting, excessive exercise) that occur on an average of at least twice per week for three months. It should be self-concept dominated by shape and weight and these symptoms must occur outside the course of AN. In athletes, excessive exercise means more exercise than originally planned to achieve the desired performance level. Importantly, athletes suffering from BN usually also have a "normal" body weight. Similar to AN, BN is divided into two subtypes defined as a non-purging subtype and a purging subtype (Table 2).

Table 2. Diagnostic criteria for BN (DSM-IV) (American Psychiatric Association., 1994).

A	Recurrent episodes of binge eating. An episode of binge eating is characterised by both the following: 1) eating, in a discrete period of time (e.g. within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances 2) a sense of lack of control over eating during the episode (e.g. a feeling that one cannot stop eating or control what or how much one is eating
B	Recurrent inappropriate compensatory behaviour in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas, or other medications; fasting; or excessive exercise.
C	The binge eating and inappropriate compensatory behaviours both occur, on average, at least twice a week for three months.
D	Self-evaluation is unduly influenced by body shape and weight.
E	The disturbance does not occur exclusively during episodes of AN.

Specific type:
Purging type: during the current episode of BN, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics or enemas.

Non-purging type: during the current episode of BN, the person has used other inappropriate weight compensatory behaviors such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics or enemas.

The most frequent diagnosis of ED is EDNOS, which is reserved for those with a clinically significant ED that does not meet the criteria for AN or BN. Included in this broad, heterogeneous category, is binge eating disorder (BED) defined by episodes of binge eating in the absence of inappropriate compensatory behaviors (Table 3). As EDNOS occasionally is called the residual category in the DSM-IV it is sometimes viewed as a "less severe" form of ED, but a recent study observed a crude mortality of 5.2%, similar to those found in AN (Crow et al., 2009). However, since EDNOS is a residual category the athletes who fulfil the EDNOS criteria differ in terms of psychopathology and medical conditions. Moreover, some of them will closely resemble cases of AN and BN. An athlete diagnosed with EDNOS often has a "normal" body weight, but is focused on body image, weight, and guilt surrounding eating (American Psychiatric Association., 1994).

Table 3. Diagnostic criteria for EDNOS (DSM-IV) (American Psychiatric Association., 1994).

A	For females, all of the criteria for AN are met except that the individual has regular menses.
B	All of the criteria for AN are met except that, despite significant weight loss, the individual's current weight is in the normal range
C	All of the criteria for BN are met except that the binge-eating and inappropriate compensatory mechanisms occur at a frequency of less than twice per week or for a duration of less than three months.
D	The regular use of inappropriate compensatory behaviour by an individual of normal body weight after eating small amounts of food (e.g., self-induced vomiting after consumption of two cookies).
E	Repeatedly chewing and spitting out, but not swallowing, large amounts of food.
F	Binge eating disorder: recurrent episodes of binge eating in the absence of the regular use of inappropriate compensatory behaviors characteristic of BN.

Athletes constitute a unique population and a few years before the EDNOS category was included in DSM-IV, a subclinical eating disorder termed *anorexia athletica* (AA) was introduced in the sports medicine field (Puglise et al., 1983; Sundgot-Borgen, 1993). This was done in an attempt to identify the group of athletes who show significant symptoms of ED without fulfilling the criteria for AN or BN. However, most athletes meeting the criteria for AA now fulfil the EDNOS criteria (Sundgot-Borgen et al., 2003).

It should be noted that the DSM-IV diagnostic criteria for ED have been criticized for having limitations, such as EDNOS being a residual diagnosis and therefore often is the largest one, that the criteria do not capture ED symptoms among children and adolescents well enough, and that some criteria have failed to prove sufficiently clinically relevant (e.g. amenorrhea) or being overly difficult to assess relatively to their diagnostic importance (e.g. weight phobia). DSM-IV's strengths and problems have therefore been reviewed thoroughly for the past years, and in May 2013 at the APA's Annual Meeting the final approved DSM-5 was released (American Psychiatric Association., 2014). The changes in DSM-5 such as BED becoming a formal ED and lowering the threshold for AN and BN aim to clarify existing criteria and to decrease the frequency with which individuals are assigned to the residual diagnosis EDNOS which provides little clinical utility (American Psychiatric Association., 2013). As a result, EDNOS has in DSM-5 been relabeled to give two separate categories (Other Specified Feeding or Eating Disorder and Unspecified Feeding or Eating Disorder). These two new categories are intended to more appropriately recognize and categorize conditions that do not more accurately fit into AN, BN, BED, or the other feeding disorders (pica, rumination and avoidant/restrictive food intake disorder (American Psychiatric Association., 2013).

Epidemiology

Prevalence of eating disorders

ED are relatively rare among the general population, but rather common among adolescent females. In the Western world the prevalence of ED is around a few percent; where the exact numbers vary between the different diagnoses (Hsu, 1996; Ghaderi & Scott, 2001). Among teenage girls the prevalence of AN is approximately 0.7% and the prevalence of BN about 1-2% among females aged 16-35 years (Fairburn & Harrison, 2003). The corresponding statistics for males are 0.09-0.2% for AN and 0.2-0.3% for BN (Hoek, 1993; O'Dea & Abraham, 2002). The prevalence of EDNOS is also higher among females than males (3% vs. 0.3%) (Patton et al., 2003). Among Norwegian females the prevalence of ED is approximately 3.0-4.5% (Gotestam & Agras, 1995; Kringlen et al., 2001; Sundgot-Borgen & Torstveit, 2004), with a prevalence of 0.4% for AN, 1.2% for BN, 3.0% for EDNOS and 3.2% for BED (Gotestam & Agras, 1995). In addition, in a Norwegian school/community-based study of adolescents (14-15 years of age), the prevalence for EDNOS was 6.5% for females and 1.7% for males (Kjelsås et al., 2004).

Among athletes, the prevalence of ED varies widely between studies. This may be explained by a number of methodological factors, such as different definitions (i.e. standard diagnostic procedures vs. nonstandard diagnostic procedures), small sample sizes, absent or inappropriate control groups, inadequate statistics, and heterogeneity in the type and level of the athletes studied (i.e. age, performance level, sport discipline) (Byrne & McLean, 2001). However, in the few well-controlled studies among elite athletes the prevalence of ED is higher among elite athletes than non-athletes, particularly among athletes competing in weight-sensitive sports (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008). Also, the results from these studies document well the higher prevalence of ED among female elite athletes compared to male elite athletes (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004), and indicate that between 18% to 28% of female elite athletes may have an ED (Sundgot-Borgen, 1993; Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008). An overview of studies examining the prevalence of ED among elite athletes representing multiple sports by using questionnaire screening and clinical interview is shown in Table 4. In Table 5, an overview of studies examining the prevalence of DE in adolescent (13-18 years) and or young adult (19-24 years) athletes at different competitive level are given.

Table 4. Studies examining the prevalence of disordered eating and eating disorders in elite athletes representing multiple sports.

Study	Population	Assessment and selection criteria	Results
Torstveit et al. (2008), Norway **Competitive level:** national team at the junior or senior level, or a member of a recruiting squad for that team **Sports:** multiple	**Females** 13–39 yr. **Part I Self-report** Athletes: n=699 Controls: n=607 **Part II Interview** Athletes: n=186 Controls: n=145	**Part I** EDI-BD EDI-DT Selection criteria[a]: EDI-BD≥14 EDI-DT≥15 BMI<18.5 kg/m^2 PWCM Self-reported ED **Part II** EDE	**Part I – At-risk (DE)** 46.2% athletes vs. 51.7% controls **Part II – ED** Of those attending the interview: 32.8% athletes vs. 21.4% controls had an ED 46.7% in leanness vs. 19.8% non-leanness sports and 21.4% controls had an ED, p<0.001 Estimated prevalence: 28.1% athletes vs. 20.8% controls
Sundgot-Borgen & Torstveit (2004), Norway **Competitive level:** placed among the 10 best in international competition, competing at national teams, and/or member of a recruiting squad for those teams **Sports:** multiple	**Male & females** 15-39 yr. **Part I Self-report** Athletes: ♂=687, ♀=572 Controls: ♂=629, ♀=574 **Part II Interview** Athletes: ♂=58, ♀=120 Controls: ♂=19, ♀=76	**Part I** EDI-DT EDI-BD Selection criteria: ♂ EDI-BD≥10 ♂ EDI-DT≥10 ♀ EDI-BD≥14 ♀ EDI-DT≥15 Positive response to ≥2 questions related to the DSM-IV criteria Self-reported ED **Part II** EDE	**Part I – At-risk (DE)** Males: 8.9% athletes vs. 3.5% Females: 21.2% athletes vs. 14.1% controls **Part II – ED** 13.5% athletes vs. 4.6% controls, p<0.001 Males: 8.0% athletes vs. 0.5% controls, p<0.001 Antigraviation sports (21.6%) vs. ballgame (5.1%), endurance (9.4%), p<0.05 Females: 20.1% athletes vs. 9.1% controls, p<0.001 Aesthetic sports (42.3%) vs. endurance (23.5%), technical (16.7%), ballgame (15.5%), p<0.05
Byrne & McLean (2002), Australia **Competitive level:** national or international level athlete,	**Male & females** 15-36 yr. **Phase I Interview** Athletes: ♂=108, ♀=155 Controls: n=263	**Phase I** CIDI **Phase II** EDI-BD	**Part I - ED** Males: 3.7% athletes vs. 0% controls Females: 21.9% athletes vs. 5.5% controls, p<0.001

fulltime member of a professional ballet company, or ballet student attending a professional ballet school **Sports:** multiple	**Phase II Self-report** Athletes: ♂=107, ♀=154 Controls: ♂=107, ♀=154	EDI-DT EDI-B BULIT-R R-TFEQ	Males: 7.3% in thin-built sensitive vs. 0% in normal built sports Females: 30.9% in thin-built vs. 8.2% normal built sports, p<0.001 **Part II – At-risk (DE)** Athletes vs. controls: higher scores on EDI-DT, EDI-B, BULIT-R & TFEQ
Sundgot-Borgen (1993), Norway **Competitive level:** national team at junior or senior level or one of the recruiting squads for those teams **Sports:** multiple	**Females** 12-35 yr. **Part I Self-report** Athletes: n=522 Controls: n=448 **Part II Interview** Athletes: n=133 Controls: n=60	**Part I** EDI Selection criteria: EDI≥40 EDI-BD≥14 EDI-DT≥15 **Part II** DSED	**Part I - At-risk (DE)** 22.4% athletes vs. 25.9% controls, p=0.08 **Part II - ED** 89% of the athletes vs. 20% of the controls at-risk met the criteria for AN, BN or AA[b], p<0.01 25% in sports in which leanness or a specific weight were considered important vs. 12% in sports which leanness or a specific weight were less important, and vs. 5% controls, p<0.01 Estimated prevalence[c]: 18% of the athletes vs. 5% of the controls, p<0.01

EDI-BD (Eating Disorder Inventory-Body dissatisfaction), EDI-DT (EDI-Drive for thinness), BMI (Body mass index), PWCM (Pathogenic weight control methods (diet pills, hunger-repressive pills, laxatives, diuretics, or vomiting to reduce weight)), EDE (Eating Disorder Examination), CIDI (Composite International Diagnostic Interview), EDI-B (EDI-Bulimia), BULIT-R (Bulimia test-Revised), R-TEFQ (Three Factor Eating Questionnaire), DSED (Diagnostic Survey for Eating Disorders), AA (Anorexia athletica). [a]In the selection process for part II of this study ("risk-profile" for the female athlete triad) also self-reported menstrual dysfunction and self-reported stress fracture was included. [b]A modified version of AA by Pugliese et al. (1983) was used to diagnose those who failed to meet the criteria for weight loss in DSM-III-R criteria for AN, or the criteria for purging included in the criteria for BN, but who nevertheless still had serious eating problems. [c]The author has in a later publication (Sundgot-Borgen & Torstveit, 2010) reported the estimated prevalence in this study to be 20.0% of the athletes vs. 5.2% of the controls.

Table 5. Studies examining the prevalence of disordered eating in adolescent (13-18 years) and or young adult (19-24 years) athletes at different competitive level.

Study	**Population**	**Assessment**	**Results**
Anderson & Petrie (2012), USA **Competitive level:** Division I **Sports:** Gymnasts, swimmers/divers	**University:** n=26 **Females:** 19.1±1.86 Gymnasts (G): n=280 Swimmers/divers (S): n=134	Self-report Q-EDD BULIT-R	**Classified as ED:** 6.3% (6.1% G and 6.7% S) **Subclinical:** 26.1% (28.9% G and 20.9% S)
Martinsen et al. (2010), Norway **Competitive level:** national team (senior, recruit or junior) or not belonging to any selection team **Sports:** multiple	**High Schools:** n=18 **Male and females**: 15-16 yr. **Elite Sport High Schools:** n=16 **Athletes:** n=606 (♂=389, ♀=217) **Regular High Schools:** n=2 **Controls:** n=355 (♂=197, ♀=158)	Self-report Symptoms of ED (≥1 criteria): ♀ EDI-BD ≥10 ♂ EDI-BD≥15 ♀ EDI-DT≥10 ♂ EDI-DT≥14 ♀ BMI<17.9 kg/m² ♂ BMI <17.5 kg/m² Current and/or ≥3 efforts to lose weight PWCM ♂ Primary or secondary amenorrhea	**Symptoms of ED** Males: 13.1% athletes vs. 30.5% controls, p<0.001 Females: 44.7% athletes vs. 70.9% controls, p<0.001
Rosendahl et al. (2009), Germany **Competitive level:** national team (senior or , junior), junior state team and not belonging to any selection team **Sports:** multiple	**High Schools:** n=not shown **Male and females:** 14-18 yr. **Elite Sport Schools** Athletes: ♂=366, ♀=210 **Regular High Schools** Controls: ♂=122, ♀=169	Self-report EAT-26	**EAT ≥10** Males: 10.4% athletes vs. 12.3% males, p=0.557 Females: 26.7% athletes vs. 36.1% controls, p<0.05 **EAT≥20** Males: no significant difference (data not shown) Females: 5.2% athletes vs. 14.8% controls, p<0.01

Holm-Denoma et al. (2009), USA **Competitive level:** Varsity (Division I), Club and Independent exercisers **Sports:** swimming, softball, soccer and basketball	**University:** n=1 **Females:** mean age 19±1.4 **Varsity athletes**: n=43 **Club athletes:** n=60 **Independent exercisers:** n=90 **Nonexercisers:** n=81	Self-report EDI-DT EDI-BD EDI-B	Athletes scored higher than nonexercisers on EDI-DT, EDI-B and EDI-BD Varsity and club athletes scored higher than independent exercisers on EDI-DT, EDI-B and EDI-BD
Greenleaf et al. (2009), UK **Competitive level:** Division I **Sports:** multiple	**University:** n=3 **Females:** 20.16 yr. **Athletes**: n=204	Self-report Q-EDD BULIT-R Symptomatic: some symptoms, but insufficient to warrant a clinical diagnosis	**Classified as ED:** 2% **Symptomatic:** 25.5% **Binge eating:** 18.6% ≥1 a week, 15.2% indicated their binge eating had lasted ≥3 months
Schtscherbyna et al. (2009), Brazil **Competitive level:** elite (reached the fifth-ranking position in state championship 2005 or 2006) **Sports:** swimming	**Elite swimmers** **Females:** 11-19 yr. **Athletes:** n=78	Self-report DE (scored positive for ≥1 of the tests): EAT-26 BITE BSQ	**Classified as DE:** 44.9% **EAT≥20:** 7.7% **BITE severity (symptom scale >10):** 21.8% **BSQ≥80:** 37.2%
Petrie et al. (2008) USA **Competitive level:** Division I **Sports:** multiple	**University:** n=3 **Males:** 20.3±1.6 yr. **Athletes**: n=203	Self-report Q-EDD BULIT-R Symptomatic: some symptoms, but insufficient to warrant a clinical diagnosis	**Classified as ED:** 0% **Symptomatic:** 19.2% **Binge eating:** 16.7% ≥1 a week, 17.2% indicated their binge eating had lasted for ≥3 months
Sanford-Martens et al. (2005), USA	**University:** n=1	Self-report Q-EDD	**Classified as ED:** Males: 1.8% athletes vs. 5.5% controls Females: 5.1% athletes vs. 8.3% controls

Table 5.Continued.

Study	Population	Assessment	Results
Competitive level: Division I **Sports:** multiple	**Athletes**: 21.02 yr. **Non-athletes:** 19.40 yr. **Athletes**: males n=165, females n=158 **Non-athletes** (controls): males n=55, females n=108	Subclinical: no diagnosable disorder, but some symptoms	**Subclinical:** Males: 21.2% athletes vs. 25.5% controls Females: 14.5% athletes vs. 31.5% controls Controls more likely than athletes to be classified as subclinical for an ED, but no differences existed between the two groups in term of clinical status Results indicated that athletes in sports that emphasized leanness and body aesthetics (lean) did not report more problematic eating behaviors than athletes in non-lean sports
Thomas (2005), USA **Competitive level:** National professional ballet companies, regional ballet companies, and local school **Sports:** ballet dancers	**Ballet workshops:** n=5 **Females:** 13-18 yr. (15.0±1.5) **National professional ballet companies** (N): n=63 **Regional ballet companies** (R): n=64 **Local school** (L): n=107 **Not known**: n=5	Self-report EDI-DT EDI-B EDI-P EDI-MF EDI-ID	**Self-report ED:** N 29.5%, R 17.5% and L 12.3% (N vs. L, p=0.021) Athletes at N and L reported higher scores on EDI, EDI-DT, and EDI-P than athletes at R No difference on EDI-B, EDI-MF and EDI-ID Athletes at N reported greater dieting scores and lifetime histories of self-induced vomiting than R and L
Toro et al. (2005), Spain **Competitive level:** top-and intermediate **Sports:** multiple	**Sport organizations:** n=3[b] **Females**: 15.3±3.1 yr. **Athletes:** 283	Self-report EAT CETCA	**Classified as ED:** 11.4% (through EAT>30) AN: 2.5%, BN: 20.1% (through CETCA)
Johnson et al. (1999), USA **Competitive level:** Division I **Sports:** multiple	**University:** n=11 **Males and females:** ♂= mean 20.1 yr., ♀=19.6 yr. **Athletes:** ♂=883, ♀=562	EDI-B Subclinical: binge eating or purging monthly or greater over last 3 months and scores on EDI-DT≥10 or EDI-BD≥12	**Classified as ED (AN/BN):** Males: 0% / 0%. Females: 0% / 1.1% **Subclinical AN/BN:** Males: 0% /0.005% Females: 2.85%/9.2%

		At-risk: >6 episodes last 3 months of binge eating, diet pills, vomiting, laxatives or diuretics or EDI-DT≥10 or EDI-BD≥12	**Self-reported (AN/BN):** Males: 1%/0.005% Females: 1.96%/5.5% **At-risk (AN/BN):** Males: 9.5%/38% Females: 34.75%/38%
Stoutjesdyk & Jevne (1993), Canada **Competitive level:** high-performance college or university athletes[a] **Sports:** multiple	**University**: n=14 **Clubs:** n=12 **Athletes**: ♂=87, ♀=104	EAT-40	**EAT≥30** Males: 4.6% Females: 10.6% Athletes in sports that emphasize leanness scored higher than those in sports in which a lower body weight is considered less important
Athletes at lower competitive level			
Thein-Nissenbaum et al. (2011), USA **Competitive level:** not defined (competing at interscholastic high school teams) **Sports:** multiple	**High School:** n=3 **Females:** mean age 15.4±1.2 **Athletes:** n= 311 Aesthetic (A): n=41 Endurance (E): n=89 Team/Anaerobic (TA): n=181	Self-report EDE-Q DE: mean score of ≥4.0 or higher on the dietary restraint, weight concern or shape concern subscales, or having a mean global score of 4.0 or higher on EDE-Q or having ≥ 1pathologic behaviors from the EDE-Q	**DE:** 35.4% A 41.5%, E 37.1%, TA 33.1%
Nichols et al. (2007), USA **Competitive level:** competing on interscholastic teams (not further described) **Sports:** multiple	**High schools:** n=6 **Females:** 15.7±1.7 yr. **Athletes:** n=423	Self-report EDE-Q DE: mean score of ≥4.0 on weight-concern, shape-concern, or dietary-restraint; had a mean global score ≥4.0; reported pathogenic behavior ≥2 days in the former 28	**DE:** 20%
Beals & Hill (2006), USA	**University:** n=1 **Females:** 19.5±1.2 yr.	Self-report EDI-SC	**DE:** 25%

Table 5. Continued.

Study	Population	Assessment	Results
Competitive level: Division II **Sports:** multiple	**Athletes**: n=112	EDE-Q Criteria for DE: clinical ED, self-diagnosed ED, and DE behaviors	
Nichols et al. (2006), USA **Competitive level:** competing on interscholastic teams (not further described) **Sports:** multiple	**High Schools:** n=6 **Females:** 13-18 yr. **Athletes:** n=170	Self-report EDE-Q DE: mean score of ≥4.0 on weight-concern or shape-concern or a mean global score ≥4.0	**DE:** 18.2%
Pernick et al. (2006), USA **Competitive level:** the school's sports team (not further described) **Sports:** multiple	**High Schools:** n=6 **Females:** 15.7±1.2 yr. **Athletes:** 453	Self-report EDE-Q DE: mean score ≥4.0 on weight-concern or shape-concern; global score ≥4.0; and/or >1 episode of self-induced vomiting, binging with loss of control, diuretic use or laxative use >past 28 days	**DE:** 19.6%
Beals & Manore (2002), USA **Competitive level:** NCAA sponsored program (not further described) **Sports:** multiple	**University:** n=7 **Females:** 19±2 yr. **Athletes:** n=425	Self-report EAT-26 EDI-BD	**Self-report ED:** 3.3% AN and 2.3% BN **At-risk for an ED:** EAT≥20: 15.2% EDI-BD≥12: 32.4%
Thiel et al. (1993), Germany **Competitive level:** national **Sports:** Wrestlers and rowers	**Wrestlers and rowers** **Males:** 21.1±2.4 yr. **Athletes:** n=84	Self-report EDI	**DE:** 11%

Q-EDD (Questionnaire for Eating Disorder Diagnoses), BULIT-R (Bulimia test-Revised), EDI-BD (Eating Disorder Inventory-Body dissatisfaction), EDI-DT (EDI-Drive for thinness), EDI-B (EDI-Bulimia), EDI-P (EDI-Perfectionism), EDI-MF (EDI-Maturity fears), EDI-ID (EDI-Interpersonal distrust), BMI (Body mass index), EAT/EAT-26 (Eating Attitudes Test-26 items), BITE (Bulimic Investigatory Test Edinburgh), BSQ (Body Shape Questionnaire), CETCA (Eating Disorders Assessment Questionnaire), EDE-Q (Eating Disorder Examination Questionnaire), EDI-SC (EDI Symptom Checklist). [a]High-performance is defined as athletes that train a minimum of 11 hours per week and have competed at provincial, national, and/or international level. [b]Subjects were recruited from three organizations training top-class sportsmen and women.

The peak onset of ED is adolescence (Byrne & McLean, 2001), a substantial risk for ED is reported among young athletes (Smolak et al., 2000; Sigman, 2003), and adult elite athletes diagnosed with ED report having started dieting and developing ED during puberty or adolescence (Sundgot-Borgen, 1994). Still, no previous well-controlled studies have examined the prevalence of ED among male and female adolescent elite athletes. Therefore, the prevalence of ED among adolescent elite athletes is unknown. Moreover, we do not know if the prevalence is higher among adolescent elite athletes than athletes at lower competition levels or non-athletes. In addition, studies focusing on DE among representative samples of adolescent elite athletes and age-matched controls are lacking. In fact, a majority of the studies examining DE among adolescent athletes include female athletes only, have small samples, include only one or a few sports, fail to consistently describe competitive level, employ different tests or do not include a control group (Smolak et al., 2000; Hausenblas & Downs, 2001). Consequently, the prevalence of DE among adolescent athletes is as seen in Table 5 inconsistent and it is difficult to compare the different studies available, not only because they do not include a clinical interview, but also because they use different criteria for DE behavior. For instance, Nichols et al. (2006) found a prevalence of 18.2% among female high school athletes (age range: 13-18) by using the EDE-Q, while Beals & Hill (2006) among collegiate female athletes (mean age: 19.5±1.2) found a prevalence of 25% by using EDI symptom check list and EDE-Q, and Thiel et al. (1993) among male wrestlers (mean age 21.1±2.4) found a prevalence of 11% of DE by using EDI. In addition, Toro et al. (2005) found that 11.4% of the female elite athletes (mean age: 15.3±3.1) had a Eating Attitudes Test (EAT) score above 30 and 22.6% were defined as having an ED based on the Eating Disorders Assessment Questionnaire. This illustrates quite well the difficulties and challenges when different samples characteristics, definition of DE (or ED), and methods of assessing DE and ED are used. Moreover, the need of a sport-specific instrument designed for athletes in different kind of sports and competitions levels. Until this is established a clinical interview is the best available method to identify ED among both elite athletes and controls and should be used for accurate identification of ED. Nevertheless, if not taking into account the different methods used in measuring DE behaviour and the included athletes' athletic level, it seems like high school athletes do not report a greater risk for the development for an ED than controls (Fulkerson et al., 1999; Smolak et al., 2000). Then again, the prevalence of DE tends to increase with the level of competition with a prevalence of 18.2% among female high school athletes (Nichols et al., 2006), 25.5% in female collegiate athletes (Greenleaf et al., 2009), and 46.2% in female elite athletes (Torstveit et al., 2008). This indicates that adolescent elite athletes might be at substantial risk for ED. However, no previous study has examined the prevalence of

ED among adolescent elite athletes. Therefore, one of the aims in this thesis was to examine the prevalence of clinical ED in adolescent male and female elite athletes and age-matched controls by using a two-tiered approach (questionnaire screening followed by clinical interviews) (Paper I).

Risk factors associated with the development of ED

Knowledge of risk factors associated with the development of ED is essential for being able to refine etiologic models, determine the optimal content of prevention programs, and identify individuals at elevated risk for ED that can be targeted with selected prevention programs (Stice et al., 2012). In elite athletes there are no controlled prospective studies focusing on risk factors for ED, and we do not know why some athletes cross the line from dieting and use of extreme weight-loss methods to clinical ED and others don't. It is also not known whether the different points on the DE continuum have the same risk factors or causative factors (Drinkwater et al., 2005). Generally, the etiology of ED is accepted to be multifactorial (Mussell et al., 2000; Stice, 2002; Skarderud et al., 2004; Beals, 2004) and presumably involves a combination of genetic, biological, and temperamental vulnerabilities that interact with environmental circumstances to increase risk (Stice et al., 2012). The multifactorial "model" proposes predisposing (or risk) factors, attributes that precipitate or trigger the development of ED, and maintaining factors (processes that perpetuate the ED). Predisposing factors include biological (e.g. genetics, gender, and puberty status), psychological characteristics (e.g. BD, low self-esteem, and personality traits such as perfectionism, loss of control, concern about weight, shape and appearance, and mental illnesses such as depression and anxiety (Ghaderi & Scott, 1999; Stice & Shaw, 2002), and sociocultural factors (e.g. culture, media influence, peer pressure, and history of bullying) (Stice, 2002). Trigger factors may be stressors such as negative comments regarding body weight and/or shape and traumatic experiences (Stice, 2002), and then maintained by maintaining factors such as approval from significant others (e.g. friends, coach), the physiological consequences of starvation or initial success (e.g. enhanced performance) (Drinkwater et al., 2005). It should be noted that a meta-analytic review of prospective and experimental studies reveals that several of the "accepted" risk factors for eating pathology have not received empirical support (e.g. sexual abuse) or have received contradictory support (e.g. dieting), while some less accepted risk factor such as thin-ideal internalization received consistent support (Stice, 2002). Thus, there is a need for more methodologically rigorous prospective risk factor studies. The challenge is to develop multivariate models that can improve our understanding of how different risk factors interact instead of simply summing up possible factors. In addition, the importance of searching for

additional risk and maintenance factors, develop more comprehensive multivariate models, and address methodological limitations that attenuate effects has been stated (Stice, 2002).

Sport-specific risk factors

Based on the additional stress associated with the athletic environment it is suggested that athletes also encounter sport-specific risk factors in addition to the general risk factors, such as early start of sport-specific training, frequent weight regulation, dieting and weight loss at early age, experienced pressure to lose weight, desire to be lean to increase performance, stressful situations and traumatic events (e.g. injuries, symptoms of overtraining), psychological factors (e.g. strive for perfection and strong achievement orientation), coaching behavior and the regulations in some sports (Sundgot-Borgen, 1994; Johnson, 1994; Smolak et al., 2000; Forsberg & Lock, 2006; Nattiv et al., 2007). Although some of these sport-specific risk factors are shared with non-athletes, it is proposed that the specific demands in the sport environment can make athletes more vulnerable to these factors than non-athletes. For instance, it has been suggested that the demands of a sport to meet a particular body requirement alone, even without a high level of BD, may be enough to lead to the development of an ED (Byrne & McLean, 2002). In the following some of the most frequently mentioned possible sport-specific risk factors are described.

Age and early start of sport-specific training

Adolescence is as previously stated a particularly vulnerable period both physically and psychologically (Beals & Manore, 2002) and a high-risk period for the development of an ED (Byrne & McLean, 2001). Research also suggests that to begin sport-specific training at an early age may increase the risk of developing an ED as it may hinder the athletes from choosing a suitable sport for their adult body. The rapid change in body composition and shape that especially females experience during puberty generally take them further away from the current ideal body shape. For an athlete such pubertal changes are not considered appropriate in all sports, and it has been reported that some female athletes try to delay puberty to enhance performance (Sundgot-Borgen, 1994).

Prolonged periods of dieting or weight cycling and dieting pressure

Losing weight to enhance performance is one of the most important reasons among athletes to start dieting, and pressure to reduce weight has been a common explanation for the high prevalence of ED among elite athletes. In weight-class sports, athletes often compete in a weight class below their natural body weight to get a competitive advantage (Steen & Brownell, 1990; Oppliger et al., 2003) and thus start dieting due to their experience of the specific body

weight/composition demands in their sport. In sports such as tae kwon do and wrestling there are few weight classes separated by many kilograms, a long wait between the weight-in and the start of competition, and only one weigh-in during tournaments. This makes it possible to reduce larger amounts of weights. To achieve fast weight loss, a number of extreme methods are used that place the athlete's health at risk. Few question the weight loss methods used, as many believe weight loss is a necessary part of these sports (Marquart & Sobal, 1994; Hall & Lane, 2001). Moreover, in aesthetic sports (e.g. gymnasts, figure skaters and divers) there is a common belief that judges are influenced by the body composition of the athletes. Comments from coaches in these sports on the athlete's body composition are associated with a psychological pressure to diet (Byrne & McLean, 2002). Thus, male and female athletes are, in addition to the socio-cultural demands to achieve and maintain an ideal body shape, under pressure to improve performance and to conform to the requirements of their sport. Consequently, weight concerns, dieting, and the use of extreme weight-loss methods become the focus for many athletes' athletic existence and some may develop and be diagnosed with an ED (Sundgot-Borgen, 1993; Matejek et al., 1999; Torstveit et al., 2008). Furthermore, there appears to be an association between the age at which athletes start losing weight and more extreme weight management behaviors (Kiningham & Gorenflo, 2001; Artioli et al., 2010). Research also indicates that the important factor may not be dieting per se, but rather in which situation the athlete is told to lose weight, the words used and whether the athlete receives guidance (Sundgot-Borgen, 1994; Sundgot-Borgen et al., 2003). Naturally, the pressures on athletes to reduce weight and body fat can create a culture for DE and thus lead to an unfortunate domino effect. Especially if success is achieved by an initial loss of weight, this may not only "force" the athlete to continue the behavior and unknowingly slip into an ED, but also "inspire" teammates and competitors who observe their success to start reducing weight. Interesting, Filaire et al. (2007) found among elite male judoists and cyclists that the main sources of pressure regarding body image and weight came from fellow judoists and cyclists. Thus, a team environment might foster a subculture that stresses the importance of thinness through pressure to diet and be thin, and teammates might not only model DE, but also encourage it to new team members.

Stressful situations and traumatic events

Stressful situations and traumatic events have been associated with the development of DE and ED among both athletes and non-athletes. For an athlete loss or change of coach, illness or injury are examples of events that might be conceptualized by some as traumatic and trigger conditions (Sundgot-Borgen, 1994). These events are seen as traumatic as they may leave the athlete feeling vulnerable and out of control. For instance, an injured or ill athlete that is unable

to train for a prolonged period may experience an undesired weight gain (or become afraid of gaining weight). This combined with the negative affects an injury or illness may cause (e.g. not being able to compete in championship) may result in increasingly restrictive eating behavior or pathogenic weight control methods (PWCM) that can increase the risk of ED (Sundgot-Borgen, 1994). Consequently, the athlete's behavior starting out as an attempt to reestablish a sense of control may eventually develop into an ED (Beals, 2004).

For the adolescent male and female elite athletes in this dissertation the Elite Sport High School setting may be an additional factor that increases the risk for DE and the development of an ED. Barker and Galambos (2009) found for instance that moving away from home to attend college increased the likelihood of binge eating among young women. Some of the factors that may lay a high pressure on the athletes attending the Elite Sport High Schools to perform on the sport field as well as in the classroom are greater personal responsibility and maturation, perceived loss of social support, competing with the best athletes in the country, evaluation by coaches on an almost daily basis, increased training volume, lack of performance, and not being the best anymore. Furthermore, some might even feel indebted to their family to achieve good results since most of the Elite Sport High Schools are private and take school fees (Norwegian regular high schools are for free and most common). For some, such sudden changes and high pressure might be experienced as traumatic events and serve as trigger conditions for the onset of ED. Some might also slip unknowingly into an ED if they are not aware of the energy demands of their increased training loads when following identical strategies as their training peers (during the transition from junior to senior athlete). In a retrospective study among female elite athletes it has been indicated that a sudden increase in training volume may induce a caloric deprivation in endurance athletes, which in turn may elicit biological and social reinforcements leading to the development of ED (Sundgot-Borgen, 1994).

Psychological factors

The relationship between ED and perfectionism has been well established, and it may influence in an indirect manner (Keel & Forney, 2013). Perfectionism has been implicated in the development and maintenance of all forms of ED (AN, BN and EDNOS), and there is emerging evidence that perfectionism may interact with other risk factors to predict eating disturbances in non-athletes (Stice, 2002). Among athletes, it is suggested that perfectionism as a personality trait combined with environmental and other factors, may increase the risk of developing an ED (Forsberg & Lock, 2006). However, the research is inconsistent as some have highlighted that perfectionism is an adaptive quality that helps athletes reach their potential (Gould et al., 2002), while others argue its maladaptive nature for achievement pursuit (Flett & Hewitt, 2005).

Interestingly, Hopkinson and Lock (2004) found by comparing Division I collegiate athletes to recreational athletes that perfectionism, rather than the level of intensity at which the athletes participated in their sport, was the most important factor in predicting DE. Furthermore, a review of the consequences of perfectionism among athletes found that dimensions assessing evaluative concerns (e.g. concern over mistakes, perceived parental and coach pressure) are associated with negative consequences while dimensions assessing a commitment to exceptionally high standards are associated with positive consequences (Stoeber & Otto, 2006). In addition, a recent longitudinal study following a large sample of adolescents aged 15-19 years over a period of 7-9 months showed that perceived parental expectations predicted longitudinal increases in socially prescribed perfectionism. No such effect was found for self-oriented perfectionism or for parental criticism (Damian et al., 2013). Both self-oriented perfectionism (the belief that perfectionism is required in personal performance) and socially prescribed perfectionism (the belief that perfectionism in personal performance is expected by others) have been independently and positively related to ED among non-athletes, and it has been suggested that women high on socially prescribed and self-oriented perfectionism are especially vulnerable (Sherry et al., 2004). On the basis of the importance athletes tend to ascribe to coaches (Pensgaard & Roberts, 2002), and that the athletes in this dissertation are at the early stages of their athletic career, it seems reasonable to suggest that those perceiving parental expectations may transfer these perceptions to their coaches. If this is the case, these athletes will believe that other people's (in this case coaches) acceptance will be contingent upon meeting these expectations being key characteristics of socially prescribed perfectionism (Damian et al., 2013). During adolescence, socially prescribed perfectionism is thought to be of particularly importance due to developmental concerns during this phase (Flett et al., 2002).

Self-esteem may be defined as a person's overall evaluation or appraisal of her or his own worth. In patients with ED low self-esteem is well recognized (Silverstone & Salsali, 2003), and it is suggested that lowered self-esteem is the final common pathway leading to ED (Gual et al., 2002). However, the research is mixed as to whether low self-esteem or negative self-concept is a risk factor for ED (Stice, 2002; Jacobi et al., 2004). Based on longitudinal assessment, there seems to be a slight overweight of studies confirming the presence of negative self-concept, low self-esteem, or higher ineffectiveness prior to the onset of an ED. On this basis, low self-esteem and ineffectiveness has been classified as variable risk factors (ranging from low to high) (Jacobi et al., 2004). In the athletic environment, athletes with AN tend to possess low self-esteem, lack a strong sense of self-concept in addition the added complexity of having to come to terms with their athletic identity (Beals, 2004). Several athletes derive a large part of their self-concept from

their sport, and thereby their sense of self-worth, and subsequently their self-esteem, is closely tied to athletic performance (Beals, 2004). It is suggested that particularly athletes who start sport-specific training at an early age or who have been involved in such training for many years, define themselves if not wholly, in part as athletes (Beals, 2004). Under such circumstances, performance may become the barometer of his or her self-worth creating overwhelming pressure to perform, and everything that can threaten performance also intimidates their sense of self. In an attempt to protect their athletic identity, this may lead the athlete to extreme behavior (e.g. pathologically controlling their weight) that may increase the risk for developing an ED.

Coaching behavior

In an athlete's life the coach is an important person, and negative practices or attitudes concerning body size/shape can have a powerful impact on behavior or attitudes (Thompson & Sherman, 1993; Williamson et al., 1995; Biesecker & Martz, 1999). The expectations coaches set forth in their practice and competition environment, in addition to the type of weight management and training they require for each specific athlete, can have a significant influence. Studies have reported that athletes started dieting stringently after a coach advised them to lose weight (Rosen & Hough, 1988; Sundgot-Borgen, 1994). Obviously, this does not mean that all who diet will develop an ED, or that all who are being told by their coach to lose weight will develop an ED, but for some (e.g. those genetically predisposed) it may trigger DE behavior and start the development of an ED. Sundgot-Borgen (1994) found for instance that among the female athletes who had been told by a coach to diet but did not develop an ED, most (75%) had received guidance during their weight loss. It is proposed, that when the demand and stress associated with a coaching position combine with inadequate knowledge and education about ED, coaches may become more likely to disperse careless comments about weight to their athletes, misinformation about weight control, and inappropriate actions that may endanger the health and well-being of their athletes (Bonci et al., 2008). For good decision making and in order to adequately perform a supportive function, many coaches need factual information related to all domains of DE (Turk et al., 1999) as well as strategies to properly communicate with their athletes about weight issues (Ryan, 1992). This illustrates the unique position of a coach to denounce unhealthy attitudes and behaviors that may trigger DE behavior, their opportunity to identifying early signs and symptoms, directing athletes to professional help, and preventing the development of ED (Sherman et al., 2005; Nattiv et al., 2007).

Rules and regulations

Rules and regulations such as weigh-in times (long wait between the weigh-in and the start of competition), number of weight classes (separated by many kilograms), and subjective judging (both technical skills and execution/artistic effects are evaluated in aesthetic sports) may encourage athletes to use extreme weight-loss methods in an attempt to increase performance. Body weight and body composition are crucial performance variables (Ackland et al., 2012), and in some sports (e.g. weight-sensitive sports such as wrestling, judo, and lightweight rowing) athletes aim to gain a competitive advantage by obtaining the lowest possible body weight with the greatest possible strength, power, and endurance. As a result, many compete in a weight class below their natural body weight (Steen & Brownell, 1990; Oppliger et al., 2003) and consequently start dieting. The degree of impairment caused by acute weight-loss strategies seems to depend on the time from weigh-in to competition and the recovery strategies used (Slater et al., 2005). In addition, sports which emphasize leanness (i.e. aesthetic, endurance and weight-class sports) show higher frequencies of dieting behavior (Torstveit et al., 2008)

Gender-specific risk factors – the male athlete

Although there seems to be more similarities between male and female athletes than differences regarding risk factors for ED (Baum, 2006), it has been hypothesized that men and women with ED differ before and after their acute phase of the ED in respect to biological and social learning processes and gender role identity (Andersen & Holman, 1997). Andersen & Holman (1997) suggest that men diet as a mean to an end, while women most often diet as an unquestioned social practice and see weight loss as the goal itself. For instance, it has been reported that male athletes tend to be more likely to engage in "defensive dieting", that is dieting to prevent weight gain during an injury or illness (Thompson & Sherman, 1993), and more frequently report dieting to improve performance (Andersen & Holman, 1997). Moreover, it has been reported that males in general tend to be more dissatisfied with their bodies when they are under- or overweight (Cohane & Pope, Jr., 2001; Presnell et al., 2004; Ricciardelli & Mccabe, 2004). Furthermore, it has been suggested that males have more focus on the upper body than lower body, desiring a shape change to a lean muscularity rather than weight loss and dieting (Berg & Andersen, 2007). Since males in many sports want to be larger and more muscular, they may be trying to gain weight by eating more, possibly overeating or even binge eating and increasing their strength training. Caloric intake and heavy lifting may be viewed as normal and desirable in some sports (e.g. ice hockey, team alpine skiing, and some athletic events) and therefore not be identified as symptomatic or problematic. Johnson and colleagues (1999) found in their study on male sport participants that 13% of the collegiate males were binge eating and 38% were at risk for BN, but

none of the male athletes were diagnosed with an ED. Athletes who want to gain muscle mass are usually striving to avoid a parallel increase in body fat since a negative energy balance favoring reductions in fat mass normally deters increases in muscle mass. Thus, for many males the ideal body (muscular but lean), is almost impossible to accomplish. For adolescent male athletes a further challenge is that the significant increase in lean body mass exceeds the total gain in weight because of the concomitant loss of adipose tissue (Rogol et al., 2000). The drive for muscularity has been found to be a more important construct among both athletic and non-athletic males than DT (Cafri et al., 2006). However, the knowledge of the drive for muscularity as a risk factor for ED is sparse and need to be explored more comprehensively.

Sport-specific risk factors - evidence

The sport-specific risk factors presented are based on case-control, cross-sectional and prospective study designs. This makes it difficult to determine whether the factors precede the onset of the ED, are maintaining factors or more consequences or "scars" of the disorder. Although a retrospective study may give more information than case-control and cross-sectional designs a retrospective assessment of risk factor information such as the study by Sundgot-Borgen (1994) is problematic. The information may be biased by retrospective recall or the subject's inaccurate memory. Therefore, it is important to keep in mind that prospective longitudinal studies are needed to examine the true risks and trigger factors for the development of ED in sports.

Prevention of eating disorders

Prevention of ED is a relatively young field and unlike other prevention foci (e.g. substance abuse), no best practice models are yet available (Piran, 2002). Former, ED prevention programs yielded few positive results, particularly with respect to behavioral change (Pearson et al., 2002). Early ED prevention programs typically utilized universal psychoeducation, providing didactic information about ED to both low- and high-risk individuals (Stice et al., 2003). However, although didactic psychoeducation is effective at increasing knowledge, different meta-analyses have found that such studies are not that effective at reducing ED pathology (Stice & Shaw, 2004; Fingeret et al., 2006; Stice et al., 2007). Consistent with meta-analyses of outcome research, there are several encouraging trends. In general, the most promising interventions for reducing symptoms of an ED were selected (versus universal) and consists of multiple interactive sessions designed for females at late adolescence or early adulthood who show some level of weight and shape preoccupation (Stice et al., 2007). In particular, research interventions based on a cognitive-

dissonance framework has gathered increased attention (see Stice et al., (2008b)). The program has generated encouraging results in high- and mixed-risk samples which have been replicated independently by a number of researchers (Stice et al., 2008b). In adolescent girls with BD there is also some support for a healthy weight prevention intervention where the participants are encouraged to make small lifestyle changes in eating and exercise to help maintain a healthy weight (Stice et al., 2001; Stice et al., 2006). An important shortcoming of such selective-targeted prevention programs is their limited reach to rather small and select groups of individuals (mostly females) who are relatively adversely affected by a host of risk factors, which leaves untouched a very large portion of the population who could benefit from prevention (Austin, 2001).

Deciding the level of prevention revolves around questions of philosophy, methodology, cost-benefit and success (Levine & Smolak, 2006b). As a result, some researchers and theorists continue to argue for universal-selective (or primary) prevention programs, while others propose that only targeted (or secondary) prevention has been, and is likely to be, successful (Levine & Smolak, 2006b). A difficulty in evaluating the different prevention programs available is the likelihood that some of the effects of the intervention may not be seen for some years after the program is completed and few of the existing studies have a long-term follow-up. Thus, no immediate intervention effect may later result in a very important long-term effect. This might especially be the case in more universal intervention programs by definition are less focused on individuals (Cowen, 1973; Cowen, 1983), and the immediate benefits might more clearly be to the ecology of the school or community than to the individual student (Levine & Smolak, 2006b). Thus, targeted prevention programs being generally more effective than the universal programs, may partly be due to biases in program content and evaluation methodology that favor targeted intervention programs (Levine & Smolak, 2006b). More importantly, it has been emphasized that regardless whether the prevention program is universal, selective, or targeted, the effect is likely to be limited in scope and duration if the ecology is ignored (Levine & Smolak, 2006b). Piran (Piran, 1999b; Piran, 2001a) highlight based on the intensive case study and outcome (Piran, 1999a) of a prevention program implemented in a residential ballet school, that prevention programs may be more successful if they target the complex cultural context in which negative body image and ED develop. The need to include both specific influential adult figures (e.g. parents, teachers, coaches) in addition to more global community resources (e.g. school administration) is underlined (Piran, 2001b; Piran, 2005; Piran, 2010). This is consistent with other fields (e.g. drug prevention) where research indicates that long-term prevention is facilitated by multidimensional programs aimed at changing student norms, at engaging the school as a

system of adults and students, and linking positive changes in the school with changes in the community, including mass media (Levine & Smolak, 2006a; Levine & Smolak, 2006c).

The entrenched ideologies inherent in the culture of sport are unique in many ways (especially at the elite level), and athletes may not respond to interventions in the same way as non-sport populations. Still, despite the well-known health risks posed to athletes by DE, the female athlete triad, and ED, there have been very few prevention studies among athletes. In fact, there are no previous intervention studies aiming to prevent the development of ED among adolescent male and female elite athletes. Moreover, among the studies available that have included athletes, mainly female athletes have been included. Other important limitations are the lack of a follow-up period and or control groups, and the fact that most of the studies are not designed to detect possible reductions in onset of ED (Table 6). For instance, Abood & Black (2000) devised an 8-week health education intervention program focusing on self-esteem, stress management, nutrition, and goal setting among 70 Division I female college athletes from seven sport disciplines. The aim was to decrease risk factors for ED, and half from each sport were randomly assigned to either the intervention group or control group. Two weeks after the intervention the athletes attending the intervention scored lower on DT and BD compared to the control athletes, and the control athletes scored lower on self-esteem and nutrition knowledge. Despite encouraging results the study did not involve any long-term follow-up measures and did not examine possible reductions in onset of ED (Abood & Black, 2000). Athletes targeting healthy exercise and nutrition alternatives (ATHENA) is another 8-week intervention program targeting female athletes (Elliot et al., 2004). In this study, 928 female athletes from 18 high schools (matched on a number of variables) were randomized to experimental group or a control group. The program used both a coach-led and peer-led format and included group sessions with educational material about the consequences of substance use and other unhealthy behaviors, the beneficial effects of appropriate sport nutrition and effective exercise training. The athletes attending the experimental group reported less ongoing and new use of diet pills and less new use of athletic-enhancing substances (e.g. amphetamines). Moreover, ATHENA athletes had coincident positive changes in strength training self-efficacy and healthy eating behaviors. Although the authors conclude that the program is effective in promoting healthy lifestyles and decreasing DE, athletic-enhancing substance use, and other health-harming behaviors (Elliot et al., 2004), it should be noted that 1 to 3 years later the ATHENA athletes showed reductions in marijuana and alcohol use, but not eating pathology (Elliot et al., 2008). Moreover, the follow-up was conducted as a second study and data from the follow-up study were not matched with the

baseline data. In addition to the previous described intervention program, ATHENA also refrained from examining a possible reduction in onset of ED (Elliot et al., 2008).

Interestingly, Smith and Petrie (2008) conducted a study among 29 female athletes to test the effectiveness of the cognitive-dissonance program among athletes. To address some of the unique experiences of athletes they slightly modified the three-session cognitive-dissonance program and the three-session healthy weight program. In addition, a waiting-list control group was included in the study (received neither of the programs). After intervention, no improvements were seen for either intervention programs compared to waiting-list control. The authors conclude that a cognitive-dissonance based intervention may be useful as exploratory post-hoc analyses suggested that the cognitive-dissonance program provided some effects, but need to be further redesigned to account for the unique aspects of an athletic population (Smith & Petrie, 2008). Unfortunately, as the first study to test the cognitive-dissonance and healthy weight program among athletes it has limited value based on the small sample of female athletes included.

BodySense is another small study designed to reduce pressure to be thin in sports, and to promote positive body image and eating behaviors in young female athletes (Buchholz et al., 2008). In this 3-month multidimensional, social ecological study, parents and coaches were included in addition to adolescent female gymnasts of gymnastic clubs. The intervention was guided by community health professionals and the participants were provided with information on eating attitudes/beliefs, accurate information about body health, unique body size/shape, resisting pressures to diet, physical activity for enjoyment, positive self-esteem, assertiveness, stress management, and balance between sport and life outside of sport. Two workshops were held (one for parents and coaches, one for athletes) introducing the participants to the 10 BodySense Basic (the core prevention model for promoting positive body image and preventing DE in sports). In addition, a BodySense Binder was given coaches, parents and club staff that included brochures on the 10 BodySense Basics (informing of ways to prevent and detect DE and to promote positive body image in the sport environment). Also, a poster and a mini-resource library of books and videos on topics related to the intervention were provided. The female gymnasts who attended the program reported less pressure from their clubs to be thin, but no difference was apparent in measures of dieting and bulimic pathology compared to controls. Moreover, the study had some important limitations such as inability to gauge participant adherence to the components of the program and no follow-up period. Also, the statistical power may have been inadequate as there was a large drop-out among athletes, parents and coaches (only 62 athletes completed the study) (Buchholz et al., 2008). Even though the

positive changes were modest, the authors suggest further investigation, and emphasize the importance of coaches, parents, judges, sports administrations and associations involvement in future prevention studies aiming to modify the sport climate messages perceived by those at risk (Buchholz et al., 2008). This is in accordance with Piran's long-standing argument that prevention efforts might be more sustained if programming engages the social system in which the individuals are embedded as described previously (Piran, 1997; Piran, 1999a; Piran, 2010). Piran (1999a) was the first to focus on peer group norms in the body image and ED field when she developed a prevention program for residential ballet school students. In this prevention program (technically being a selective intervention) three all-school surveys were conducted in 1987 (n=68), 1991 (n=65) and 1996 (n=65) (Piran, 1999a). The aim of the program was to reduce body weight and shape preoccupation through creating a school environment where students feel comfortable with the process of puberty and growth and believe in their right to feel both safe and positive in their diverse bodies. In order to achieve this, the program focused on creating systematic changes. To inform and guide the prevention program dialogues with administration, teachers, and students in focus group were used. Systematic factors for the development of body weight and shape preoccupation were identified and addressed in the meetings with school staff and within the peer group meetings (knowledge- through-dialogue) during the study (Piran et al., 1999). Though this was not a longitudinal or sequential cohort design, over time and across the three different cohorts of females, most measures of eating symptomatology, restrictive eating, and disturbed attitudes towards eating and weight were associated with reductions. Moreover, the prevalence of AN dropped tenfold to just 1% and there were no new cases of BN. In addition, increases in healthy eating patterns were reported. Despite that the study have some important limitations such as no control group and relatively small group sizes, it is the first study to show the benefits of a multidimensional ecological approach in a high-risk environment (Piran, 1999a).

In summary, substantial advances have been made in general over the last decade with regard to the development of ED prevention programs. However, few studies have measured the effectiveness of the intervention through 6 months (all in nonathletes) (Neumark-Sztainer et al., 1995; Stewart et al., 2001; Stice et al., 2006; McVey et al., 2007; Jones et al., 2008) and only two programs have documented a reduced risk for future onset of ED (the Body Project and the Healthy weight) (Stice et al., 2008a). Despite that research indicate a high prevalence of ED in elite athletes, particularly among those competing in weight-sensitive sports (Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008), limited work has been done in preventing ED among athletes. Still, it is well known that early identification decreases possible medical and

psychological consequences as well as most likely the difficulty and length of treatment (Nattiv et al., 2007). In fact, although preventing ED (as well as DE and the female athlete triad) among athletes has been recommended frequently (Thompson & Sherman, 1993; Beals, 2004; Drinkwater et al., 2005; Nattiv et al., 2007; Bonci et al., 2008), there are no studies aiming to prevent the development of ED among male and female elite athletes. Therefore, in an effort to combat the high prevalence of DE and ED in elite athletes and decrease treatment delay and related complications, we conducted the first RCT to prevent the development of ED and symptoms associated with ED among adolescent male and female elite athletes including both athletes (Paper II) and coaches (Paper III).

Table 6. Studies on preventing symptoms associated with ED and/or ED among athletes.

Reference Design	Sample	Intervention	Assess-ment	Results	Follow-up	Comments
Black Becker et al. (2011), USA RCT	Division III university: N=1 Female athletes: N=157 18-22 yr. (mean age 18.94±1.04) AM-DBP: N=73 AM-HW: N=84	Effectiveness of peer-led versions of AM-DBP and AM-HWI at reducing ED risk factors in female athletes AM-DBP: included information on the female athlete triad as well as a discussion of the body image pressures placed on athletes in their specific sports AM-HWI: included information on the female athlete triad as well as a discussion of the sport-specific thin-ideal and the athlete-specific healthy ideal 3 weeks 1-session per wk. a 60-80. min.	Self-report IBSS-R DRES EDE-Q PANAS-X	Both AM-DBP and AM-HW reduced thin-ideal internalization, dietary restraint, bulimic pathology, shape and weight concern, and negative affect at 6 wk., and bulimic pathology, shape concern, and negative affect at 1 yr. It appears that when provided with a script and appropriate training, peers are well suited to teaching one another about the female athlete triad	Yes 6 wk. 1 yr.	No control group Intervention was run within teams: half of each team was randomized to AM-DPB and the other half to AM-HWI Did not examine possible reductions in onset of ED
Buchholz et al. (2008), Canada RCT	Gymnastic clubs: N=7 Female gymnasts: N=62 11-18 yr. (mean age 13.4±1.45) Mothers: n=32 Fathers: n=11* Coaches: n=18*	BodySense Multidimensional, social ecological study designed to promote positive body image in young female athletes 12 weeks 2 workshops: 1 parents/coaches, 1 athletes Focus groups: Athletes separated from parents/coaches	Self-report EAT-26 SATAQ CISSS[a] BESAA SED PEA-Q	Less pressure from their clubs to be thin No changes in body esteem, weight, attribution awareness, EAT-26, or the SATAQ (awareness, internalization or self-efficacy)	No	Small sample size with large drop-out (e.g. coaches and parents in the follow-up evaluation precluded any cogent conclusions about its impact on the adult stakeholders) Inability to gauge participant adherence to the components of the program Did not examine possible reductions in onset of ED

Table 6. Continued.

Reference Design	Sample	Intervention	Assess-ment	Results	Follow-up	Comments
Smith & Petrie, (2008), USA RCT	Division I university: N=1 Female athletes: N=29 Mean age 19.32±0.94 yr. Cognitive-dissonance (CD): N=12 Healthy weight (HW): N=7 Wait-list control (C): N=10	CD: participants speak and act against the thin-ideal standard of female beauty through a series of interactive activities with the aim of creating cognitive dissonance HW: participants are encouraged to make small lifestyle changes in eating and exercise to help maintain a healthy weight CD: no intervention 3 weeks 1 session per wk.	Self-report BAA-R BPSS-R BSQ-10-R PANAS-X[b] BULIT-R DRES	No difference between groups Exploratory post-hoc analyses: CD: Decrease: sadness/ depression Increase: internalization of a physically fit and in shape body type, and body satisfaction. Only program not to show more negative symptoms during the study C: Improvements: body satisfaction and anxiety More internalization	No	First after controlling for the athletes competitive schedules and that some had worked formerly with the facilitators, 29 of the 39 identified and eligible athletes were randomized The athletes in CD and C were older than the athletes in the HW group Low power, groups were not comparable across all of the variables Did not examine possible reductions in onset of ED
Elliot et al. (2004), USA Prospective controlled trial	High school: N=18 Female athletes: N=928 Mean age 15.4 yr. Experimental group (EG):N=457 Control group (C): N=471	ATHENA: school-based, sport team-centered program to prevent young female high school athletes DE and body-shaping drug use Gender-specific, both coach-led and peer-led format and explicitly scripted Topics: healthy sport nutrition, effective exercise training, drug use and other unhealthy behaviors effect on sport performance, media images of females, and depression prevention	Self-report RSES EAT EDI CES-D OSIQ	ATHENA increased four potentially significant mediators: media literacy, drug resistance skills, self-efficacy in controlling mood, and the perception that few peers endorse and use body-shaping drugs EG: Less weight reduction drug use Significant positive changes in dietary habits and exercise training self-efficacy Increased total daily protein consumption Greater belief that what they ate	No	No between-groups differences in body image or in perception of their coaches' attitudes Indicates that a sport-team-centered, gender-specific, peer-led curriculum can be an effective means to alter a young female's knowledge, attitudes, and behaviors Did not examine possible reductions in onset of ED

		C: offered preprinted pamphlets concerning DE, drug use and sport nutrition information 8 weeks 1 session per week a 45-min.		affected their sport performance Favorable changes toward future vomiting to lose weight, and use of diet pills, tobacco, and creatine		
Elliot et al. (2008), USA Prospective randomized trial	High school: N=18 Female athletes: N=400 Graduates >18 yr. Intervention: N=203 Control: N=197	To identify longer-term effects, control and intervention ATHENA participants were reassessed one to three years following high school graduation 1 yr. after the intervention's last yr. an anonymous survey was sent all participants who had completed high school and were ≥18 yr.	Self-report[c]	1-3 yr. following graduation intervention athletes who had received ATHENA reported less use of cigarettes, marijuana, and alcohol No difference was observed between conditions in use of diet pills, diuretics, laxatives and self-induced vomiting		The follow-up was conducted as a second study (anonymous), and unable to match with baseline data Years from graduation among the participants differed between 1 to 3 yr. No longer clustered on teams and in schools Exclusive use of self-report measures
Abood & Black, (2000), USA RCT	Division I university N=1 Female athletes: N=70 Mean age 19±0.78 yr. Experimental group (EG): N=35 Comparison group (CG): N=35	Health education intervention focus on health-promoting attitudes and behaviors Designed to increase awareness and skills for developing positive health states and to learn how these states enhance athletic performance. Content areas: self-esteem, performance pressure, nutrition knowledge and beliefs/myths related to athletic performance, and stress management (each topic were allotted two weeks) 8 weeks 1 session per week	EDI-BD EDI-DT SCAT RSES SAS NI Interview[d]	EG scored lower on EDI-DT ($p<0.01$) and EDI-BD ($p<0.05$) CG scored lower on self-esteem ($p<0.001$) and nutrition knowledge ($p<0.05$) The educational intervention was associated with decreased EDI-DT ($p<0.05$) and decreased EDI-DT was associated with decreased EDI-BD ($p<0.01$) Both groups experienced reductions in self-esteem (only athletes in CG significant reduction)	No	High participation rate (96% completed all sessions) Scores for both EG and CG on EDI-DT and EDI-BD did not meet the EDI-2 cutoffs (>14, and EDI-DT >10) Did not examine possible reductions in onset of ED

Table 6. Continued.

Reference Design	Sample	Intervention	Assess-ment	Results	Follow-up	Comments
Piran, (1999a), Canada 3 cohort survey: 1987, 1991 & 1996	Residental ballet school: N=1 Female gymnasts: N=68, 65, 65 12-18 yr.	Selective intervention to reduce body weight and shape preoccupation The program followed the health-promoting school model developed by the WHO Dialogues with administration, teachers and students in focus groups were used to inform and guide the prevention program Systematic factors for the development of body weight and shape preoccupation were identified during the dialogues and addressed both with school staff and within the peer groups Focus groups: 2-6 sessions annually	EDI-DT EDI-B EDI-BD DSED EAT-26	Athletes who scored above EAT >20 and those who have binged, vomited for the purpose of weight loss, or used laxatives during the past year, were compared between the cohorts Decreased DE patterns, disturbed attitudes about eating and body shape between the cohorts Increased healthy eating patterns Prevalence of AN dropped tenfold to 1%, while there was no new cases of BN Among the girls aged 15-18 the percentage scoring above EAT>20 fell from 50% in 1987 to around 15% in 1991, where it remained in 1996	Yes >1yr.	No control group and small group sizes means the results must be interpreted cautiously The results suggests it is possible to create a sub-culture where healthier norms regarding body shape and weight can be incorporated, to the benefit of students No curriculum or pre-established set of "lessons"

AM-DBP (athlete-modified cognitive dissonance prevention), AM-HW (athlete-modified healthy weight intervention), IBSS-R (Ideal Body Stereotype Scale-Revised), DRES (Dutch Restrained Eating Scale), EDE-Q (Eating Disorder Examination Questionnaire), PANAS-X (Positive Affect and Negative Affect Schedule-Revised), EAT/EAT-26 (Eating Attitudes Test–26 items), SATAQ (Sociocultural Attitudes Towards Appearance Questionnaire), CISSS (Climate in Sport Setting Scale), BESAA (Body-Esteem Scale for Adolescents and Adults), SED (Self-Efficacy over Dieting), PEA-Q (Parental Eating Attitudes Questionnaire), BAA-R (Beliefs About Attractiveness Scale-Revised), BPSS-R (Body Parts Satisfaction Scale-Revised), BSQ-10-R (Body Shape Questionnaire-Revised – 10 items), BULIT-R (Bulimia Test-Revised), DRES (Dutch Restrained Eating Scale), RSES (Rosenberg Self-Esteem Scale), EDI (Eating Disorder Inventory), CES-D (Center for Epidemiologic Studies Depression Scale), OSIO (Offer Self-Image Questionnaire for adolescents), EDI-BD (EDI-Body dissatisfaction), EDI-DT (EDI-Drive for thinness), SCAT (Sport Competition Anxiety Test), SAS (Self-Rating Anxiety Scale), NI (Nutrition Inventory), EDI-B (EDI-Bulimia), DSED (Diagnostic Survey for Eating Disorders). [a]Only the "Pressure to be Thin" subscale of the CISSS was used in this study. [b]Sad/depressed, anxious, shame, guilt and stress items from PANAS-X were used to quickly assess negative affect. [c]The mailed questionnaire was brief and limited to demographics, drug use and eating behaviors, and selected attitudes. [d]Participants were randomly interviewed about the impact of the work-shops on their health and well-being.

Assessment of eating disorders

Development and modification of instruments for identification of clinically significant ED has been a major research interest for years (Friborg et al., 2013), and various assessment methods have been developed such as clinical interviews, questionnaires, self-monitoring, observation, clinical rating scales and symptom check lists. In clinical and research settings the most commonly used methods are semi-structured clinical methods, self-monitoring and questionnaires. Widely used questionnaires that have consistently shown to be valid and reliable in screening for ED include the Eating Disorder Inventory (EDI) (Garner & Olmsted, 1984), the EAT (Garner et al., 1982) and the Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994; Fairburn & Beglin, 2008). Examples of clinical interviews are the Eating Disorder Examination (EDE) (Fairburn et al., 2008) and the Interview for Diagnosis of Eating Disorders (Williamson, 1990) (Table 7). The EDE is frequently used clinically and in research. It is generally considered the best established instrument for assessing ED psychopathology and the "gold standard" for establishing a diagnosis (Byrne & McLean, 2002; Fairburn & Bohn, 2005). An advantage of using an interview measure is that it permits the interviewer to explain and elaborate the questions to the participant, allowing for the attainment of more specific information and thus decrease the likelihood of false positive diagnoses (Peterson & Miller, 2005). On the other hand, an interview requires a trained interviewer, it is not suitable when anonymity or group administration is required, and when studying large samples it is cumbersome and expensive to conduct individual clinical interviews. In contrast, self-report questionnaires tend to be relatively inexpensive, are reasonable quick and easy to administer, objectively scored, and free of interview bias (Garner, 2002). An important drawback is that they are self-reported and rely on the accuracy and honesty of the individual's report. It has also been argued that clinical interviews are needed to obtain accurate prevalence data (Oppliger et al., 1993; Sundgot-Borgen, 1994). Therefore, in population-based studies the preferred design often involves two steps. First, screening with self-report questionnaires to identify those who are likely to have significant levels of eating pathology and need further assessment. Second, all subjects above a certain cut-off point or similar are followed-up with a clinical interview to establish a possible diagnosis.

Screening athletes at risk for an ED or who already have developed an ED may be challenging as they rarely self-identify and the health consequences are not always readily apparent. It may also be challenging to determine whether DE and dieting behaviors are transient, safely managed

behaviors associated with the demands of the sport, or if the symptoms are more stable and signify a clinical ED. Unfortunately, an important limitation of the instruments mentioned being used in screening for ED is that they have not been adequately validated in the athletic population, and may not be appropriate screening instruments for athletes (Beals, 2004; Bonci et al., 2008). Furthermore, screening questionnaires developed specifically for athletes (such as the Athletic Millieu Direct Questionnaire (Nagel et al., 2000), The Female Athlete Screening Tool (McNulty et al., 2001), The Psychological Screening Test (Black et al., 2003) and the College Health Related Information Survey (Steiner et al., 2003)) have not been tested or validated sufficiently in large groups of athletes at different competitive levels (Beals, 2004; Bonci et al., 2008). As a result, most studies among athletes have used questionnaires originally designed for clinical settings. Among the few studies on elite athletes and ED that have gone beyond the administration of self-reported questionnaire screening, most have used a combination of standardized questionnaire subscales such as the EDI-Body dissatisfaction (EDI-BD) and the EDI-Drive for thinness (EDI-DT) from the EDI, and additional self-developed questions (Sundgot-Borgen, 1993; Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008). Results from these studies show that elite athletes underreport and non-athletes overreport symptoms associated with ED, resulting in a high percentage of athletes classified as false negative when compared to a clinical interview for the diagnosis of ED (Sundgot-Borgen, 1993; Torstveit et al., 2008). Based on the difficulties that exist when it comes to identifying elite athletes "at risk" for ED and the need for a clinical interview to identify athletes who already have developed an ED a two-tiered approach is recommended (questionnaire screening followed by clinical interview). For an accurate estimation of the prevalence of ED among athletes both athletes "at risk" and a random sample of athletes "not at risk" should be included in the clinical interview. A description of the most frequently used instruments is presented in Table 7.

As a result of the substantial limitations with the instruments being used when screening athletes for ED, one aim of this thesis was to design an accurate, yet less comprehensive screening questionnaire with the ability to discriminate between adolescent female elite athletes with an ED from those without an ED (Paper IV).

Table 7. Frequently used screening instruments for assessment of DE or ED in athletes.

Instrument	Method	Description	Reliability and validity	Limitations
Body Shape Questionnaire (BSQ) (Cooper et al., 1987)	Self-report questionnaire	Assess the extent of psycho-pathology of concerns about body shape, in particular the experience of feeling fat. Consist of 34 items (6-point, never to always). Whether 34 items are needed to assess a single concept has been questioned (Evans & Dolan, 1993) and several short versions have been developed.	High test-retest reliability, internal consistency, and high split-half reliability using data from general population (females), student sample (81% females) and a clinical sample (females). Correlate highly with the EDI-BD, and show high discriminant validity (Ghaderi & Scott, 2004).	Not specific to athletes. Not validated in athletic populations.
Bulimia Test-Revised (BULIT-R) (Thelen et al., 1991)	Self-report questionnaire	Assess the severity of symptoms and behaviors associated with BN categorized into: binges, feelings, vomiting, food, weight, laxative/diuretic abuse, and menstrual regularity. Consists of 28 items (5-point, Likert-type scale).	Reliable and valid measure of bulimic symptoms in clinical and nonclinical female college populations (Thelen et al., 1991; Brelsford et al., 1992; Thelen et al., 1996). Demonstrate good reliability with adolescent samples (Vincent et al., 1999).	Inability to discriminate within the non-bulimic group (e.g. individuals with AN will not be differentiated from those without ED). Not specific to athletes. Not validated sufficiently in athletic populations.
Eating Attitude Test (EAT-40) (Garner & Garfinkel, 1979)	Self-report questionnaire	Assess thoughts, feelings and behaviors associated with AN. Consists of 40 items (6-point, never to always).	Valid in both clinical (AN) and non-clinical samples. High internal consistency, and good test-retest reliability (Garner & Garfinkel, 1979). High validity for differentiating DSM-IV ED and non-disordered non-clinical female samples (Mintz & O'Halloran, 2000).	Not specific to athletes. Not validated in athletic populations.
Eating Attitude Test (EAT-26) (Garner et al., 1982)	Self-report questionnaire	Assess thoughts, feelings and behaviors associated with AN. Shortened version of EAT-40. Consists of 26 items. A cut-off of 20 is used to identify those individuals with disturbed eating patterns who may be at risk of receiving a clinical diagnosis of AN.	Valid and reliable in both clinical and nonclinical female samples (Garner et al., 1982). High validity for differentiating DSM-IV ED and non-disordered non-clinical female samples (Mintz & O'Halloran, 2000).	Not specific to athletes. Not validated sufficiently in athletic populations.

Table 7. Continued.

Instrument	Method	Description	Reliability and validity	Limitations
Eating Disorder Inventory (EDI) (Garner & Olmsted, 1984)	Self-report questionnaire	Assess attitudes, feelings and behaviors associated with AN and BN. Consists of 64 items that generate 8 subscales (6-point, always to never). The subscales EDI-DT, EDI-BD, and EDI-Bulimia assess behaviors regarding body image, eating, and weight control practices. The additional subscales assess the various psychological disturbances characteristic of those with ED. See also page 57.	Valid and reliable in both clinical and nonclinical samples (Garner & Olmsted, 1984); (Norring & Sohlberg, 1988).	Not specific to athletes. Not validated sufficiently in athletic populations.
Eating Disorder Inventory-2 (EDI-2)(Garner, 1991)	Self-report questionnaire	Contains the same 8 subscales as EDI and adds 3 additional subscales (Asceticism, Impulse Regulation, and Social Insecurity). In total 11 subscales (91 items). See also page 57.	Test-retest reliability is good for short durations (<1 year) (Garner, 1991). Valid in clinical and non-clinical female samples (Nevonen & Broberg, 2001). The EDI-2 scales generally less reliable for men (Spillane et al., 2004).	Not specific to athletes. Not validated sufficiently in athletic populations.
Interview for Diagnosis of Eating Disorders-IV (IDED-IV) (Williamson, 1990; Kutlesic et al., 1998)	Semi-structured interview	Developed for diagnosing AN, BN, and binge ED. Consists of 20 items (5 point Likert-type scale) pertaining to DSM-IV criteria generating to 3 subscales.	Yields sufficiently reliable and valid data to be used for determining diagnoses (AN, BN and binge eating (Kutlesic et al., 1998). Research is needed on its concurrent validity. Could be used in clinical practice to evaluate individual symtpoms and their changes as a result of treatment interventions.	Time consuming (a qualified professional is required to conduct the interview and interpret the results). Not validated in an athletic population.
Eating Disorder Examination (EDE) (Cooper & Fairburn, 1987; Fairburn et al., 2008)	Semi-structured interview	Assesses ED psychopathology and key ED behaviors. It consists of 4 subscales (dietary restraint, shape concern, weight concern and eating concern). Ratings for subscale items are scored on a seven-point Likert scale with higher scores representing greater severity of psychopathology. See also page 59.	High reliability and validity in clinical and non-clinical samples (Cooper & Fairburn, 1987; Cooper et al., 1989).	Time consuming (need course and extensive training to conduct the EDE and interpret the results). Not formally validated in an athletic population.

Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994; Fairburn & Beglin, 2008)	Self-report questionnaire	Self-report version of EDE consisting of 36 items. EDE-Q 6.0 used in this thesis consists of 28 items. Main difference is that the original version includes questions about diuretic misuse and subjective binge eating episodes, whereas EDE-Q 6.0 does not. Both include the same 22 items assessing the core attitudinal features of ED psycho-pathology. In addition, EDE-Q 6.0 contains some minor adjustments in the phrasing of some items. Parallel to the EDE the EDE-Q spans an identical 28-day timeframe, uses the same seven-point rating scale (0-6), and generates the same four subscales to represent severity of aspects of the psychopathology of ED. See also page 59.	High level of agreement between EDE and EDE-Q for core attitudinal features of ED psychopathology in both community and clinical samples of adolescent and young adult women (Fairburn & Beglin, 1994; Carter et al., 2001; Grilo et al., 2001). Suitable for use in adolescent boys, with the qualification that eating and weight/shape control behaviors that are largely confined to males may not be adequately assessed (Mond et al., 2014).	Not specific to athletes. Not validated in athletic populations.

Aims of the thesis

The overall aim of this thesis was to examine if it is possible to prevent the development of new cases of ED among adolescent male and female elite athletes through a one-year school-based intervention program.

The specific aims were:

1. To examine the prevalence of clinical ED in adolescent male and female elite athletes and age-matched controls by using a two-tiered approach, including a questionnaire screening followed by clinical interviews (Paper I)
2. To examine the effect of a one-year school-based intervention program to prevent the development of new cases of ED and symptoms associated with ED among adolescent male and female elite athletes (Paper II)
3. To examine the effect of the educational program on the coaches' total knowledge and for each of the three knowledge content areas of nutrition, weight regulation, and ED (including recognition and management). A second aim was to examine the coaches' subjective evaluation of their knowledge of ED (Paper III)
4. To design an accurate, yet less comprehensive screening questionnaire with the ability to discriminate between adolescent female elite athletes with an ED from those without an ED (Paper IV)

Methods

The four papers (I-IV) constituting this thesis are based on data from the research project "Is it possible to prevent ED among young elite athletes? The Health, Body and Sports Performance Study." All Norwegian Elite Sport High Schools (n=16) and two randomly selected regular high schools participated in the three school-year project period (September 2008 to June 2011) (Figure 1). The project was designed as a RCT.

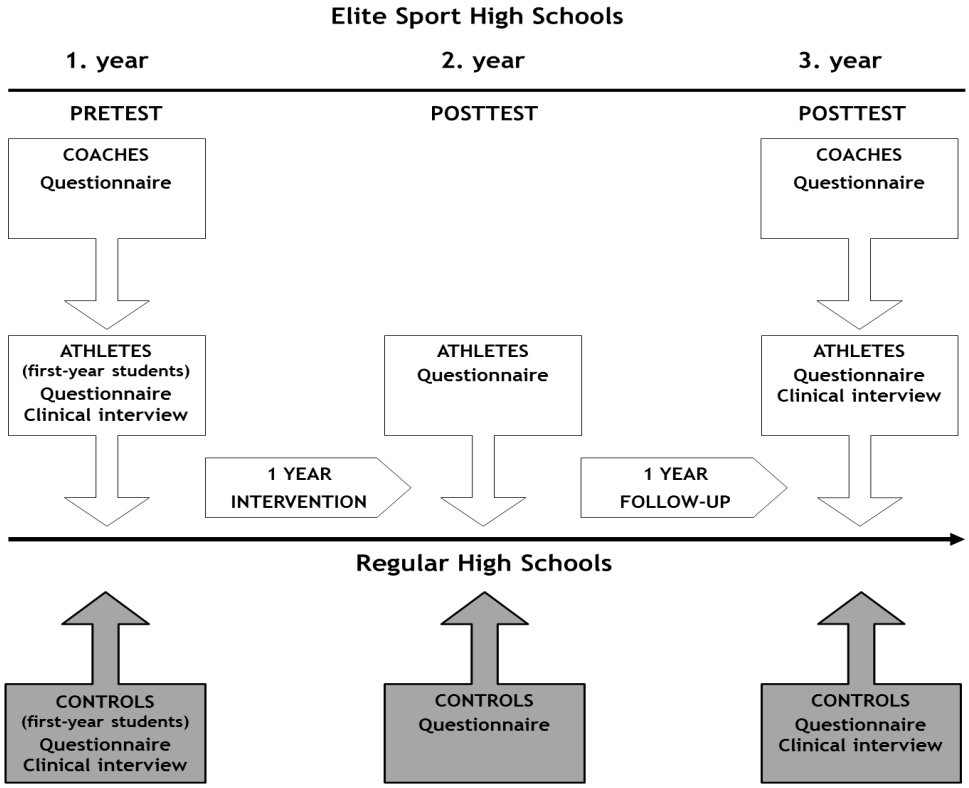


Figure 1. An overview of the research project "Is it possible to prevent ED among young elite athletes? The Health, Body and Sports Performance Study" from September 2008 to June 2011.

The project was divided into phase I and II (Figure 2). In phase I (pretest), we included all the Elite Sport High Schools and the regular high schools for screening. In phase II, the different Elite Sport High Schools were stratified (by size) and randomized to the intervention group (n=9) or control group (n=7). The intervention group received a one-year intervention program

aiming to prevent the development of new cases of ED and symptoms associated with ED among the athletes. The Elite Sport High Schools in the control group and the regular high schools received no intervention throughout the project period.

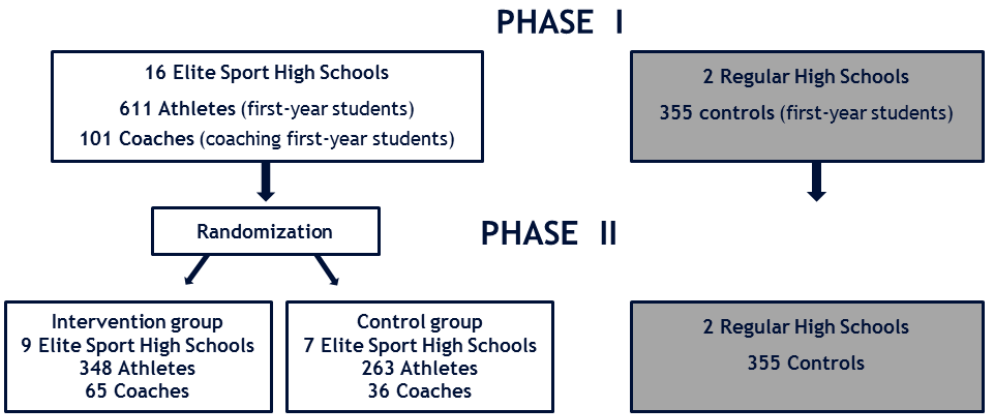


Figure 2. The Health, Body and Sports Performance Study divided into phase I and II.

In this thesis, I have included data from the Elite Sport High Schools at phase I and II, and from the regular high schools at phase I. **Paper I** present the prevalence of ED among the total population of first-year students at the 16 Elite Sport High Schools and the two regular high schools at pretest. In **Paper II**, we describe the school-based intervention program and examine its effectiveness in preventing new cases of ED and symptoms associated with ED among the student athletes during high school. A description of the special educational program developed for the coaches employed at, and working with the student athletes at the Elite Sport High Schools is given in **Paper III**. The interventional effect on the coaches' knowledge of nutrition, weight regulation, and ED (including recognition and management) in addition to the coaches' subjective evaluation of their knowledge was examined. In **Paper IV**, a new brief questionnaire able to discriminate between female elite athletes with and without an ED are described and validated. The paper includes the adolescent female elite athletes from Paper I and II, as well as an external validation sample with gender- and age-matched female elite athletes (Torstveit & Sundgot-Borgen, 2005). Figure 3 provides an overview of the design and participants movement for Papers I-III.

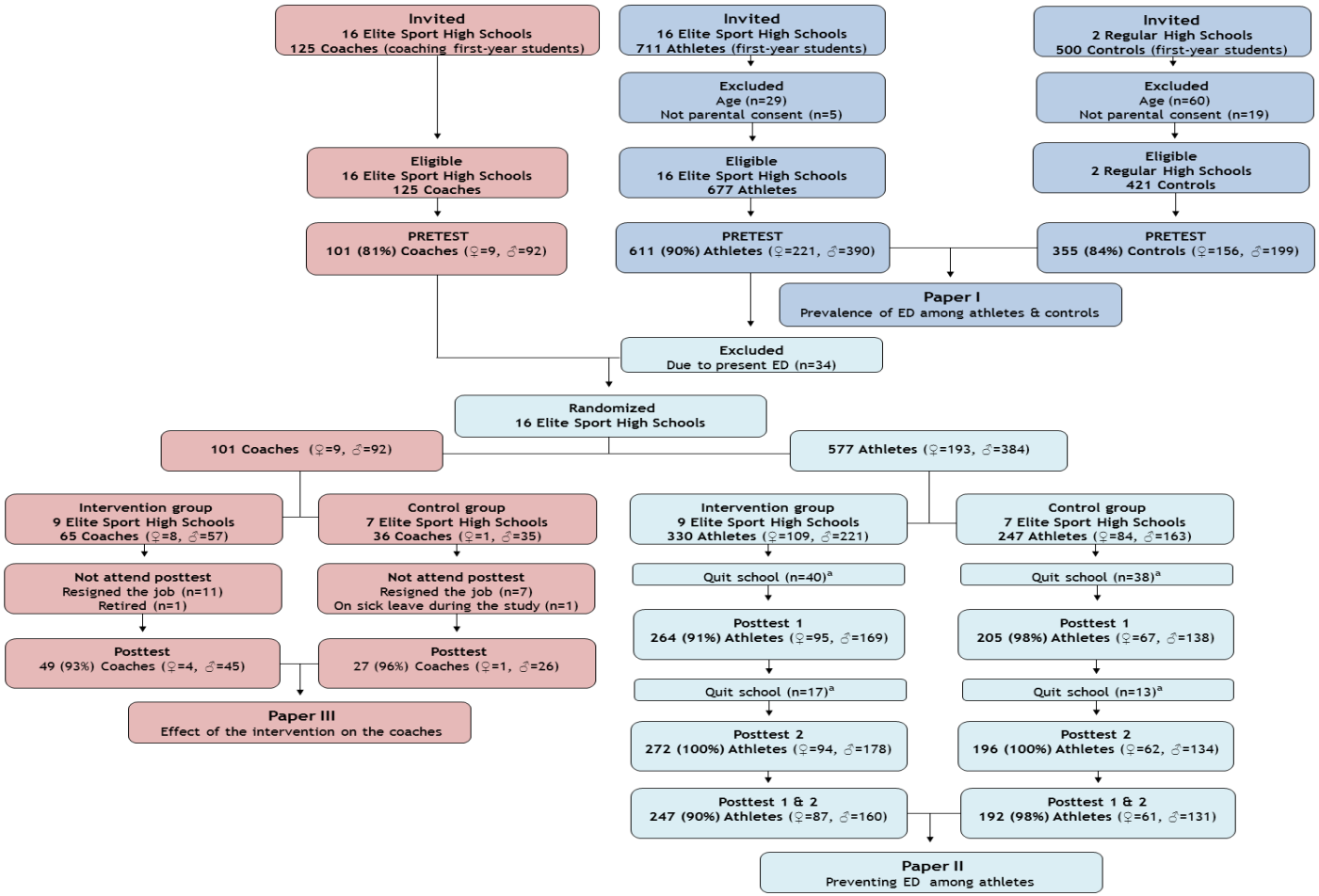


Figure 3. Flow chart of the design and participants movement for Paper I-III. [a]Changed to regular high schools.

Design, participants & intervention program

The Norwegian Elite Sport High Schools

The Norwegian Elite Sport High Schools are selective, private and public high schools designed for highly talented athletes. The schools state that they aim to provide the best conditions possible, combining education and sports, and give athletes the opportunities to compete on a national or an international level and at the same time acquire high school graduation. Prior to this dissertation there were 16 Elite Sport High Schools in Norway (all of them included). The schools are located all over the country, and some will have to move away from home for the first time to attend one of the schools (Figure 4). It is reason to believe the athletes are highly motivated to succeed when they start as first-year student athletes at one of the Elite Sport High Schools.

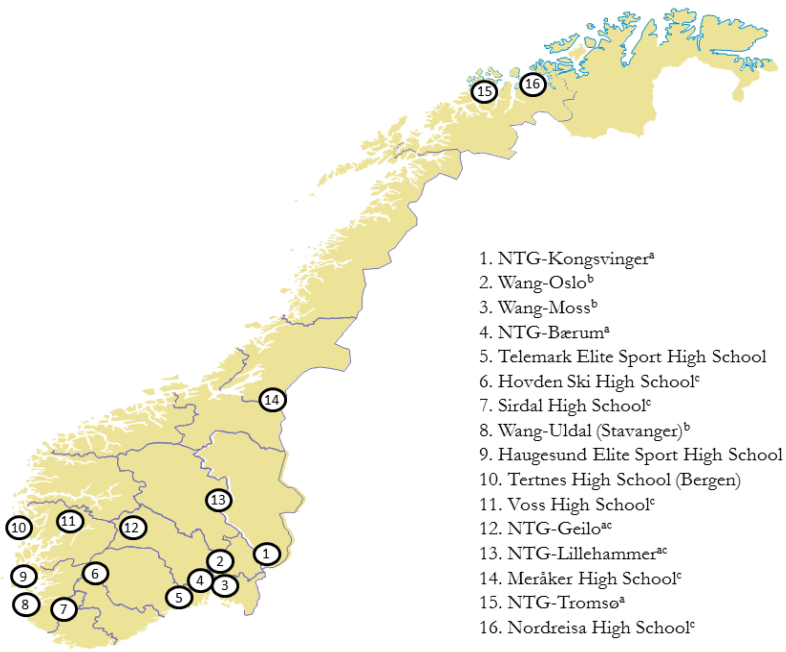


Figure 4. Map of Norway indicating the 16 different Elite Sport High Schools included in the study. [a]NTG (The Norwegian College of Elite Sport – Norges Toppidrettsgymnas). [b]Wang (Wang Sports Academy – Wang Toppidrett).[c]Cooperating with the Norwegian Ski Federation.

Paper I

We conducted this cross-sectional study in two phases: self-reported questionnaire (part I) and clinical interview (part II). In part I, we invited the total population of first-year students attending Elite Sport High Schools (n=16) in Norway and age-matched controls from two randomly selected regular high schools in Buskerud county in Norway to participate. Inclusion criteria for part I of the study were enrolment as a first-year student and a birth date in 1992 (ie, age of 15 or 16 at the time of data collection). Written parental consent was required before the participants were contacted for participation (see Research ethics page 62). In total, 1211 first-year students, 711 athletes and 500 controls, were invited to participate in the initial screening during the 2008-2009 school year (Figure 3). A total of 34 athletes and 79 controls were excluded (due to age: 29 athletes and 60 controls; failure to obtain parental consent: 5 athletes and 19 controls). Of the remaining 677 athletes and 421 controls, 66 athletes and 66 controls did not participate because they did not attend school during the test day. Reasons reported for not attending school that day for the athletes were training camp, competition, or illness, while among the controls no specific reasons were reported. This resulted in a final sample of 611 athletes (response rate 90%) and 355 controls (84%) that answered the self-reported questionnaire (pretest), representing 50 different sport disciplines (Figure 3).

Based on the data from part I, 51 male and 102 female athletes (n=153, 25.0%) and 67 male and 113 female controls (n=180, 50.7%) were classified as being "at risk" with symptoms associated with ED (Figure 5). We invited all "at-risk" athletes (n=153) and a randomly selected sample (50%) of "at-risk" controls (n=91, 34 males and 57 females) to participate in the clinical interview Eating disorder examination 16.0 (EDE) (Fairburn et al., 2008). We included the clinical interview to determine whether athletes and controls classified as being "at risk" for ED during the self-reported questionnaire screening met the DSM-IV criteria for AN, BN, or EDNOS (American Psychiatric Association., 1994) and to determine the presence and frequency of core ED symptoms.

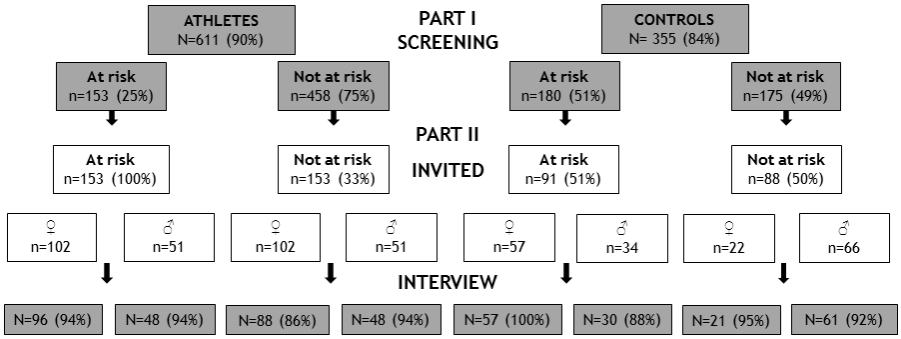


Figure 5. Number and percentage of subjects participating in parts I and II (Paper I).

Paper II

The first-year student athletes eligible for the Health, Body and Sports Performance Study participating in Paper I formed the basis for this RCT. After pretest (Paper I) all the Elite Sport High Schools were stratified (by size) and randomized to the intervention group (n=9) or control group (n=7). To minimize contamination bias within schools, we utilized a cluster-randomized design. All athletes (and coaches, Paper III) from each school were randomized to the same treatment arm (intervention or control). The statistician (Ingar Holme) who conducted the randomization did not take part in the intervention. The schools were told that those allocated to the intervention group would receive a one-year intervention program aiming at preventing the development of ED and reducing reported symptoms associated with ED among young elite athletes. Among the 611 first-year student athletes participating in the pretest (Paper I), 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 attending the pretest, posttest 1 and posttest 2. Further, athletes (n=27) meeting the criteria for ED prior to the intervention program were excluded from all analyses on the effect of the intervention (Figure 3). In this study the athletes completed the self-reported questionnaire screening at pretest (Paper I), posttest 1 (after the one-year intervention) and posttest 2 (9 months after the intervention). The clinical interview EDE was conducted after questionnaire screening at pretest (as described in Paper I) and at posttest 2 (1-year follow-up) (Figure 1). In the clinical interview conducted at posttest 2 all athletes were invited (attended: n=463, 99.6%).

Paper III

In this part of the RCT we wanted to assess the effect of the special educational program developed for coaches and included as a separate part of the intervention program for athletes and coaches. This educational program was developed to provide the coaches with knowledge and strategies regarding identification, management, and prevention of ED. To assess the effect of the educational program on the coaches, the total population of coaches employed at and working with the first-year students at the Elite Sport High Schools during the 2008-2009 school year were invited to participate (Figure 3). In total, 125 coaches were invited. Of these, 24 did not participate. Other than illness, reasons for not participating included involvement in training camps, competitions, and teaching/working outside the school that day. Among the 101 coaches attending the pretest 18 quit working at the schools, one retired, and one went on sick leave. This resulted in a final sample of 76 coaches (intervention group (n=49) and control group (n=27)) completing the questionnaire screening at pretest and posttest (9-months after intervention). Ninety-three percent of them were males (Figure 3).

Paper IV

We conducted this prospective cross-sectional study in three phases in order to design and validate a brief questionnaire able to discriminate between adolescent female elite athletes with an ED from those without an ED (Figure 6). To be included in the study the athletes had to participate in the questionnaire screening and clinical interview. Phase I and III were based on data from the female adolescent elite athletes participating in Paper I and II. Phase I consist of data from the self-reported questionnaire and clinical interviews conducted at pretest (Paper I), whereas phase III includes data from the questionnaire and clinical interviews at posttest 2 in Paper II (approximately two years after pretest and referred to as posttest in this paper). In phase II, we included 54 gender- and age-matched elite athletes from one of our earlier studies as an external validation sample (Torstveit & Sundgot-Borgen, 2005). This was the total number of eligible athletes from that study who matched the current sample on age. In that study an elite athlete was defined as one who qualified for the national team at the junior or senior level, or who was a member of a recruiting squad for that team. The 54 athletes included from the external dataset represented 23 different sport disciplines.

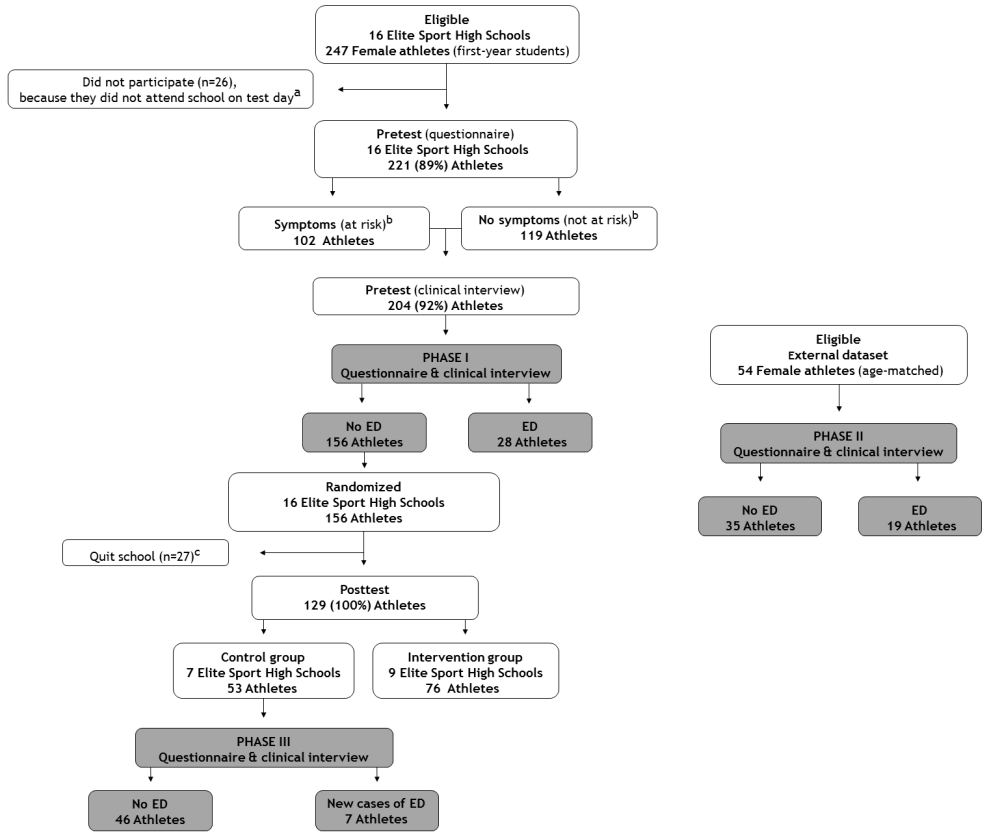


Figure 6. Flow chart of the study and participants in phase I, II and III in Paper IV. [a]Reasons reported were training camps, competition and illness. [b]Athletes who reported at least one symptom associated with ED were classified as "at risk" (the symptoms associated with ED are further described in the Definition section page 55). [c]Changed to regular school.

In phase I (the try out sample), we extracted items from the comprehensive questionnaire screening at pretest, which revealed good predictive abilities for a diagnosis of ED to the Brief ED in Athletes Questionnaire (BEDA-Q) version 1 and 2 (Table 8). Version 1 consisted of 7 items from the EDI-BD, EDI-DT, and questions regarding dieting. In version 2, two items from the EDI-P subscale were added.

Table 8. The different items included in BEDA-Q version 1 and 2.

Items	Version	
	1	*2*
1 I feel extremely guilty after overeating (EDI-DT11)[a,c] □ always □ usually □ often □ sometimes □ rarely □ never	X	X
2 I am preoccupied with the desire to be thinner (EDI-DT32)[a,c] □ always □ usually □ often □ sometimes □ rarely □ never	X	X
3 I think that my stomach is too big (EDI-BD2)[a,c] □ always □ usually □ often □ sometimes □ rarely □ never	X	X
4 I feel satisfied with the shape of my body (EDI-BD19)[a,b] □ always □ usually □ often □ sometimes □ rarely □ never	X	X
5 My parents have expected excellence of me (EDI-P43)[c] □ always □ usually □ often □ sometimes □ rarely □ never		X
6 As a child, I tried very hard to avoid disappointing my parents and teachers (EDI-P29)[c] □ always □ usually □ often □ sometimes □ rarely □ never		X
7 Are you trying to lose weight now?[d] □ Yes □ No	X	X
8 Have you tried to lose weight?[d] □ Yes □ No	X	X
9 If yes, how many times have you tried to lose weight?[d] □ 1-2 □ 3-5 □ >5 times	X	X

The responses on the EDI items six-point format are weighted from 0 to 3, and the scores are computed by summing the item scores. Positive scores are weighted as follows: always = 3, usually = 2, often = 1, sometimes = 0, rarely = 0, never = 0, and reverse-scored items are weighted in the opposite manner (Garner, 1991). [a]Included as EDI_4 in BEDA-Q version 1. [b]Reversed-scored. [c]Included as EDI_6 in BEDA-Q version 2. [d]The items "trying to lose weight now" and/or "tried to lose weight before ≥3 was combined into one variable (dieting) in the analyses combined with EDI_4 in version 1 and EDI_6 in version 2.

Intervention program

On the basis of current knowledge about possible risk factors and the conditions, theory, and results from existing studies aiming to prevent DE and ED in the general (Stice, 2002; Børresen & Rosenvinge, 2003; Stice et al., 2007; Yager & O'Dea, 2008), and athletic population (Sundgot-Borgen, 1994; Piran, 1999a; Drinkwater et al., 2005; Torstveit et al., 2008), we devised a one-year intervention program. The Health, Body and Sports Performance intervention program was sport-specific in the sense that the program was developed for athletes and coaches. It was built on the social-cognitive framework (Bandura, 1986), and the primary focus was to enhance self-esteem by strengthening the athletes self-efficacy. To underpin the importance of building a

strong self-less contingent on performance issues and significant others, motivational aspects such as the meaning of intrinsic versus extrinsic motivation (Deci & Ryan, 2000) and mastery versus performance goals (Nicholls, 1989) were included. We focused on systematic changes within the intervention schools and aimed at intervening at the social system level and the individual level (Piran, 1999a). The intervention was also influenced by the elaboration-likelihood model (Petty & Cacioppo, 1986) and the cognitive-dissonance theory (Festinger, 1957). 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 (Petty & Cacioppo, 1986). For maximal reinforcement, we used a one-year implementation period over two school years (May 2009 to May 2010), repeating many of the messages. An overview of the components of the intervention program is given in Table 9.

Due to coaches having daily and intensive contact with their athletes, they can play an important role in their unique position by identifying early signs and symptoms, directing athletes to professional help, and preventing the development of ED (Sherman et al., 2005; Nattiv et al., 2007). Furthermore, based on the importance athletes tend to ascribe to coaches (Pensgaard & Roberts, 2002), successful prevention programs in the athletic setting are unlikely to succeed without commitment and support from their coaches and "significant others" (Sundgot-Borgen et al., 2003). Thus, in order to use the power and influence of coaches to create supportive environments regarding the prevention of ED, a special education program was developed for the coaches at the Elite Sport High Schools and included as a separate part of the Health, Body and Sports Performance intervention program. This educational program was developed to provide the coaches with knowledge and strategies regarding identification, management, and prevention of ED. In addition, dialogues with administration, teaching staff and parents were established to inform about the study 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.

Intervention program - for athletes

The athletes in the intervention schools were presented various mental training techniques to enhance self-esteem and renowned Norwegian elite athletes were used as models (in line with Bandura's recommendations (Bandura et al., 1977; Bandura, 1986)) through Facebook posts. We also included an educational program in nutrition and psychological and physiological development in adolescence. In addition, to educate 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 9). The lectures consisted of four 90-minutes sessions conducted at school during school hours by Marianne Martinsen (the project leader; PL) 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/it's learning). Facebook was used during the final six 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 the athletes can relate to (Bandura et al., 1977), we used both male and female elite athletes representing different sports. We also added videos, tips and links on the included 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 (Table 9).

Intervention program - for coaches

The educational program from the intervention targeting the coaches focused on self-esteem, self-efficacy, mental training, sports nutrition, body composition, and weight issues (Table 9). Additionally, they were provided with knowledge and strategies to identify, manage and prevent ED among athletes. We organized two seminars (2x3 hours) and provided a Coaches guide to increase knowledge about nutrition, and how to identify and manage ED in the sport environment. In the Coaches guide, we also included questions that the coaches were required to answer and return to the PL. These questions were related to nutrition, dieting, ED, and how to identify and manage ED in the sport environment. Individual feedback was given all the coaches on their assignments. In addition to the seminar lectures, identification and management of clinical and subclinical cases were discussed in the workshop during the seminar at school.

Coaches were informed about the intervention program provided for the athletes, and were also encouraged to attend the lectures arranged for the athletes. Moreover, the coaches were presented with ideas on how to include, and follow-up with the mental training assignments in their coaching (Table 9).

Table 9. The Health, Body and Sports Performance intervention program.

ATHLETES		
Time point Arena Organisation	**Themes**	**Purpose**
Spring 2009 Classroom Lecture 1[a]	*Motivation* I: Goal setting; intrinsic and extrinsic *Self-esteem* I: Role of self-confidence; Stress management I *Nutrition* I: Health; Physical training; Performance *Physiology* I: *G*rowth and development; Energy metabolism *Sports sciences* I: Training principles *Prevention I*: Injury (e.g. energy availability, overtraining); Illness (e.g. nature and course of ED, what to do when worried (yourself /classmate)	• Increasing knowledge and awareness of the relation between physical skills, physical fitness, and mental skills on sport performance • Be familiar with psychological and physiological changes during puberty and how this may affect e.g. sport performance and become possible stress factors • Increase knowledge about nutrition and the association to health and sport performance • Understand the principles of specificity, overload, recovery, adaptation, and reversibility in addition to training and performance • 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
Fall 2009 Classroom Lecture 2[a]	*Motivation II*: Process goals; Mastery orientation; Reduce/avoid risk factors *Self-esteem II*: Body image; Stress management II *Nutrition II*: Sports nutrition I (e.g. intake before, during and after training/ competition); Dieting (energy balance; DE, and ED) *Physiology II*: Growth and development II *Sports Sciences II*: Developing athlete	• Understand the concepts of motivation • Be aware of possible stress factors and how to handle them/ cope with it • Improve recovery routines (e.g. by stress management, sufficient nutrition) • Obtain adequate nutrition to optimize health and sports performance • Encourage critical evaluation of "hot" topics and supplements • Be familiar with psychological and physiological changes during puberty and the association with performance and perceived stress factors • Be aware of own fluid and fuel intake during and after training/competition and how it can be optimized • Increase awareness by discussing how to show concern for a classmate without making accusations, and who to contact about your concern

Table 9. Continued.

ATHLETES		
Time point Arena Organisation	**Themes**	**Purpose**
Assignments • Group	*Mental training I*: Requirements and expectations; Stress regulation; Self-esteem *Nutrition*/Sport sciences: Plan and facilitate fluid and fuel intake before, during and after training/ competition? *Prevention*: Illness (what to do if worried of DE and ED (yourself/ classmate))	See previous page.
Home Assignments • Theoretical • Practical	*Motivation*: Goal setting *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) *Nutrition III*: Sports nutrition II (e.g. carbohydrate, protein, fat and antioxidant and mineral needs, smart nutritional planning) *Sports Sciences III*: Training principals (overtraining, restitution, healthy activity habits); Dieting and weight loss (sport performance, dispel myths) *Prevention II:* Injury II (e.g. overtraining, fatigue; recovery); Illness II (what to do if you worried one of your classmate are struggling with DE)	• Examples of content and how goal setting can enhance motivation • Increase knowledge of the 24-h athlete • Encourage critical thinking
Assignments • individual	*Nutrition*: Fluid and fuel intake during a normal day *Sports sciences*: Training diary for the last week	• Improve recovery routines • 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 (pre-game, participation, long-term) *Mental training II*: Relaxation; Self-talk; Visualization *Initiated activities*: Facebook page; Athlete of the week; Self-reflection diary	• Be aware of how own thinking may affect behavior and performance • Be introduced to some practical skills to enable development of own mental abilities • Enhance self-esteem and underpin the importance of building a strong self-less contingent on performance issues and significant others

Table 9. Continued.

ATHLETES		
Time point Arena Organisation	**Themes**	**Purpose**
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 as self-talk and visualization • Enhance physical skills during training, competition and in the athletes preparation
	Self-esteem: Write three positive events, not related to sports performance, happening each day for a specific period	
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 *Physiology*: Growth and development; Adolescent athletes health *Prevention*: Detecting and managing ED	• Increase knowledge, challenge myths and correct possible misinformation related to nutrition, health, and performance • Be aware of the physical and psychological challenges related to puberty (e.g. self-appearance, self-esteem) and how they may affect sport performance and become possible stress factors • Understand how athletes experience pressure to lose weight from coaches and peers • Increase confidence in 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); Manage ED (how to prepare and plan the first consultation/meeting and follow up with athletes who might be suffering)	• Be able to recognize signs, symptoms associated with ED in the general population 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
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 in athletes; Stress management *Prevention*: Detecting ED (Symptoms and signs, understand the nature and course; Discussing cases); Managing ED (difficulties, guidelines (e.g.	• 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 or optimizing the policies for early detection and

Table 9. Continued.

Coaches at the school		
	training); Responsibility (as coach, the school etc.); Management protocol; Team infrastructure	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

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

Data collection and assessments

Definitions

Symptoms associated with ED (Paper I, II and IV)

To be classified as "at risk" for ED, subjects had to meet at least one of the following criteria: a) EDI-DT score ≥15 for girls and ≥10 for boys, b) EDI-BD score ≥14 for girls and ≥10 for boys, c) Body mass index (BMI) corresponding to the underweight values (Cole et al., 2007), d) Trying to lose weight now, e) Tried to lose weight before ≥3 times, e) Current and/or previous use of PWCM: 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 (Paper I, II and IV)

ED were determined by using the clinical interview EDE (Fairburn et al., 2008). For being diagnosed with an ED the DSM-IV criteria for AN, BN or EDNOS had to be met (American Psychiatric Association., 1994).

Sport disciplines

The first-year student athletes at the Elite Sport High Schools included in this thesis represented 50 different sport disciplines. For part of the analysis and in accordance with recent research (Ackland et al., 2012), they were classified into weight-sensitive and less weight-sensitive sports (Paper I). In paper III, only the female athletes at the Elite Sport High Schools are included

representing 37 different sport disciplines. Also 54 gender- and age-matched adolescent elite athletes representing 23 different sport disciplines from a previous study were included in paper III (Torstveit & Sundgot-Borgen, 2005).

Knowledge indexes (Paper III)

From the coaches' posttest, we divided all the questions measuring knowledge and strategies regarding identification, management, and prevention of ED into the following sub-indexes: nutrition (10 questions), weight regulation (5 questions), and ED (15 questions). The sub-index scores on nutrition, weight regulation, and ED were also combined to create a total knowledge index score consisting of 30 questions with a maximum score of 55 points. In the analysis at posttest, we adjusted for the total knowledge index score at pretest.

The nutrition index consisted of 10 questions measuring knowledge about energy and nutrient intake for health and performance. Questions regarding existing recommendations and resources of protein, fat, carbohydrate, calcium, and iron were also included in the index. Also more practical questions were included. The coaches' answers were scored from 0-1 or 0-3 depending on the question's comprehensiveness. The maximum nutrition index score was 16 points.

Same procedure was followed for "weight regulation" and "ED-index". The weight regulation index consisted of five questions measuring coaches' ability to manage issues concerning body weight, puberty, and performance. The coaches' answers were scored from 0-1, 0-2 and 0-3 with a maximum total weight regulation index score of 10 points. The ED-index consisted of 15 questions measuring three factors: ability to detect and manage ED, awareness of ED, and responsibility for the athlete. The coaches' answers were scored from 0-1, 0-2 and 0-3 with a maximum total ED index score of 29 points.

Self-developed questionnaires

The participants completed the questionnaire at school during school hours in the presence of members of the research group. They were all informed that an ID number was written on the questionnaire to make sure the analysis of the data was anonymous. However, a few coaches work part time and have other employers, and were not able to be at the school on the questionnaire screening days. Moreover, some coaches were at training camps or competitions. Therefore, at some schools, it was impossible to arrange the questionnaire screenings at times when every coach was available. These coaches filled out the questionnaire as soon as possible afterwards.

Athletes (Paper I, II and IV) and controls (Paper I)

The questionnaire was piloted at a regular high school by students (n=31) in the same age range with sports and physical education as major. The pilot resulted in minor editing to make the questionnaire more readable. It also gave us important information about what we had to inform the participants about before answering the questionnaire. The final questionnaire(s) included a battery of assessment questions regarding training history, physical activity and nutritional patterns, menstrual history, oral contraceptive use, dieting and weight fluctuation history, use of PWCM, injuries, self-report of previous and/or current ED and standardized questionnaires such as the EDI-2, short version of Hopkins Symptom Checklist (SCL-5) and the Contingent Self-Esteem Scale (CSE).

Coaches (Paper III)

The coaches completed a questionnaire including questions regarding educational background, athletic career, coaching experience, and coaching philosophy at pretest and posttest. The specific topics dealt with in the intervention, such as their knowledge about nutrition (related to health, physical training and performance), growth and development, knowledge and awareness of training principles, weight regulation, and ED, were assessed with the questionnaire. The questionnaire was tested in a pilot study with five coaches working at high schools with sports specialization (not Elite Sport High Schools), resulting in minor changes in the questions regarding formal education.

Standardized questionnaires

The Eating Disorder Inventory-2 (Paper I, II and IV)

The EDI-2 is a 91-item, 6-point force-choice self-report measure assessing symptoms and psychological features of ED (Garner, 1991). It consist of 11 clinically and theoretically subscales measuring (1) EDI-DT, (2) Bulimia (EDI-B), (3) EDI-BD, (4) Ineffectiveness, (5) EDI-P, (6) Interpersonal distrust, (7) Interceptive awareness, (8) Maturity fears, (9) Asceticism, (10) Impulse regulation, and (11) Social insecurity (Garner, 1991). Three of the subscales measure central ED symptoms: EDI-DT, EDI-B and EDI-BD. High score on EDI-DT and EDI-BD, as well as use of PWCM have been reported to be symptoms of DE and/or ED (Sundgot-Borgen & Larsen, 1993; Beals & Manore, 2002). High total score on EDI-DT and EDI-BD have also been used as selection criteria when screening for athletes "at risk" for ED (Sundgot-Borgen, 1993). Among the additional subscales measuring more psychological correlates associated with ED, the EDI-P

subscale has been widely used (Lampard et al., 2012). EDI-P was originally constructed as a one-dimensional measure of perfectionism, but it has been observed that the subscale measures intrapersonal and interpersonal domains corresponding to the "self-oriented" and "socially prescribed" perfectionism dimensions (Sherry et al., 2004). In Paper IV, two items from the socially prescribed perfectionism dimensions were included in the analyses in addition to items from EDI-DT and EDI-BD.

Hopkins Symptom Checklist - short version (Paper I)

The short version of Hopkins Symptom Checklist (SCL-5) is a five-item scale designed to measure symptoms of anxiety and depression. These five items are scored on a four-point scale ranging from 1 = "not at all" to 4 = "extremely". The item score is calculated by dividing the total score of the number of items answered (ranging between 1 and 4), and a cutoff score of 2 indicates psychological distress (Strand et al., 2003). The SCL-5 has been proven reliable, and it is significantly correlated to the original instrument (Tambs & Moum, 1993). In addition, a comparison study of several instruments found the reliability of this short version acceptable, with the recommendation to use the short version if included in a comprehensive questionnaire (Strand et al., 2003).

The Contingent Self-Esteem Scale (CSE) (Paper II)

The CSE is a fifteen-item scale designed to measure self-esteem contingencies, in domains such as living up to expectations, successful performance and acceptance from others (Kernis, 2003). Each item is rated on a five-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 Eating Disorder Examination Questionnaire (EDE-Q) (Paper I)

The participants filled out the EDE-Q version 6.0 when attending the clinical interviews. The EDE-Q 6.0 is a 28-item self-report measure derived from the EDE and is described below the clinical interview paragraph and in Table 7 page 39.

Clinical interview

The clinical interview was based on the EDE version 16:0 (Fairburn et al., 2008), including sport-specific questions regarding the suggested predisposing, precipitating, and perpetuating factors related to ED risk, as well as the EDE-Q 6.0 (Fairburn & Beglin, 2008). Clinical interviews was conducted after questionnaire screening at pretest (Paper I, II and IV) and one-year after

intervention (posttest 2), Paper II and IV (Figure 1 page 41). Since we gave priority to those classified as being "at risk" based on the questionnaire screening at pretest, there was a difference in the time from finishing the data collection from the screening part to attending the interview between those "at risk" and not "at risk" (12.1±4.0 (SD) vs 16.3±3.1 months, P <0.0001). There was no difference between the athletes and controls (14.2±5.0 months vs 14.0±2.2, P = 0.435), Paper I. In addition, there were no differences in the time between athletes in the intervention group compared to athletes in the control group at pretest (14.6±4.6 vs 15.5±4.6, p=0.229) and posttest 2 (1.8±0.7 vs 1.8±0.8, p=0.343), Paper II.

The interviews were conducted by four persons at pretest (one psychiatrist and three trained in using the EDE) and two of them did the interviews at posttest 2. All had clinical experience with ED patients and special competence in physical activity and sports. The PL conducted interviews at both pretest and posttest 2. For reliability assessments a random selection of 37 subjects (16 who fulfilled and 21 who did not meet ED criteria) from the first clinical interview (pretest) were re-interviewed again by a second interviewer (pretest). We also re-interviewed 13 athletes (5 who fulfilled and 8 who did not meet the ED criteria) after the second clinical interview (posttest 2). In all cases, there was complete agreement between the two interviewers concerning the diagnostic classification.

The Eating Disorder Examination Interview (EDE) (Paper I, II and IV)

The EDE is an investigator-based interview that assesses ED psychopathology, i.e., undue importance of weight and shape in determining self-worth, as well as key ED behaviors (Fairburn et al., 2008). It focuses on the previous 28 days, except for diagnostic items that are rated for duration stipulations on the DSM-IV. The EDE consists of four subscales: dietary restraint, shape concern, weight concern and eating concern. A mean value is calculated on a 0-6 point scale, with higher score representing greater severity of psychopathology. We included the EDE version 16.0 to determine whether the participants met the criteria for clinical ED and to determine the presence and frequency of core ED symptoms. Both EDE 16.0 and EDE-Q 6.0 is translated into Norwegian-language versions and validated (Ricca et al., 2001; Reas et al., 2011).

The EDE-Q (Paper I)

The EDE-Q 6.0 is a 28-item self-report measure derived from the EDE as a practical, cost-effective and highly efficient version (Fairburn et al., 2008). Similar to the interview, the EDE-Q focuses on key attitudinal and behavioural features of ED during the past 28 days. It incorporates

an identical rating scheme, and generates four subscales and a global score (Fairburn & Beglin, 2008)(see Table 7 page 39 for further description).

Statistical methods

The statistical analyses were carried out using SPSS version 18 (Paper I and II) and version 21 (Paper III and IV) IBM Corporation, Route, Somers, NY, USA. In Paper II, we also used Stata version 12.0 (StataCorp, College Station, TX). Generally, categorical data were expressed as absolute numbers (N) and percentages (%), and continuous data as mean values with their standard deviations (SD). Fisher's exact test was used to calculate the *P* value in cases where the expected number of cases per cell was five or less (Paper II and III). To compare mean group differences, an independent-sample t-test was used. We also used chi-square test and Mann-Whitney U test to compare group differences when appropriate. The significance level was set to 0.05 for all analysis.

Power calculations

The sample size estimation was not based on a conventional calculation for cluster-RCT because valid data for rates of ED in adolescent male and female elite athletes were not available. Then again, we included the total population of male and female first-year students (n=611) attending the Elite Sport High Schools in Norway. On the other hand, 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 group (6.5% vs 13%) (Paper II). For an 80% reduction (2.6% vs 13%), we would have needed 101 females in each group. Accordingly, the study was underpowered to demonstrate even gross intervention effects on ED in females. No specific power calculations were made for Paper III, because the primary study was designed for other purposes (Paper II).

Paper I

We calculated the sensitivity as the proportion of the athletes and controls correctly identified as having ED and specificity as the proportion correctly identified as healthy. The negative predictive value (true negative) was calculated among the proportion of the athletes and controls classified as not "at risk" correctly identified as healthy. We estimated the total prevalence of ED from the prevalence of "at-risk" and healthy subjects participating in the clinical interview, factoring the distribution of "at-risk" and not "at-risk" subjects in the total sample. This was

done separately for the athletes and controls with the use of the following formula: $P_{pop} = P_1 \times W_1 + P_2 \times W_{2,}$ where P_{pop} = Estimated prevalence in the total population; P_1 = Prevalence of the disorder in "at-risk" subjects in part I; W_1=weighted distribution of at-risk subjects in part I; P_2 = Prevalence of the disorder in subjects classified as not "at-risk" subjects in the clinical interview; W_2=weighted distribution of not at-risk subjects in part I.

Paper II

To compare differences in reported symptoms associated with ED 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 standard errors) 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 tested by the Wald method. When 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.

Paper III

In this paper we have not accounted for a clustered design since in the dataset from the primary study (Paper II) we found that the effect of clustering was small. A binary logistic regression analysis was conducted to test for difference by treatment group of the likelihood of reporting "somewhat good" knowledge or better at posttest. We used the reported knowledge as the dependent variable and school type (intervention/control) and pretest value as covariates. To compare differences in the coaches' scores on knowledge at posttest, a general linear model was used. We used the knowledge score as the dependent variable with school type (intervention/control) as fixed factor and total knowledge score at pretest as a covariate. OR and regression coefficients are presented with 95% CI and *P* values.

Paper IV

Logistic regression models were used with symptoms associated with ED or ED as dependent variables and risk factors, such as EDI-DT, and trying to lose weight now as predictor per unit change in the predictors were calculated with 95% confidence limits. Receiver operating characteristics (ROC) calculations were used to illustrate the ability of the tests to distinguish

athletes with and without an ED, where no discriminatory ability corresponds to an area under the ROC curve of 0.5, and perfect discriminatory ability to an area of 1.0. It is considered acceptable if the area under the curve is fair if>0.70, good if >0.80, while >0.90 is excellent. The predicted probabilities from each regression model were used as the independent variable, and ED (yes/no) was used as the dependent variable for the ROC curve analysis. Optimal cutoff score for version 1 and 2 defined as the value that maximized product of sensitivity and specificity, the corresponding sensitivity, specificity and the positive likelihood ratio and negative likelihood ratio for a positive and negative test result were reported. The likelihood ratios were calculated by the following formulas:

Positive likelihood = sensitivity / (1 - specificity)
Negative likelihood = (1 - sensitivity) / specificity

In phase II regression coefficients from the try out sample was used to estimate logistic scores and estimated probabilities of ED with levels of the predictors found in the external validation data set. These were then used to calculate ROC areas in the validation data. To correct for over optimism in the regression model fit in phase I we adjusted the coefficients according to a method by Van Houwelingen and Le Cessie (equation 77) in the external dataset (Van Houwelingen & Le Cessie, 1990). Internal reliability was assessed with Cronbach's alpha coefficient.

Research ethics

Procedures and methods used in the present study conform to the ethical guidelines defined by the World Medical Association's Declaration of Helsinki and its subsequent revisions. The study was approved by the Regional Committee for Medical and Health Sciences Research Ethics in Southern Norway, and the Norwegian Social Science Data Services. Each school principal received detailed written information about the procedures and aims of the study. After receiving permission to collect data from each school principal the participants (athletes and controls) parents and the coaches received written information about the study. Written parental consent was required before the athletes and controls were contacted for participation. The participants (athletes, controls and coaches) also provided written consent. For coaches not in attendance the day written consent was obtained in person, consent was provided by phone or e-mail. In addition, the athletes included from the external dataset in Paper IV had to complete a written consent in order to participate, and written parental consent was required for responders younger than 16 (Torstveit & Sundgot-Borgen, 2005). The participants were free to withdraw from the study at any time, without explanation.

Results and discussion

Prevalence of ED (Paper I)

In Paper I, we examined the prevalence of symptoms associated with ED and clinical ED among male and female adolescent elite athletes and controls. Based on the questionnaire, a higher proportion of controls than athletes reported symptoms associated with ED and were classified as being at risk for ED (50.7% vs 25.0%, P<0.001). Moreover, a higher proportion of females compared with males were classified as being at risk for ED in both groups (athletes: 46.2% vs 13.1%, p<0.001; controls: 72.4% vs 33.7%, p<0.001). The number of athletes and controls who were classified as at risk or not at risk that participated in the clinical interview and met the DSM-IV criteria is shown in Figure 6.

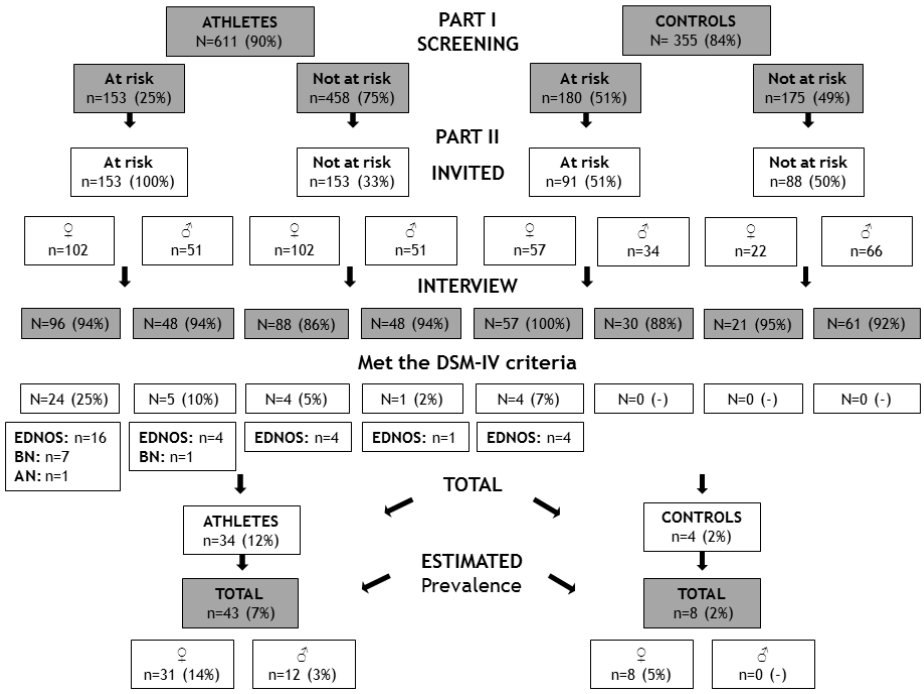


Figure 6. Number and percentage of athletes and controls participating in parts I and II and fulfilling the DSM-IV diagnostic criteria for an ED.

The prevalence of athletes and controls meeting the criteria for ED was standardized according to the total distribution of at-risk and not at-risk subjects for ED in part I of the study based on their questionnaire response (Figure 6). Based on the clinical interviews (Part II), 7.0% of the athletes and 2.3% of the controls were estimated to met the criteria for an ED, with a difference of 4.7% (95% CI, 3.4 to 6.0; P=0.001). The estimated ED prevalence was higher among female athletes (14.0%) compared to female controls (5.1%), with a difference of 8.9% (95% CI, 6.0 to 11.8; P=0.005). Among the male athletes, 3.2% were estimated to meet the diagnostic criteria, a difference from the female athletes of 10.8% (95% CI, 8.3 to 13.3; P <0.001). For the different sport disciplines we detected no difference in the prevalence of ED between females representing weight-sensitive than less weight-sensitive sport groups (19.7% vs 11.9%, P = 0.136). Because of few cases of ED among the male athletes, no subgroup comparisons were possible.

The results from this study provide novel information of the prevalence of ED among adolescent male and female elite athletes and age-matched controls. As the first study using a two-tiered approach when investigating ED in adolescent elite athletes, it confirms two previous important statements: 1) a clinical interview is the best available method to identify ED among both elite athletes and controls, and 2) there is a need for further development and validation of screening instruments designed for athletes. Since there are no studies available that have examined the prevalence of clinical ED among adolescent male and female elite athletes representing a wide range of sports, it is difficult to compare the prevalence of ED found in this study with that of others. In general, comparing prevalence data of ED is difficult since studies use a variety of methodological approaches. Keeping this in mind, the higher prevalence of ED in the adolescent elite athletes than controls and general prevalence estimates (Smink et al., 2012) are in accordance with studies on adult elite athletes using a two-tiered approach (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004). However, even if the adolescent athletes in our study are considered to be in the period of greatest vulnerability and the age when ED typically occur, the prevalence of ED seems to be even higher among adult elite athletes (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008). Several explanations may be relevant for this finding, for example the longer duration of pressure to improve performance of adult elite athletes and to confirm to the specific requirements of their sport (e.g. competing in sports with a weight class system and where the procedure during competitive events may temp the athletes to use of extreme weight loss methods, physique-revealing uniforms, or competing in sports in which appearance and performance are being judged).

Interestingly, in contrast to previous studies on adult elite athletes (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008), we found no difference in the

prevalence of ED between athletes in weight-sensitive sports compared to less weight-sensitive sports. Furthermore, although BD is considered an important symptom of ED (American Psychiatric Association., 1994), only 50% of the athletes diagnosed with an ED in our study had BD scores above clinical values. However, all reported sport-specific BD meaning their dissatisfaction and concern about shape and or weight and the desire to lose weight is sport related. This may support the assumption that other factors than general BD may be essential for the development of ED diagnosis among athletes. In addition, de Bruin et al. (2007) found that dieting among elite female gymnasts was more a result of weight-related causal attributions or perceived weight pressure from their coaches than negative body image. Additionally, Torstveit and colleagues (2008) found that even though the prevalence of ED was highest among the female athletes competing in weight-sensitive sports, fewer were dissatisfied with their bodies compared to athletes in less weight-sensitive sports and controls. Thus, it may be speculated that the higher prevalence among the adult elite athletes than the adolescent elite athletes in our study is due to a longer duration of exposure to sport-specific demands. In addition, Paper II in this thesis indicates that there may be a trend with increasing prevalence of ED from the first year through the third year of high school for adolescent elite athletes when no intervention is offered. Furthermore, although we were not able to find a significant difference between adolescent athletes in weight-sensitive sports compared to less weight-sensitive sports, this was most likely due to limited study power. We calculated the lowest detectable difference to 17.1% when the observed was 7.8%. With a power of 80%, we could only expect to detect a difference between these groups if the number per group had been fourfold that observed.

The importance of using a clinical interview to determine the prevalence of ED accurately, and the difficulties with identifying athletes "at risk" for an ED by questionnaire screening is clearly demonstrated by the two-tiered approach used in this study. In accordance with what has been reported among older elite athletes (Sundgot-Borgen, 1993; Torstveit et al., 2008), many of the adolescent elite athletes underreported the use of unhealthy behaviors such as PWCM at the questionnaire screening compared to the reported use in the clinical interview. Why more controls than athletes report symptoms associated with ED despite more athletes than controls having an ED may partly be explained by the higher percentage of overweight (BMI), higher percentage with BD, and percentage reporting dieting in controls (Martinsen et al., 2010). It has also been indicated that females in particular are generally dissatisfied with their bodies and tend to report DE or have high scores on the EDI without actively dieting or using extreme methods to reduce or control weight (Sundgot-Borgen, 1994). In addition, it has been argued that athletes may look at their DE behavior as a natural part of their sport, and are not necessarily generally

dissatisfied with their body shape or weight (Owens & Slade, 1987; Byrne & McLean, 2001; Sundgot-Borgen & Torstveit, 2010), do not realize that they have a problem (Beals, 2004), and thus do not report DE problems. Accordingly, their DE behaviour may reflect a rational response to pressure to achieve a body shape that will ensure optimal performance and reflect dedication to the sport rather than psychopathology (Byrne & McLean, 2001). Consequently, the specific psychological concerns of adolescent elite athletes may be somewhat different to those of nonathletes presenting a similar clinical picture. This explains why it is important to use clinical interviews to assess the specific psychopathology of ED, as prevalence studies based on self-reported questionnaires will not be able to distinguish these differences. Therefore, by using the clinical interview EDE and sport-specific questions in our study, we were able to get more accurate information about the intensity and duration of the most severe symptoms being essential to diagnose ED among both the adolescent athletes and controls.

As this study forms the baseline data for the intervention aiming to prevent the development of new cases with ED and symptoms associated with ED among athletes (Paper II), obtaining as accurate information as possible about the athlete's health status was paramount. We therefore composed our at-risk criteria based on previous studies of elite athletes (Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008), the DSM-IV diagnostic criteria for ED (American Psychiatric Association., 1994), as well as the assumption that DE occurs on a continuum of severity (Fairburn & Bohn, 2005). However, it is clear that an important limitation of the screening questionnaires being used is that they have not been validated adequately in the athletic population (Beals, 2004; Bonci et al., 2008). Consequently, this may result in inaccurate information. Although high total score on EDI-DT and EDI-BD have been used as selection criteria when screening for athletes "at risk" for ED (Sundgot-Borgen, 1993), neither score is sport- or gender-specific. For example, EDI-BD assesses dissatisfaction with areas of the body such as the stomach and hips that well-trained athletes and especially male athletes are likely generally satisfied with. In addition, 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. Furthermore, research on risk models in female elite athletes indicate that variables predicting ED may be different for athletes in weight-sensitive sports compared to less weight-sensitive sports and to controls (Torstveit et al., 2008). For this reason, we considered it important to examine symptoms of DE, including BD, DT, underweight, dieting and use of PWCM, menstrual dysfunction and not only the clinical concept of ED. We used a wide range of symptoms associated with ED as "at-risk" criteria and chose to invite both athletes and controls classified as "at-risk" and not "at-risk" to attend the clinical interview. This resulted (as expected)

in a high number of false positives. However, more strict "at-risk" criteria could have resulted in too many false negatives (Torstveit et al., 2008), which would have been less advisable in light of the main objective of this study. In fact, by interviewing a high number of athletes and controls classified as healthy from the screening, 3.7% (n=5) of the athletes and none of the controls were diagnosed with an ED and classified as false negatives.

Thus, the present study shows that the prevalence of ED among adolescent elite athletes is high and higher than among age-matched controls. In addition, the need for further development and validation of screening instruments designed for athletic populations is supported. Until this is established, a clinical interview is the best method available to identify ED among both athletes and controls.

Preventing new cases of ED and symptoms associated with ED (Paper II)

Among the athletes who were healthy (did not fulfil the criteria for an ED) at the pretest (Paper I) and completed the study (n=439), 8 of 61 female athletes representing the control schools had developed and fulfilled the DSM-IV criteria for EDNOS (n=7) or BN (n=1), (p=0.001 at posttest 2). In comparison, none of the 87 female athletes from the intervention schools had developed an ED. Furthermore, the risk of reporting symptoms was lower in intervention than control schools at posttest 1 (OR: 0.45, 95% CI 0.23 to 0.89). This effect was attenuated by posttest 2 (OR: 0.57, 0.29 to 1.09). The intervention showed a relative risk reduction for current dieting (OR: 0.10, 0.02 to 0.54) and ≥3 weight loss attempts (OR: 0.47, 0.25 to 0.90). 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. Conversely, 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.

Among the male athletes, there was only one new case of ED at posttest 2 (control school). Thus, no difference in the risk of reporting symptoms between groups at posttest 1 or 2 was detected. However, among male athletes we found a weaker association with the EDI-BD in the intervention schools from pretest to posttest 1 compared to control schools, after separate regressions per treatment group were performed (score: 0.26, 0.13 to 0.40 vs control: 48, 0.31 to 0.65). Also, a weaker association between the total pretest EDI score and the posttest 2 score among the male athletes in the intervention schools compared to control schools was found (score: 0.32, 0.25 to 0.38 vs control: 0.75, 0.46 to 1.04). On the contingent self-esteem scale, a

lower score was found at posttest 1 and 2, and at posttest 2 the score was lower at the intervention schools compared to the control schools.

In total, 222 of 247 athletes from the intervention schools attended at least three out of four lectures during the intervention (55.5% attended all 4). Moreover, 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. As 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. Nevertheless, 24.7% reported the mental training assignments to be useful, 15.8% a little useful, 24.7% neutral and 2.1% not useful (13.7% did not respond). Totally, 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 following the intervention.

It has been indicated that the efficacy of preventive programs is demonstrated when the plan for implementation is followed, program participants show a lower incidence of ED than the population incidence, and the reduced incidence is mediated by a decrease in risk factors or an increase in protective factors (Levine & Smolak, 2007). This cluster RCT demonstrates that all of these criteria were fulfilled through a one-year school-based intervention program. In addition, our study shows that it is possible to prevent new cases of ED among female elite athletes and also indicated positive effects on the risk of reporting symptoms associated with ED. The results are unique as there is no previous RCT aiming to prevent the development of new cases of ED and symptoms associated with ED among adolescent male and female elite athletes.

Because very little work has been done on the prevention of ED in athletes, there is no consensus on best practice. However, focus on health-promoting factors and on increasing possible protective factors has in general been highlighted as essential (Børresen & Rosenvinge, 2003). In our study, the Health, Body and Sports Performance intervention was sport-specific in the sense that the program was developed for athletes and coaches. The intervention was built on the social-cognitive framework (Bandura, 1986), and the primary focus was to enhance self-esteem by strengthening the athletes' self-efficacy. We focused on systematic changes within the intervention schools and aimed at intervening at the social system level and the individual level. The intervention was also influenced by the elaboration-likelihood model (Petty & Cacioppo, 1986) and the cognitive-dissonance theory (Festinger, 1957). To reach out to a large group of adolescent elite athletes, as well as be able to create supportive environments, the intervention was school-based and we included all the Elite Sport High Schools in Norway. To date, the most promising prevention study in a high-risk setting comparable to ours is the study by Piran (1999a). This study, done in a competitive residential ballet school, broke new ground in the field

of ED prevention by creating an ecological approach to prevention imbued with a feminist lens (McVey et al., 2012). The study suggests that it is possible to create a subculture where healthier norms regarding body shape and weight can be incorporated, to the benefit of students. Unfortunately, although the study yielded very promising results, it failed to include a control group, and the long-term results are based on three different sets of female gymnasts at the elite ballet school (Piran, 1999a).

The lack of long-term follow-up is a common and important limitation in ED prevention research, making it impossible to determine the effectiveness of the programs over time. For instance, it has been indicated that a fade over time may be unavoidable given the ubiquitous sociocultural pressure for thinness in our culture (Stice et al., 2007). Moreover, the study of Stice et al. (2008a) involving nonathletes showed that the prophylactic effects become stronger at the latter follow-ups, while the effects that reflect reductions in initial symptoms and risk factors were greatest at earlier follow-ups. The authors indicate this finding might be due to that the incidence of eating pathology and obesity were greatest at the latter follow-ups, this effect would not have been detected without the follow-ups. Our study gives a good picture of the importance of including a long-term follow-up to fully characterise the effect of the prevention program. Initially, by conducting clinical interviews among all the athletes one year after the intervention, we were able to show that the intervention program had a positive effect on preventing new cases of ED of at-least one year. Moreover, by including self-reported questionnaires at posttest 1 and 2 in addition to at pretest, we were able to identify that although the effect on the risk of reporting symptoms associated with ED was greatest among the female athletes at posttest 1, the most pronounced changes for some of the symptoms associated with ED (e.g. present dieting) was strongest at posttest 2. This adds important information to better understand the perseverance of the intervention program. Since an early start of dieting is likely to set the stage for ongoing use (Neumark-Sztainer et al., 2011), and frequent weight fluctuation have been suggested being an important trigger factor for the development of ED in athletes (Brownell et al., 1987; Sundgot-Borgen, 1994), this was an especially encouraging and important additional finding.

The school setting is often considered ideal for prevention work as it offers a unique opportunity to reach out to large groups of children and youth as well as to their teachers, parents, and other professionals and authorities (Levine et al., 2012). Together they form essential elements of the school's broad educational environment. In our study the school-based intervention was sport-specific and both athletes and coaches were included. Athletes (especially elite) constitute a unique population as they in addition to the socio-cultural pressure also are under pressure to

improve performance and conform to the requirements of their sport. They may therefore not respond to interventions in the same way as nonathletes. For instance, although nothing is more important than one's physical and psychological health, just telling athletes that they should eat well in order to be healthy is not apt to have great appeal (Thompson & Sherman, 2010b). On the other hand, if the information indicates that healthy eating can increase the likelihood of good sport performance (e.g. by focusing on the relationship between body composition, health, nutrition and performance), the athletes would most likely pay more attention (Thompson & Sherman, 2010b). In our study, in addition to educating the athletes we wanted to challenge myths, correct possible misinformation, and encourage critical thinking through lectures, teamwork, exercises, and practical and theoretical assignments. The results indicate that the adolescent elite athletes attending the intervention have found the themes included in the program relevant.

The importance of developing an intervention program adapted for the athletic environment may be illustrated by the studies by Smith and Petrie (2008) and Becker and colleagues (2012) among female athletes. Both studies included female athletes to test the effectiveness of the cognitive-dissonance program among athletes. However, while Smith & Petrie (2008) slightly modified the cognitive dissonance program and the healthy weight program, Becker and colleagues (2012) made a full range of modifications they believed were necessary to address some of the unique experiences of athletes. Interesting, in the study by Smith and Petrie (2008) no improvements were seen for either intervention compared to wait list control. In contrast, the peer-led pilot study by Becker and colleagues (2012) indicated positive effects for both interventions. Although both studies have important limitations such as not including any control group (Becker et al., 2012) and no follow-up (Smith & Petrie, 2008), they illustrate the importance of developing sport-specific prevention programs when the aim is to prevent DE and or ED among athletes.

Despite the fact that the prevalence of ED is higher among female than male athletes and higher in weight-sensitive sports than less weight-sensitive sports, ED is non-discriminatory. ED might occur in all sport disciplines and the need for preventive programming with all sport participants has been stressed (Thompson & Sherman, 2010b). The present RCT is the first to show that a one-year intervention program developed for male and female athletes representing a wide-range of sports can prevent new cases of ED and symptoms associated with ED among female athletes. The intervention program also indicates that there may be positive long-term effects on the male athletes at the intervention schools (i.e. no new cases of ED and lower scores for contingent self-esteem).

The interventional effect on the coaches' knowledge of nutrition, weight-regulation and ED (Paper III)

In Paper III, we examined the effect of the educational program on the coaches' total knowledge and for each of the three knowledge content areas of nutrition, weight regulation, and ED (including recognition and management). Also the coaches' subjective evaluation of their knowledge of ED was examined.

Seventy-six of the coaches (intervention group (n=49) and control group (n=27)) answered the questionnaire screening at pretest and posttest (9-months after intervention). At posttest (adjusted for pretest value), the coaches at the intervention schools had higher index scores than control school coaches for weight-regulation (6.2±1.7 vs. 4.8±1.3, $p<0.001$), ED (including recognition and management) (19.3±4.4 vs. 16.5±5.0, $p=0.004$), and total knowledge (weight-regulation, ED, and nutrition) (35.0±7.2 vs. 31.6±8.0, $p=0.021$). On the nutrition index knowledge score there was no significant difference between the intervention and control school coaches (9.5±3.5 vs. 10.3±3.3, $p=0.260$). In addition, the coaches attending the intervention also subjectively evaluated their knowledge about ED to be higher than the coaches at the control schools at the follow-up. In fact, the likelihood of reporting "somewhat good" knowledge or better was 7 times higher for coaches at intervention schools than control schools (OR= 7.1, 95% CI 2.2 to 23.3, $p=0.001$).

Since we were interested in whether the coaches would be able to display constructive behavior or bring their knowledge to practice, the coaches were asked about how they would behave and manage ED in athletes with two questions (also included in the ED knowledge index score): "If you get concerned that one of your athletes has an ED, what would you do?" which were scored 0 (not correct), 1 (average) and 2 (very good). There was no difference between the reported management at the intervention schools at posttest adjusted for pretest value on question one (mean: 0.892 vs mean 0.863, difference in mean: 0.29, 95% CI -0.347 to 0.406, $p=0.877$). However, when the coaches answered the follow-up question (question number two): "If you still are concerned that one of your athletes has an ED after you have had a meeting/conversation, you should?" a higher percentage of the coaches at the intervention schools than control schools reported a correct approach (98.0% vs 77.8%, $p=0.007$). Also, in the weight-regulation knowledge index, two questions measured the coaches' management of athletes wanting to reduce weight (see description in Paper III). In both questions the intervention school coaches scored higher than coaches at the control schools by reporting the most preferred approach.

Overall, 89.8% of the 49 coaches participating in the intervention completed the questionnaire test included in the Coaches guide. Furthermore, 71.4% of the coaches at the intervention schools attended the seminar at school. The coaches at the intervention schools were required to read and complete the test based on information contained in the Coaches guide. Moreover, all coaches working at the Elite Sport High Schools the day of the seminars were required to attend. Still, because some of the coaches work part time and have other employers, they were not able to be at school the day of the seminars. In addition, some coaches were away at training camps or competition. Consequently, at some schools it was impossible to arrange the seminar at a time when every coach was available. However, both coaches participating and those who were unable to be at the seminars in person were sent information about the content of the seminar, the Coaches guide, and the intervention program targeting the athletes by e-mail.

The unique position of coaches to identify early signs and symptoms, direct athletes to professional help, and preventing the development of ED has been emphasized (Sherman et al., 2005; Nattiv et al., 2007). More specifically, the ACSM (Nattiv et al., 2007) and IOC Medical Commission (Drinkwater et al., 2005) recommend that professionals participating in health maintenance and performance enhancement of athletes should be provided with specific knowledge and problem-solving skills to better detect, manage, and prevent extreme dieting, ED, and the triad components. Still, one major shortcoming in current programs to prevent DE and or ED among athletes has been insufficient attention to their coaches and the athletic environment. Thus, the present study is unique by examining the interventional effect of a separate educational program for coaches included in the Health, Body and Sports Performance intervention program.

The results from this study indicate that a specific theory-based education program designed for coaches who work with adolescent elite athletes can be an effective means to promote long-term retention of information (at least 9-months). In contrast, increases in knowledge were not maintained by cheerleading coaches over an 8-11 month follow-up as part of a brief intervention which included verbal and written information about ED and nutrition (Turk et al., 1999). In that study, however, although the increased knowledge from the posttest was not maintained, the coaches from the experimental group self-reported engaging in increased efforts to prevent ED on their squads as compared to control group coaches at the follow-up (Turk et al., 1999). Still, it should be acknowledged that little is known about whether short-term increases in knowledge can affect behavior. Knowledge is also most likely not the only factor which may have an impact on coaches' attitudes and behavior; one's confidence in that knowledge may also play an important role (Turk et al., 1999). Interestingly, Turk et al. (1999) found that although coaches

may feel confident about managing or preventing ED, they may give incorrect information if they have low knowledge. In such cases low knowledge in addition to high level of confidence may pose more threat than the combination of high knowledge and low confidence. Then again, if coaches in the interventions schools in our study are in fact more knowledgeable about identification, management, and prevention of ED, and believe themselves to be more knowledgeable; they will most likely be more confident in the suggestions they give, the vocabulary they use, and how to appropriately communicate with their athletes. Accordingly, coaches that are properly educated may feel more assured that they are offering sound advice about nutrition, weight regulation, and body composition while not negatively affecting the health and performance of the athletes. For coaches working with young upcoming athletes as in our study, where the principle of physical growth, biological maturation and behavioral development occur, this may be particularly important. On this basis, we find the combination of higher knowledge score and the higher subjective evaluation of ED knowledge found among the coaches at the intervention schools in our study particularly encouraging.

Although education is certainly an important part of any ED prevention program, it is unlikely to be effective unless it is accompanied by preventive efforts designed to change the beliefs and behaviors of the participants (Beals, 2004). Interestingly, Norwicka et al. (2013) found by interviewing eighteen Swedish elite coaches in high risk sports, that those who did not have sufficiently knowledge of ED symptoms easily questioned their own observations in the face of athletes' statement of denial. The researchers also found that thorough knowledge of ED on its own did not automatically enhance the coaches to act. In fact, many of the coaches were uncomfortable and found it difficult to talk with their athletes when they observed symptoms of ED (Nowicka et al., 2013). In our study the coaches not only received factual information, but were provided with strategies to identify, manage and prevent ED among their athletes. By teaching the coaches practical skills we aimed to increase their confidence in their knowledge and enable them to take an active role in the prevention and management of ED. In addition to the seminar lectures, identification and management of clinical and subclinical cases were discussed in the workshop during the seminar at school. We believe the combination of higher knowledge score and higher subjective evaluation of ED knowledge among the coaches at the intervention schools than at the control schools in our study is likely due to this approach.

In the present study the coaches at the intervention schools had higher knowledge scores than control schools coaches on weight-regulation and ED at posttest, but not on nutrition. Whether good nutrition knowledge among coaches and or athletes prevents ED is not known, although a common misunderstanding is that DE and ED is a problem of simply understanding nutrition.

Instead, it has been reported that dieting athletes who do not receive guidance for weight-regulation more often develop ED than those who are supervised during the weight loss period (Sundgot-Borgen, 1994). As athletes can be underweight, normal weight or overweight regardless of the presence of extreme dieting or ED, high knowledge on weight-regulation and ED seems especially important. Thus, the increased knowledge on both weight-regulation and ED among the coaches as found in our study may be an important step in preventing unhealthy behavior among athletes.

It has been indicated that successful prevention programs in the athletic setting are unlikely to succeed without commitment and support from their coaches (Sundgot-Borgen et al., 2003). To have the potential to behave in a particular way, knowledge is required. This study shows that an intervention program developed to provide coaches with strategies regarding identification, management and prevention of ED produced significant long-term effect (at least 9-months). The intervention also shows positive effects on the coaches' subjective evaluation of their knowledge. However, because this study is based on questionnaire screening, we do not know if the increased knowledge in the intervention group compared to control group also changed the behavior regarding identification, management and prevention of ED. In future trials it will be important to develop evaluation tools that undergo vigorous validity and reliability testing that can be shared among the scientific community along with the constructs of the intervention.

The development of the BEDA-Q (Paper IV)

To date, there are important limitations in the screening instruments being used in screening athletes for ED (see page 35 to 39). In order to facilitate early identification and treatment, we present in paper IV a brief and easily administrated screening questionnaire (BEDA-Q) appearing well-suited to discriminate between adolescent female elite athletes with and without an ED. The development of the BEDA-Q is described in detail in paper IV. Briefly; after examining how well our questions previously used (symptoms associated with ED) discriminated between the female adolescent elite athletes with and without an ED at pretest (Table 2 Paper IV), examining the different items included in EDI-DT, EDI-BD and EDI-P subscales individually, reviewing the current evidence and the collective expertise of the authors, we ended up with 9 items (Table 8). This resulted in the BEDA-Q version 1 (7 items) and version 2 (9 items) that we wanted to test further.

BEDA-Q version 1 and 2 showed good ability in distinguishing between the female elite athletes with and without an ED at phase I with ROC areas of 0.83 (95% CI, 0.74 to 0.92) and 0.86 (95%

CI, 0.78 to 0.93), respectively. Version 2, where two items from the EDI-P were added, improved with approximately 0.03 area units compared to version 1 without the EDI-P items. For version 1, we calculated the optimal cutoff point to be 0.26 with a sensitivity of 85.7% (95% CI, 80.6 to 90.8) and specificity of 78.8% (95% CI, 73.0 to 84.7). This resulted in a positive likelihood ratio of 4.0 and a negative likelihood ratio of 0.2. For version 2, the optimal cutoff point was 0.27 with a sensitivity of 82.1% (95% CI, 76.6 to 87.6) and specificity of 84.6% (95% CI, 79.4 to 89.8). This gave a positive likelihood ratio of 5.3 and negative likelihood ratio of 0.2.

We also constructed individual predictive scores by means of the coefficients from the logistic models for version 1 and 2 to classify athletes at risk for an ED if the score was greater than the optimal cutoff value and not at risk otherwise. The formulas used to calculate the estimated probabilities of ED for version 1 and 2 are described in Paper IV.

Because no previous studies examining the prevalence of ED among adolescent female elite athletes have included items from the EDI-P, we were only able to carry out an external validation for version 1 (phase II). We used the regression coefficients from the derivation dataset adjusted for overoptimism to estimate logistic scores and estimated probabilities of ED in the validation data by using the adjusted formula for version 1. The estimated probabilities were then used in the ROC analysis calculation for ED in version 1 resulting in an area under the ROC curve of 0.77 (95% CI, 0.63 to 0.91).

In phase III of the study, we wanted to test the ability of BEDA-Q version 1 and 2 to predict new cases of ED among the 53 athletes (100%) attending the posttest classified with no ED diagnosis at pretest attending the control schools (Figure 6 page 48). Seven of the 53 athletes (13.2%) had developed an ED during these two years and were classified as new cases of ED. In predicting new cases, version 2 showed higher diagnostic accuracy than version 1 with a ROC area of 0.73 (95% CI, 0.52 to 0.93) compared to 0.70 (95% CI, 0.48 to 0.92).

The main finding in this study was the ability of BEDA-Q version 1 and 2 to distinguish between adolescent female elite athletes with and without an ED. Both versions appear well-suited for screening purposes in this population with ROC areas above 80%. However, it is worth noticing the increased accuracy found when including the socially prescribed perfectionism items measuring parent's expectations and avoiding disappointing parents and teachers from the EDI-P. By adding these two items the discriminative accuracy increased with approximately 0.03 area units for version 2 compared to version 1. Even though it is difficult to interpret absolute differences in ROC area, an improvement above 0.02 area units (more than 4-5%) is regarded to be clinically important (Holme et al., 2012). Thus, version 2 consisting of 9 items, seems to be an

even better suited version than version 1 in distinguishing between adolescent female elite athletes with and without an ED. However, both versions are inexpensive, easy to understand and showed valid results.

In accordance with expectations, most of the female first-year students attending the Elite Sport High Schools with an ED were diagnosed with EDNOS (71.4%) (Paper I). This indicates that the athletes included are representative of the athletic population in which BEDA-Q is meant being used as EDNOS is the most common ED encountered among athletes (Torstveit et al., 2008; Paper I). Interestingly, it has also been found in a previous study among female university students that social dimensions of perfectionism were broadly related to ED as well as self-esteem, while self-oriented perfectionism was related only to anorexic tendencies (Hewitt et al., 1995). Furthermore, a high level of socially prescribed perfectionism has shown strong and consistent positive correlations with negative affect, anxiety, suicidal ideation (Enns & Cox, 2002) and athlete burnout among adolescent elite athletes (Hill et al., 2010). Thus, the socially prescribed perfectionisms association to negative psychological outcomes (Flett & Hewitt, 2005), and its particular importance during adolescence (Flett et al., 2002), may explain the higher discriminative accuracy of version 2 than version 1 in distinguishing athletes with and without an ED. Nevertheless, because of the cross-sectional nature of this part of the study it is not possible to interpret causality. Hence, whether the athletes with an ED diagnosis compared to the athletes without an ED diagnosis were more socially prescribed perfectionistic before they developed an ED, or whether this is a consequence or antecedent to the athletic participation itself, needs further investigation.

A particular strength of the development of the BEDA-Q is that it was conducted and tested among a large nationally representative sample of female adolescent elite athletes representing a wide range of sports. Besides, comparisons were made to the clinical interview EDE, considered as one of the most reliable clinical methods to correctly diagnose an ED (Mond et al., 2008). Though, as a consequence of being the first study including items from the EDI-P with a two-tiered approach among female elite athletes, we were unable to measure the external validity for version 2. On the other hand, version 1 showed a high discriminating ability in distinguishing between the female elite athletes with and without an ED in the external dataset. Furthermore, the differences found between the derivation dataset and external dataset in athletes competing in weight-sensitive sports and selected for national team (Table 1 in Paper IV), reflect expected differences between different dataset and strengthen the validation. Thus, based on the efficacy of version 1, there is reason to believe that version 2 also would have shown a high discriminating ability in an external dataset. This was further supported in phase III were the

ability to predict new cases of ED (posttest assessments) increased with 0.03 area units by using version 2 instead of version 1. Still, although version 2 most likely would have shown high discriminating ability, the lack of an external validation of version 2 is a concern that limits the external validation part of the study.

A valid screening instrument being able to predict new cases of ED among young athletes may be an important step in preventing ED. Accordingly, the better diagnostic accuracy of version 2 than version 1 at posttest is an important contribution to our understanding of the role social (parental) expectations play in the development of socially prescribed perfectionism as well as ED. However, it's clear that since the number of athletes with an ED diagnosis at posttest was low and consequently the CI wide (ranging between excellent and poor distinguishing ability), BEDA-Q's predictive ability needs to be tested in a larger sample. Still, as the only difference between version 1 and 2 is the two items measuring the athletes' perception that the parents expect them to be perfect, the results imply they may be essential.

An important question to answer when developing a new screening questionnaire is how accurate the test should be to be clinically useful. Generally, a moderate number of false positive results are usually accepted for screening tests, though negative results are not desirable. Furthermore, when it comes to diseases with high morbidity and mortality, the sensitivity of the test (detection of the disease) is more important than the specificity (detection of healthy cases). In our study, we calculated the optimal cut-off value for BEDA-Q at which optimal balance between sensitivity and specificity is achieved. In phase I, a cutoff value of 0.26 showed a high ability in both detecting athletes with an ED as well as athletes without an ED with a sensitivity and specificity of 82.1% and 84.6% (version 2). This gave a positive likelihood ratio of 4.0 and a negative likelihood ratio of 0.2. In comparison, the sensitivity and specificity by using the symptoms associated with ED criteria previously used to classify the athletes in this study "at risk" and not "at risk" (Paper I) were 85.7% and 53.8%. This would have given a positive likelihood ratio of 0.9 and a negative likelihood ratio of 0.3. Thus, by using BEDA-Q version 2 the likelihood of having an ED with a score at or above the cutoff is more than five-fold compare to the symptoms associated with ED criteria. The advantage of calculating likelihood ratios instead of for instance positive and negative predictive values is that likelihood ratios are independent of prevalence. In contrast, a positive predictive value expresses the proportion of those with positive test results who truly have disease (Attia, 2003). Since this is critically dependent on the population chosen and the prevalence of disease, it will perform less well the lower the prevalence. Consequently, the positive predictive value or negative predictive values are not transferable from one patient to another or from one setting to another. Likelihood ratios on

the other hand are based on a ratio of sensitivity and specificity, and do not vary in different populations or settings (Attia, 2003).

The present study shows that in order to facilitate early identification and treatment, BEDA-Q, containing 9 items, revealed very promising psychometric and predictive features when it comes to distinguish between female athletes with and without an ED. But, more studies are needed including larger samples, athletes with different competitive levels, and both gender represented in order to further confirm these results and also to test the predictive ability of BEDA-Q.

Methodological considerations

First, the strengths of the present thesis include the study design and the large number of nationally representative participants representing a wide range of sport events. The sport-specific intervention program developed for athletes and coaches, lasting one-year, was theoretically informed and systematic developed based on the current best practice (knowledge, theory and results from existing studies) and designed to be feasible in the school setting and not financially demanding. Also, the two-tiered approach including the clinical interview EDE with participants both at-risk and not at-risk, the long-term follow-up and the external validation of BEDA-Q version 1 represent strengths.

Although we included the total population of first-year student athletes at the different Elite Sport High Schools in Norway, the study was underpowered. Having a sufficient sample size is crucial to determining the effects of an intervention. As indicated in Paper II, the study was underpowered to demonstrate even gross intervention effects on ED in females. Thus, a multicenter study would have added further strength to especially the interventional effect. Including a higher number of male and female adolescent elite athletes would also have resulted in a higher number of coaches included in our study which would have added power to the results presented in Paper III.

Well-designed RCTs are considered the best scientific study design to evaluate cause-effect relationships and to assess the efficacy of interventions (Moher et al., 2010). However, the RCT design has some weaknesses such as contamination, threats to external validity and ethics of randomization (Sanson-Fisher et al., 2007). To minimize contamination bias within schools, a cluster-randomized design was used with schools as the unit of randomization. As a result, all athletes and coaches from each school were randomized to the same treatment arm (intervention or control). Based on this approach and that the clinical interviews at posttest 2 were conducted at the different Elite Sport High Schools by the main supervisor (JSB) and PL, it was impossible

to blind us from knowing if we visited and interviewed athletes from an intervention or a control school. Because of the time limit (the clinical interviews needed to be conducted as soon as possible after the questionnaire screening and then before graduation), the number of clinical interviews that had to be conducted at the second posttest (n=463, 99.6%), our limited economic recourses, and the fact that the different Elite Sport High Schools in Norway are all over the country, it was impossible to conduct this part of the study without our involvement. Still, we recognize that the most preferable approach would have been that someone else conducted the clinical interviews in a blinded design. Then again, importantly, we were unaware of the athlete's health status. We did not know what the athletes had answered at the different questionnaire screenings during the study or if they had previously been classified as at risk or not at risk for an ED. Moreover, for reliability assessments as previously described, a random sample of athletes were reinterviewed at the second posttest (n=13) as was done at pretest (n=28). In all cases, there was complete agreement between the two interviewers concerning the diagnostic classification. Our decision of reinterviewing a random sample of the athletes instead of videotaping the interviews was confirmed as the preferred method by the first author of the EDE (Christopher Fairburn personal communication), January 2011.

Finally, when investigating intervention effects of a one-year intervention program including different components, it is not possible to sort out whether or how the components included in the program worked separately or if the effect would have been even stronger (or less strong) by adding more components or by making the program more intensive. However, we could possibly have added more information about the effect of the special education program developed for the coaches by interviewing a random sample of them in addition to the questionnaire screening. This could have given a deeper and more comprehensive understanding of their strategies to identify, manage and prevent ED among their athletes. Especially since observing the coaches' coaching behavior and contact with their athletes on a regular basis before, during and after the intervention-program would have been an almost impossible task.

Perspectives and implications

The Health, Body and Sport Performance study has shown that a one-year sport-specific school based intervention program can prevent new cases of ED and symptoms associated with ED among adolescent elite athletes. In our prevention study we used male and female athletes and coaches at Elite Sport High Schools as models. As there are minimal direct costs and side effects

associated with this school-based intervention program, it seems clear that the program should be implemented in the Elite Sport High Schools on a regular basis.

In an effort to combat the high prevalence of DE and ED in adolescent elite athletes and decrease treatment delay and related complications a major goal in the Health, Body and Sport Performance study was to also target the coaches during the intervention. With the success of the intervention approach employed, hopefully more coaches will have the opportunity to learn skills needed to assist and/or prevent ED among their athletes. Future prevention studies should use the power and influence of coaches to create supportive environments regarding prevention of ED among athletes and include education programming that targets coaches as a separate part of the intervention program for the athletes. Moreover, based on the coaches as well as other athletic staff members prime position to monitor their athletes' behaviors and reactions, mandatory education programs should be implemented on an annual basis. Sport organizations such as the International Federations, National Olympic Committees and National Sport Federations should support the coaches and provide preventive education programs for coaches, athletic staff and athletes. Also judges and sport administrators need to be targeted. These organizations can provide policies for coaches on the healthy practice of managing athletes eating behavior, weight and body composition, as well as implement rule modifications/changes to address weight-sensitive issues in sport (Mountjoy et al., 2014).

Based on the high prevalence of ED found in our study among the adolescent male and female elite athletes it is tempting to suggest that education about health and performance-related nutrition and body composition should be administrated at an earlier age than high school. In addition, the first-year students showed low knowledge of nutrition at the pretest questionnaire screening (data not shown). However, it is important to remember that such education will only succeed in the long run if the participants find the topics relevant and adopt them.

Early identification of athletes at risk for an ED facilitates targeted prevention programs for the athlete, the athlete entourage, and the sport organization. However, knowledge of factors or circumstances that can lead to an ED is limited. The BEDA-Q may be an important contribution in making it easier to identify those athletes in need for further examination. In order to further confirm the results and also test BEDA-Q's predictive ability more studies are needed including larger samples, athletes with different competitive levels and both gender represented. Finally, controlled longitudinal studies are needed to thereby possible true risk and trigger factors for the development of ED in sports can be explored.

Because we included a wide range of sport events and the intervention program was sport-specific it seems reasonable to assume that the program also could be used in high schools focusing on competitive sports without being classified as Elite Sport High Schools. For athletes in another age ranges or non-athletes attending regular high schools, some of the topics will need adjustment. If the positive findings observed in the present study period and at the one-year follow-up were to continue during young adulthood and adulthood, this would be of major health significance for athletes. Furthermore, if the beneficial changes observed in the present study could be translated into benefits for other mentioned population groups, this could also be of public health significance.

Conclusions

1. The prevalence of ED is higher among adolescent male and female elite athletes than controls and higher in female than male athletes. A clinical interview is needed to determine the accurate prevalence of ED.
2. A 1-yr sport-specific school-based intervention program can prevent new cases of ED and symptoms associated with ED in adolescent female elite athletes. Long-term follow-up is important.
3. A special educational program for coaches included as a separate part of the intervention program can be an effective means by which to promote long-term retention of information (at least 9-months) on total knowledge, weight-regulation, and ED. The educational program also shows positive effects on the coaches' subjective evaluation of their ED knowledge.
4. The BEDA-Q containing 9-items reveal good ability to distinguish between female elite athletes with and without an ED. This brief and easy administrated screening questionnaire appear to be well-suited as a first-step to identify athletes that may have an ED and are in need of further medical and psychological examination. BEDA-Q's predictive ability has to be tested in larger samples.

References

Abood DA and Black DR. Health education prevention for eating disorders among college female athletes. Am J Health Behav 2000: 24: 209-219.

Ackland TR, Lohman TG, Sundgot-Borgen J, Maughan RJ, Meyer NL, Stewart AD, and Muller W. Current status of body composition assessment in sport: review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I.O.C. Medical commission. Sports Med 2012: 42: 227-249.

American Psychiatric Association. Eating Disorders.In: Diagnostic and statistical manual of mental disorders: DSM-IV Washington, DC: American Psychiatric Association, 1994 Pp. 539-550.

American Psychiatric Association. Eating Disorders.In: Diagnostic and Statistical Manual of Mental Disoorders Washington, DC: American Psychiatric Association, 2000 Pp. 583-595.

American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 5th ed. (DSM-5). Washington, DC: American Psychiatric Association,2013.

American Psychiatric Association. DSM-5 Development. American Psychiatric Association. 2014. Retrieved May 2014 from http://www.dsm5.org/Pages/Default.aspx

Andersen AE and Holman JE. Males with eating disorders: Challenges for treatment and research. Psychopharmacol Bull 1997: 33: 391-397.

Anderson C and Petrie TA. Prevalence of Disordered Eating and Pathogenic Weight Control Behaviors Among NCAA Division I Female Collegiate Gymnasts and Swimmers. Res Q Exerc Sport 2012: 83: 120-124.

Artioli GG, Gualano B, Franchini E, Scagliusi FB, Takesian M, Fuchs M, and Lancha AH, Jr. Prevalence, magnitude, and methods of rapid weight loss among judo competitors. Med Sci Sports Exerc 2010: 42: 436-442.

Attia J. Moving beyond sensitivity and specificity: using likelihood ratios to help interpret diagnostic tests. Aust Prescr 2003: 26: 111-113.

Austin SB. Population-based prevention of eating disorders: An application of the Rose prevention model. Prev Med 2001: 32: 268-283.

Baldwin SA and Hoffmann JP. The dynamics of self-esteem: A growth-curve analysis. J Youth Adolescence 2002: 31: 101-113.

Bandura A. Social foundations of thought and action - A social cognitive theory. New Jersey: Prentice-Hall,1986.

Bandura A, Adams NE, and Beyer J. Cognitive processes mediating behavioral change. J Pers Soc Psychol 1977: 35: 125-139.

Barker ET and Galambos NL. Exploring Criterion Confounding in the Measurement of Binge Eating Symptoms and Negative Affect. J Psychopathol Behav 2009: 31: 43-50.

Baum A. Eating disorders in the male athlete. Sports Med 2006: 36: 1-6.

Baxterjones ADG, Helms P, Maffulli N, Bainespreece JC, and Preece M. Growth and Development of Male Gymnasts, Swimmers, Soccer and Tennis Players - A Longitudinal-Study. Ann Hum Biol 1995: 22: 381-394.

Beals KA. Disordered eating among athletes: a comprehensive guide for health professionals. Champaign,III.: Human Kinetics,2004.

Beals KA and Hill AK. The prevalence of disordered eating, menstrual dysfunction, and low bone mineral density among US collegiate athletes. Int J Sport Nutr Exe 2006: 16: 1-23.

Beals KA and Manore MM. Disorders of the female athlete triad among collegiate athletes. Int J Sport Nutr Exe 2002: 12: 281-293.

Becker CB, McDaniel L, Bull S, Powell M, and McIntyre K. Can we reduce eating disorder risk factors in female college athletes? A randomized exploratory investigation of two peer-led interventions. Body Image 2012: 9: 31-42.

Berg SL and Andersen AE. Eating disorders in special populations: Medical comorbidities and complicating or unusual conditions. Edited by Yager,J. and Powers,P.S.,In: Clinical manual of eating disorders Arlington: American Psychiatric Press, 2007 Pp. 335-356.

Biesecker AC and Martz DM. Impact of coaching style on vulnerability for eating disorders: An analog study. Eat Disord 1999: 235-244.

Black DR, Larkin LJS, Coster DC, Leverenz LJ, and Abood DA. Physiologic screening test for eating disorders/disordered eating among female collegiate athletes. J Athl Training 2003: 38: 286-297.

Bonci CM, Bonci LJ, Granger LR, Johnson CL, Malina RM, Milne LW, Ryan RR, and Vanderbunt EM. National athletic trainers' association position statement: preventing, detecting, and managing disordered eating in athletes. J Athl Train 2008: 43: 80-108.

Børresen R and Rosenvinge JH. From Prevention to Health Promotion. Edited by Treasure,J., Schmidt,U., and Van Furth,E.,In: Handbook of Eating Disorders Chisester: Wiley, 2003 Pp. 455-466.

Brelsford TN, Hummel RM, and Barrios BA. The Bulimia Test-Revised: a psychometric investigation. Psychol Assess 1992: 399-401.

Brownell KD, Steen SN, and Wilmore JH. Weight Regulation Practices in Athletes - Analysis of Metabolic and Health-Effects. Med Sci Sports Exerc 1987: 19: 546-556.

Buchholz A, Mack H, McVey G, Feder S, and Barrowman N. BodySense: An Evaluation of a positive body image intervention on sport climate for female athletes. Eat Disord 2008: 308-321.

Byrne S and McLean N. Eating disorders in athletes: a review of the literature. J Sci Med Sport 2001: 4: 145-159.

Byrne S and McLean N. Elite athletes: effects of the pressure to be thin. J Sci Med Sport 2002: 5: 80-94.

Cafri G, Blevins N, and Thompson JK. The drive for muscle leanness: a complex case with features of muscle dysmorphia and eating disorder not otherwise specified. Eat Weight Disord 2006: 11: e117-e118.

Carter JC, Aime AA, and Mills JS. Assessment of bulimia nervosa: A comparison of interview and self-report questionnaire methods. Int J Eat Disord 2001: 30: 187-192.

Cash TF and Pruzinsky T. Body image. A handbook of theory, research, and clinical practice. New York: The Guilford Press,2002.

Cohane GH and Pope HG, Jr. Body image in boys: a review of the literature. Int J Eat Disord 2001: 29: 373-379.

Cole TJ, Flegal KM, Nicholls D, and Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. Br Med J 2007: 335: 194-197.

Cooper PJ, Taylor MJ, Cooper Z, and Fairburn CG. The Development and Validation of the Body Shape Questionnaire. Int J Eat Disord 1987: 6: 485-494.

Cooper Z, Cooper PJ, and Fairburn CG. The Validity of the Eating Disorder Examination and Its Subscales. Br J Psychiatry 1989: 154: 807-812.

Cooper Z and Fairburn C. The Eating Disorder Examination - A Semistructured Interview for the Assessment of the Specific Psychopathology of Eating Disorders. Int J Eat Disord 1987: 6: 1-8.

Cote J. The influence of the family in the development of talent in sport. Sport Psychol 1999: 13: 395-417.

Cote J. The road to continued sport participation and sport excellence. Edited by Hung,T., Lidor,R., and Hackfort,D.,In: International perspectives on sport and exercise psychology: psychology of sport excellence Morgantown: Fitness Information Technology, 2009 Pp. 97-104.

Cote J, Baker J, and Abernethy B. Practice and play in the development of sport expertise. Edited by Eklund,R. and Tenenbaum,G.,In: Handbook of sport psychology (3rd edition) Hoboken: Wiley, 2007 Pp. 184-202.

Cote J and Hay J. Children's involvement in sport: a developmental perspective. Edited by Silva,M. and Stevens,D.E.,In: Psychological foundations of sport Boston: Allyn and Bacon, 2002 Pp. 484-502.

Cowen EL. Primary prevention in mental health: Past, present, and future. Edited by Felner,R.D., Jason,L.A., Moritsugu,J.N., and Farber,S.S.,In: Preventive psychology: Theory, research, and practice New York: Pergamon, 1983 Pp. 11-25.

Cowen EL. Social and community intervention. Annu Rev Psychol 1973: 423-472.

Crow SJ, Peterson CB, Swanson SA, Raymond NC, Specker S, Eckert ED, and Mitchell JE. Increased Mortality in Bulimia Nervosa and Other Eating Disorders. Am J Psychiatry 2009: 166: 1342-1346.

Damian LE, Stoeber J, Negru O, and B-âban A. On the development of perfectionism in adolescence: Perceived parental expectations predict longitudinal increases in socially prescribed perfectionism. Pers Indiv Differ 2013: 55: 688-693.

de Bruin AP, Oudejans RRD, and Bakker FC. Dieting and body image in aesthetic sports: A comparison of Dutch female gymnasts and non-aesthetic sport participants. Psychol Sport Exerc 2007: 8: 507-520.

Deci EL and Ryan RM. The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychol Inq 2000: 11: 227-268.

DeSouza MJ, Arce JC, Pescatello LS, Scherzer HS, and Luciano AA. Gonadal-Hormones and Semen Quality in Male Runners - A Volume Threshold Effect of Endurance Training. Int J Sports Med 1994a: 15: 383-391.

DeSouza MJ, Luciano AA, Arce JC, Demers LM, and Loucks AB. Clinical-Tests Explain Blunted Cortisol Responsiveness But Not Mild Hypercortisolism in Amenorrheic Runners. J Appl Physiol 1994b: 76: 1302-1309.

Dolan E, McGoldrick A, Davenport C, Kelleher G, Byrne B, Tormey W, Smith D, and Warrington GD. An altered hormonal profile and elevated rate of bone loss are associated with low bone mass in professional horse-racing jockeys. J Bone Miner Metab 2012: 30: 534-542.

Drinkwater, B., Loucks, A., Sherman, R., Sundgot-Borgen, J., and Thompson, R. International Olympic Committee Medical Commission Working Group Women in Sport:position stand on the female athlete triad. International Olympic Committee. 2005. Retrieved September 2010 from http://www.olympic.org/Documents/Reports/EN/en_report_917.pdf

Elliot DL, Goldberg L, Moe EL, DeFrancesco CA, Durham MB, and McGinnis W. Long-term outcome of the ATHENA (Athletes Targeting Healthy Exercise and Nutrition Alternatives) program for high school athletes. J Alcohol Drug Educ 2008: 73-92.

Elliot DL, Goldberg L, Moe EL, DeFrancesco CA, Durham MB, and Hix-Small H. Preventing substance use and disordered eating - Initial outcomes of the ATHENA (Athletes Targeting Healthy Exercise and Nutrition Alternatives) Program. Arch Pediat Adol Med 2004: 158: 1043-1049.

Enns MW and Cox BJ. The nature and assessment of perfectionism: A critical analysis. Edited by Flett,G.L. and Hewitt,P.L.,In: Perfectionism Washington, DC: American Psychological Association, 2002 Pp. 33-62.

Evans C and Dolan B. Body Shape Questionnaire - Derivation of Shortened Alternate Forms. Int J Eat Disord 1993: 13: 315-321.

Fairburn CG and Beglin S. Eating Disorder Examination Questionnaire (EDE-Q 6.0). Edited by Fairburn,C.G.,In: Cognitive Behavior Therapy and Eating Disorders New York: The Guilford Press, 2008 Pp. 309-314.

Fairburn CG and Beglin SJ. Assessment of Eating Disorders - Interview Or Self-Report Questionnaire. Int J Eat Disord 1994: 16: 363-370.

Fairburn CG and Bohn K. Eating disorder NOS (EDNOS): an example of the troublesome "not otherwise specified" (NOS) category in DSM-IV. Behav Res Ther 2005: 43: 691-701.

Fairburn CG, Cooper Z, and O'Connor ME. Eating Disorder Examination (Edition 16.0D). Edited by Fairburn,C.G.,In: Cognitive Behavior Therapy and Eating Disorders New York: The guilford press, 2008 Pp. 265-308.

Fairburn CG and Harrison PJ. Eating disorders. Lancet 2003: 361: 407-416.

Federation Internationale de Gymnastique. FIG Code of Ethics. Tenerife: Federation International de Gymnastique. 2001. Retrieved February 2014 from http://www.fedintgym.com/rules/files/main/Code%20of%20Ethics%20(english).pdf

Festinger L. A theory of cognitive dissonance. Stanford, Calif.: Stanford University Press,1957.

Filaire E, Rouveix M, Pannafieux C, and Ferrand C. Eating attitudes, perfectionism and body-esteem of elite male judoists and cyclists. J Sports Sci Med 2007: 6: 50-57.

Fingeret MC, Warren CS, and Cepeda-Benito A. Eating Disorder Prevention Research: A Meta-Analysis. Eat Disord 2006: 191-213.

Fletcher GF, Balady G, Blair SN, Blumenthal J, Caspersen C, Chaitman B, Epstein S, Froelicher ESS, Froelicher VF, Pina IL, and Pollock ML. Statement on exercise: Benefits and recommendations for physical activity programs for all Americans - A statement for health professionals by the committee on exercise and cardiac rehabilitation of the council on clinical cardiology, American Heart Association. Circulation 1996: 94: 857-862.

Flett GL and Hewitt PL. The perils of perfectionism in sports and exercise. Curr Dir Psychol Sci 2005: 14: 14-18.

Flett GL, Hewitt PL, Oliver JM, and Macdonald S. Perfectionism in children and their parents: A developmental analysis. Edited by Flett,G.L. and Hewitt,P.L.,In: Perfectionism: Theory, Research, and Treatment Washington, DC: American Psychological Association, 2002 Pp. 88-132.

Forsberg S and Lock J. The relationship between perfectionism, eating disorders and athletes: A review. Minerva Pediatr 2006: 525-36.

Friborg O, Clausen L, and Rosenvinge JH. A five-item screening version of the Eating Disorder Inventory (EDI-3). Compr Psychiatry 2013: 54: 1222-1228.

Fulkerson JA, Keel PK, Leon GR, and Dorr T. Eating-disordered behaviors and personality characteristics of high school athletes and nonathletes. Int J Eat Disord 1999: 26: 73-79.

Garner DM. Eating disorder inventory-2: professional manual. Odessa, Fl.: Psychological Assessment Resources,1991.

Garner DM. Measurement of eating disorder psychopathology. Edited by Fairburn,C.G. and Brownell,K.D.,In: Eating disorders and obesity: A comprehensive handbook New York: Guilford, 2002 Pp. 141-146.

Garner DM and Garfinkel PE. Eating Attitudes Test - Index of the Symptoms of Anorexia-Nervosa. Psychol Med 1979: 9: 273-279.

Garner DM and Olmsted MP. Eating disorder inventory manual. Odessa, FL.: Psychological Assessment Resources,1984.

Garner DM, Olmsted MP, Bohr Y, and Garfinkel PE. The Eating Attitudes Test - Psychometric Features and Clinical Correlates. Psychol Med 1982: 12: 871-878.

Georgopoulos N, Markou K, Theodoropoulou A, Paraskevopoulou P, Varaki L, Kazantzi Z, Leglise M, and Vagenakis AG. Growth and pubertal development in elite female rhythmic gymnasts. J Clin Endocr Metab 1999: 84: 4525-4530.

Ghaderi A and Scott B. Prevalence and psychological correlates of eating disorders among females aged 18-30 years in the general population. Acta Psychiatr Scand 1999: 99: 261-266.

Ghaderi A and Scott B. Prevalence, incidence and prospective risk factors for eating disorders. Acta Psychiatr Scand 2001: 104: 122-130.

Ghaderi A and Scott B. The reliability and validity of the Swedish version of the Body Shape Questionnaire. Scand J Psychol 2004: 45: 319-324.

Golden NH, Katzman DK, Kreipe RE, Stevens SL, Sawyer SM, Rees J, Nicholls D, and Rome ES. Eating disorders in adolescents: position paper of the Society for Adolescent Medicine. J Adolesc Health 2003: 33: 496-503.

Gotestam KG and Agras WS. General Population-Based Epidemiologic-Study of Eating Disorders in Norway. Int J Eat Disord 1995: 18: 119-126.

Gould D, Dieffenbach K, and Moffett A. Psychological characteristics and their development in Olympic champions. J Appl Sport Psychol 2002: 14: 172-204.

Graber JA and Sontag LM. Internalizing problems during adolescence. Edited by Lerner,R.M. and Steinberg,L.D.,In: Handbook of adolescent psychology, Volume 1, Individual bases of adolescent development (3rd edition) New York: John Wiley & Sons, Inc, 2009 Pp. 642-682.

Greenleaf C, Petrie TA, Carter J, and Reel JJ. Female Collegiate Athletes: Prevalence of Eating Disorders and Disordered Eating Behaviors. J Am Coll Health 2009: 57: 489-495.

Grilo CM, Masheb RM, and Wilson GT. A comparison of different methods for assessing the features of eating disorders in patients with binge eating disorder. J Consult Clin Psychol 2001: 69: 317-322.

Gual P, Perez-Gaspar M, Martinez-Gonzalez MA, Lahortiga F, de Irala-Estevez J, and Cervera-Enguix S. Self-esteem, personality, and eating disorders: baseline assessment of a prospective population-based cohort. Int J Eat Disord 2002: 31: 261-273.

Hall CJ and Lane AM. Effects of rapid weight loss on mood and performance among amateur boxers. Br J Sports Med 2001: 35: 390-395.

Hansen DM, Larson RW, and Dworkin JB. What adolescents learn in organized youth activities: A survey of self-reported developmental experiences. J Res Adolescence 2003: 13: 25-55.

Hausenblas HA and Downs DS. Comparison of Body Image between Athletes and Nonathletes: A Meta-Analytic Review. J Appl Sport Psychol 2001: 13: 323-339.

Hawkley LC and Cacioppo JT. Loneliness Matters: A Theoretical and Empirical Review of Consequences and Mechanisms. Ann Behav Med 2010: 40: 218-227.

Hewitt PL, Flett GL, and Ediger E. Perfectionism Traits and Perfectionistic Self-Presentation in Eating Disorder Attitudes, Characteristics, and Symptoms. Int J Eat Disord 1995: 18: 317-326.

Hill AP, Hall HK, and Appleton PR. Perfectionism and athlete burnout in junior elite athletes: the mediating role of coping tendencies. Anxiety Stress and Coping 2010: 23: 415-430.

Hoek HW. Review of the epidemiological studies of eating disorders. Int Rev Psychiatr 1993: 61-74.

Holm-Denoma JM, Scaringi V, Gordon KH, Van Orden KA, and Joiner TE. Eating Disorder Symptoms among Undergraduate Varsity Athletes, Club Athletes, Independent Exercisers, and Nonexercisers. Int J Eat Disord 2009: 42: 47-53.

Holme I, Pedersen TR, Boman K, Egstrup K, Gerdts E, Kesaniemi YA, Malbecq W, Ray S, Rossebo AB, Wachtell K, Willenheimer R, and Gohlke-Barwolf C. A risk score for predicting mortality in patients with asymptomatic mild to moderate aortic stenosis. Heart 2012: 98: 377-383.

Hopkinson R and Lock J. Athletics, perfectionism, and disordered eating. Eat Weight Disord 2004: 99-106.

Hsu LKG. Epidemiology of the eating disorders. Psychiatr Clin North Am 1996: 19: 681-&.

International Olympic Committee. The Olympic movement medical code. Lausanne: International Olympic Commitee. 2009. Retrieved November 2013 from http://www.olympic.org/PageFiles/61597/Olympic_Movement_Medical_Code_eng.pdf

Jacobi C, Hayward C, de Zwaan M, Kraemer HC, and Agras WS. Coming to terms with risk factors for eating disorders: Application of risk terminology and suggestions for a general taxonomy. Psychol Bull 2004: 130: 19-65.

Johnson C, Powers PS, and Dick R. Athletes and eating disorders: the National Collegiate Athletic Association study. Int J Eat Disord 1999: 26: 179-188.

Johnson MD. Disordered Eating in Active and Athletic Women. Clin Sports Med 1994: 13: 355-369.

Jones M, Luce KH, Osborne MI, Taylor K, Cunning D, Doyle AC, Wilfley DE, and Taylor CB. Randomized, controlled trial of an internet-facilitated intervention for reducing binge eating and overweight in adolescents. Pediatrics 2008: 121: 453-462.

Keel PK and Forney KJ. Psychosocial risk factors for eating disorders. Int J Eat Disord 2013: 46: 433-439.

Kernis MH. Toward a conceptualization of optimal self-esteem. Psychol Inq 2003: 14: 1-26.

Kiningham RB and Gorenflo DW. Weight loss methods of high school wrestlers. Med Sci Sports Exerc 2001: 33: 810-813.

Kjelsås E, Bjørnstrøm C, and Götestam KG. Prevalence of eating disorders in female and male adolescents (14 -15 years). Eat Behav 2004: 5: 13-25.

Kringlen E, Torgersen S, and Cramer V. A Norwegian psychiatric epidemiological study. Am J Psychiatry 2001: 158: 1091-1098.

Kutlesic V, Williamson DA, Gleaves DH, Barbin JM, and Murphy-Eberenz KP. The Interview for the Diagnosis of Eating Disorders IV: Application to DSM-IV diagnostic criteria. Psychol Assess 1998: 10: 41-48.

Lampard AM, Byrne SM, McLean N, and Fursland A. The Eating Disorder Inventory-2 Perfectionism scale: Factor structure and associations with dietary restraint and weight and shape concern in eating disorders. Eat Behav 2012: 13: 49-53.

Larson RW. Toward a psychology of positive youth development. Am Psychol 2000: 55: 170-183.

Law M, Cote J, and Ericsson KA. Characteristics of expert development in rhytmic gymnastics: a retrospective study. Int J Sport Exerc Psychol 2007: 82-103.

Le Gall F, Carling C, and Reilly T. Biological maturity and injury in elite youth football. Scand J Med Sci Spor 2007: 17: 564-572.

Levine MP, McVey GL, Piran N, and Bruce Ferguson H. Introduction. Edited by McVey,G.L., Levine,M.P., Piran,N., and Bruce Ferguson,H.,In: Preventing Eating-Related and Weight-Related Disorders: Collaborative research, advocacy, and policy change. Waterloo, Ontario, Canada: Wilfrid Laurier University Press, 2012 Pp. 1-15.

Levine MP and Smolak L. Changing the Ecology. Edited by Levine,M.P. and Smolak,L.,In: The Prevention of Eating Problems and Eating Disorders: Theory, Research, and Practice New Jersey: Lawrence Erlbaum Associates, 2006a Pp. 282-305.

Levine MP and Smolak L. Deciding the Level of Prevention: Universal, Selective, or Targeted? Edited by Levine,M.P. and Smolak,L.,In: The Prevention of Eating Problems and Eating Disorders: Theory, Research, and Practice New Jersey: Lawrence Erlbaum Associates, 2006b Pp. 335-357.

Levine MP and Smolak L. Lessons From the Field II: Practical Issues in Program Evaluation and Delivery. Edited by Levine,M.P. and Smolak,L.,In: The Prevention of Eating Problems and Eating Disorders: Theory, Research, and Practice New Jersey: Lawrence Erlbaum Associates, 2006c Pp. 264-281.

Levine MP and Smolak L. Prevention of negative body image, disordered eating, and eating disorders: An update. Edited by Wonderlich,S., Mitchell,J.E., de Zwaan,M., and Steiger,H.,In: Annual Review of Eating Disorders Part I - 2007 Oxon, United Kingdom: Radcliffe Publishing Ltd, 2007 Pp. 1-13.

Loucks AB, Kiens B, and Wright HH. Energy availability in athletes. J Sports Sci 2011: 29 Suppl 1: S7-15.

Malina RM, Eisenmann JC, Cumming SP, Ribeiro B, and Aroso J. Maturity-associated variation in the growth and functional capacities of youth football (soccer) players 13-15 years. Eur J Appl Physiol 2004: 91: 555-562.

Malina RM, Reyes MEP, Eisenmann JC, Horta L, Rodrigues J, and Miller R. Height, mass and skeletal maturity of elite Portuguese soccer players aged 11-16 years. J Sports Sci 2000: 18: 685-693.

Manore MM. Dietary recommendations and athletic menstrual dysfunction. Sports Med 2002: 32: 887-901.

Marquart LF and Sobal J. Weight-Loss Beliefs, Practices and Support Systems for High-School Wrestlers. J Adolesc Health 1994: 15: 410-415.

Martinsen M, Bratland-Sanda S, Eriksson AK, and Sundgot-Borgen J. Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. Br J Sports Med 2010: 44: 70-76.

Matejek N, Weimann E, Witzel C, Molenkamp G, Schwidergall S, and Bohles H. Hypoleptinaemia in patients with anorexia nervosa and in elite gymnasts with anorexia athletica. Int J Sports Med 1999: 20: 451-456.

McNulty KY, Adams CH, Anderson JM, and Affenito SG. Development and validation of a screening tool to identify eating disorders in female athletes. J Am Diet Assoc 2001: 101: 886-892.

McVey G, Levine MP, Piran N, and Ferguson HB. Conclusion. Edited by McVey,G., Levine,M.P., Piran,N., and Ferguson,H.B.,In: Preventing Eating-Related and Weight-Related Disorders: Collaborative research, advocacy, and policy change. Waterloo, Ontario, Canada: Wilfrid Laurier University Press, 2012 Pp. 269-278.

McVey G, Tweed S, and Blackmore E. Healthy Schools-Healthy Kids: a controlled evaluation of a comprehensive universal eating disorder prevention program. Body Image 2007: 4: 115-136.

Mintz LB and O'Halloran MS. The Eating Attitudes Test: Validation with DSM-IV eating disorder criteria. J Pers Assess 2000: 74: 489-503.

Moher D, Hopewell S, Schulz K, Montori V, Gøtzsche PC, Devereaux PJ, Elbourne D, Egger M, and Altman DG. CONSORT 2010 Explanation and Elaboration: updated guidelines for reporting parallel group randomised trials. Br Med J 2010: 340:c869.

Mond J, Hall A, Bentley C, Harrison C, Gratwick-Sarll K, and Lewis V. Eating-disordered behavior in adolescent boys: Eating disorder examination questionnaire norms. Int J Eat Disord 2014: 47: 335-341.

Mond JM, Myers TC, Crosby RD, Hay PJ, Rodgers B, Morgan JF, Lacey JH, and Mitchell JE. Screening for eating disorders in primary care: EDE-Q versus SCOFF. Behav Res Ther 2008: 46: 612-622.

Mountjoy M, Sundgot-Borgen J, Burke L, Carter S, Constantini N, Lebrun C, Meyer N, Sherman R, Steffen K, Budgett R, and Ljungqvist A. The IOC consensus statement: beyond the Female Athlete Triad-Relative Energy Deficiency in Sport (RED- S). Br J Sports Med 2014: 48: 491-+.

Mussell MP, Binford RB, and Fulkerson JA. Eating disorders: Summary of risk factors, prevention programming, and prevention research. Couns Psychol 2000: 28: 764-796.

Nagel DL, Black DR, Leverenz LJ, and Coster DC. Evaluation of a screening test for female college athletes with eating disorders and disordered eating. J Athl Training 2000: 35: 431-440.

Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, and Warren MP. American College of Sports Medicine position stand. The female athlete triad. Med Sci Sports Exerc 2007: 39: 1867-1882.

Neumark-Sztainer D, Butler R, and Palti H. Eating disturbances among adolescent girls: Evaluation of a school-based primary prevention program. J Nutr Educ 1995: 27: 24-31.

Neumark-Sztainer D, Wall M, Larson NI, Eisenberg ME, and Loth K. Dieting and disordered eating behaviors from adolescence to young adulthood: findings from a 10-year longitudinal study. J Am Diet Assoc 2011: 111: 1004-1011.

Nevonen L and Broberg AG. Validating the Eating Disorder Inventory-2 (EDI-2) in Sweden. Eat Weight Disord 2001: 6: 59-67.

Nicholls JG. The competitive ethos and democratic education. Cambridge, Mass.: Harvard University Press,1989.

Nichols JF, Rauh MJ, Barrack MT, Barkai HS, and Pernick Y. Disordered eating and menstrual irregularity in high school athletes in lean-build and nonlean-build sports. Int J Sport Nutr Exe 2007: 17: 364-377.

Nichols JF, Rauh MJ, Lawson MJ, Ji M, and Barkai HS. Prevalence of the female athlete triad syndrome among high school athletes. Arch Pediatr Adolesc Med 2006: 160: 137-142.

Norring C and Sohlberg S. Eating Disorder Inventory in Sweden - Description, Cross-Cultural-Comparison, and Clinical Utility. Acta Psychiatr Scand 1988: 78: 567-575.

Nowicka P, Eli K, Ng J, Apitzsch E, and Sundgot-Borgen J. Moving from Knowledge to Action: A Qualitative Study of Elite Coaches' Capacity for Early Intervention in Cases of Eating Disorders. Int J Sports Sci Coach 2013: 8: 343-355.

O'Dea JA and Abraham S. Eating and exercise disorders in young college men. J Am Coll Health 2002: 273-278.

Oppliger RA, Landry GL, Foster SW, and Lambrecht AC. Bulimic Behaviors Among Interscholastic Wrestlers - A Statewide Survey. Pediatrics 1993: 91: 826-831.

Oppliger RA, Steen SAN, and Scott JR. Weight loss practices of college wrestlers. Int J Sport Nutr Exe 2003: 13: 29-46.

Owens RG and Slade PD. Running and Anorexia-Nervosa - An Empirical-Study. Int J Eat Disord 1987: 6: 771-775.

Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, Buchner D, Ettinger W, Heath GW, King AC, Kriska A, Leon AS, Marcus BH, Morris J, Paffenbarger RS, Patrick K, Pollock ML, Rippe JM, Sallis J, and Wilmore JH. Physical activity and public health - A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995: 273: 402-407.

Patton GC, Coffey C, and Sawyer SM. The outcome of adolescent eating disorders: findings from the Victoria Health Cohort Study. Eur Child Adolesc Psychiatry 2003: 125-129.

Pearson J, Goldklang D, and Striegel-Moore RH. Prevention of eating disorders: Challenges and opportunities. Int J Eat Disord 2002: 31: 233-239.

Pensgaard AM and Roberts GC. Elite athletes' experiences of the motivational climate: The coach matters. Scand J Med Sci Spor 2002: 12: 54-59.

Pernick Y, Nichols JF, Rauh MJ, Kern M, Ji M, Lawson MJ, and Wilfley D. Disordered eating among a multi-racial/ethnic sample of female high-school athletes. J Adolesc Health 2006: 38: 689-695.

Peterson CB and Miller KB. Assessment of eating disorders. Edited by Wonderlich,S., Mitchell,J.E., de Zwaan,M., and Steiger,H.,In: Annual review of eating disorders Oxford: Radcliffe Publishing, 2005 Pp. 105-126.

Petrie TA, Greenleaf C, Reel J, and Carter J. Prevalence of Eating Disorders and Disordered Eating Behaviors Among Male Collegiate Athletes. Psychol Men Masc 2008: 9: 267-277.

Petty RE and Cacioppo JT. Communication and persuasion : central and peripheral routes to attitude change. New York: Springer-Verlag,1986.

Piran N. Eating disorders: A trial of prevention in a high risk school setting. J Prim Prev 1999a: 20: 75-90.

Piran N. On the move from tertiary to secondary and primary prevention: Working with an elite dance school. Edited by Piran,N., Levine,M.P., and Steiner-Adair,C.,In: Preventing eating disorders: A handbook of interventions and special challenges Philadelphia: Brunner/Mazel, 1999b Pp. 256-269.

Piran N. Re-inhabiting the body from the inside out: Girls tranform their school environment. Edited by Tolman,D.L. and Brydon-Miller,M.,In: From subjects to Subjectivities: A handbook of interpretative and participatory methods New York: New York University Press, 2001a Pp. 218-238.

Piran N. The body logic program: Discussion and reflections. Cogn Behav Pract 2001b: 8: 259-264.

Piran N. Prevention of Eating Disorders. Edited by Fairburn,C.G. and Brownell,K.D.,In: Eating Disorders and Obesity: A Comprehensive Handbook New York: The Guilford Press, 2002 Pp. 367-371.

Piran N. Prevention of eating disorders: a review of outcome evaluation research. Isr J Psychiatry Relat Sci 2005: 42: 172-177.

Piran N. A Feminist Perspective of Risk Factor Research and the Prevention of Eating Disorders. Eat Disord 2010: 183-198.

Piran N, Levine MP, and Steiner-Adair C. Preventing eating disorders: a handbook of interventions and special challenges. Philadelphia: Brunner/Mazel,1999.

Presnell K, Bearman SK, and Stice E. Risk factors for body dissatisfaction in adolescent boys and girls: a prospective study. Int J Eat Disord 2004: 36: 389-401.

Puglise MT, Lifshitz F, Grad G, Fort P, and Marks-Katz M. Fear of obesity. A cause of short stature and delayed puberty. N Engl J Med 1983: 513-518.

Reas DL, Wisting L, Kapstad H, and Lask B. Convergent Validity of the Eating Disorder Examination and the Eating Disorder Examination-Questionnaire Among University Women in Norway. Eur Eat Disord Rev 2011: 19: 357-361.

Ricca V, Mannucci E, Di Bernardo M, Zucchi T, Paionni A, Placidi GP, Rotella CM, and Faravelli C. Psychopathological and clinical features of outpatients with an eating disorder not otherwise specified. Eat Weight Disord 2001: 157-165.

Ricciardelli LA and Mccabe MP. A biopsychosocial model of disordered eating and the pursuit of muscularity in adolescent boys. Psychol Bull 2004: 130: 179-205.

Robins RW and Trzesniewski KH. Self-esteem development across the lifespan. Curr Dir Psychol Sci 2005: 14: 158-162.

Rogol AD, Clark PA, and Roemmich JN. Growth and pubertal development in children and adolescents: effects of diet and physical activity. Am J Clin Nutr 2000: 72: 521S-528S.

Rosen LW and Hough DO. Pathogenic weight-control behaviors of female college gymnasts. Physician Sportsmed 1988: 16: 141-144.

Rosendahl J, Bormann B, Aschenbrenner K, Aschenbrenner F, and Strauss B. Dieting and disordered eating in German high school athletes and non-athletes. Scand J Med Sci Sports 2009: 19: 731-739.

Ryan R. Management of eating problems in athletic settings. Edited by Brownell,K.D., Rodin,J., and Wilmore,J.H.,In: Eating, body weight and performance in athletes Philadelphia: Lea & Febiger, 1992 Pp. 344-362.

Sanford-Martens TC, Davidson MM, Yakushko OF, Martens MP, Hinton P, and Beck N. Clinical and subclinical eating disorders: An examination of collegiate athletes. J Appl Sport Psychol 2005: 17: 79-86.

Sanson-Fisher RW, Bonevski B, Green LW, and D'Este C. Limitations of the randomized controlled trial in evaluating population-based health interventions. Am J Prev Med 2007: 33: 155-161.

Schtscherbyna A, Soares EA, de Oliveira FP, and Ribeiro BG. Female athlete triad in elite swimmers of the city of Rio de Janeiro, Brazil. Nutrition 2009: 25: 634-639.

Sherman R, Thompson R, Dehass D, and Wilfert M. NCAA Coaches Survey: The Role of the Coach in Identifying and Managing Athletes with Disordered Eating. Eat Disord 2005: 13: 447-466.

Sherry SB, Hewitt PL, Besser A, Mcgee BJ, and Flett GL. Self-oriented and socially prescribed perfectionism in the Eating Disorder Inventory Perfectionism Subscale. Int J Eat Disord 2004: 35: 69-79.

Shisslak CM, Crago M, and Estes LS. The Spectrum of Eating Disturbances. Int J Eat Disord 1995: 18: 209-219.

Sigman GS. Eating disorders in children and adolescents. Pediatr Clin North Am 2003: 50: 1139-1177.

Silverstone PH and Salsali M. Low self-esteem and psychiatric patients: Part I - The relationship between low self-esteem and psychiatric diagnosis. Ann Gen Hosp Psychiatry 2003: 2: 2.

Skarderud F, Rosenvinge JH, and Gotestam KG. [Eating disorders--an overview]. Tidsskr Nor Laegeforen 2004: 124: 1938-1942.

Slater GJ, Rice AJ, Sharpe K, Tanner R, Jenkins D, Gore CJ, and Hahn AG. Impact of acute weight loss and/or thermal stress on rowing ergometer performance. Med Sci Sports Exerc 2005: 37: 1387-1394.

Smink FR, van HD, and Hoek HW. Epidemiology of eating disorders: incidence, prevalence and mortality rates. Curr Psychiatry Rep 2012: 14: 406-414.

Smith A and Petrie T. Reducing the risk of disordered eating among female athletes: a test of alternative interventions. J Appl Sport Psychol 2008: 392-407.

Smolak L, Murnen SK, and Ruble AE. Female athletes and eating problems: a meta-analysis. Int J Eat Disord 2000: 27: 371-380.

Spillane NS, Boerner LM, Anderson KG, and Smith GT. Comparability of the eating disorder inventory-2 between women and men. Assessment 2004: 11: 85-93.

Steen SN and Brownell KD. Patterns of weight loss and regain in wrestlers:Has the tradition changed? Med Sci Sports Exerc 1990: 762-768.

Steiner H, Pyle RP, Brassington GS, Matheson G, and King M. The College Health Related Information Survey (CHRIS-73): A screen for college student athletes. Child Psychiat Hum D 2003: 34: 97-109.

Stewart DA, Carter JC, Drinkwater J, Hainsworth J, and Fairburn CG. Modification of eating attitudes and behavior in adolescent girls: A controlled study. Int J Eat Disord 2001: 29: 107-118.

Stice E. Risk and maintenance factors for eating pathology: A meta-analytic review. Psychol Bull 2002: 128: 825-848.

Stice E, Chase A, Stormer S, and Appel A. A randomized trial of a dissonance-based eating disorder prevention program. Int J Eat Disord 2001: 29: 247-262.

Stice E, Marti CN, Spoor S, Presnell K, and Shaw H. Dissonance and healthy weight eating disorder prevention programs: Long-term effects from a randomized efficacy trial. J Consult Clin Psychol 2008a: 76: 329-340.

Stice E and Shaw H. Eating disorder prevention programs: A meta-analytic review. Psychol Bull 2004: 130: 206-227.

Stice E, Shaw H, Becker CB, and Rohde P. Dissonance-based interventions for the prevention of eating disorders: Using persuasion principles to promote health. Prev Sci 2008b: 9: 114-128.

Stice E, Shaw H, Burton E, and Wade E. Dissonance and healthy weight eating disorder prevention programs: A randomized efficacy trial. J Consult Clin Psychol 2006: 74: 263-275.

Stice E, Shaw H, and Marti CN. A Meta-Analytic Review of Eating Disorder Prevention Programs: Encouraging Findings. Annual Rev Clin Psycho 2007: 207-231.

Stice E and Shaw HE. Role of body dissatisfaction in the onset and maintenance of eating pathology - A synthesis of research findings. J Psychosom Res 2002: 53: 985-993.

Stice E, South K, and Shaw H. Future Directions in Etiologic, Prevention, and Treatment Research for Eating Disorders. J Clin Child Adolesc Psychol 2012: 0: 1-11.

Stice E, Trost A, and Chase A. Healthy weight control and dissonance-based eating disorder prevention programs: results from a controlled trial. Int J Eat Disord 2003: 33: 10-21.

Stoeber J and Otto K. Positive conceptions of perfectionism: Approaches, evidence, challenges. Pers Soc Psychol Rev 2006: 10: 295-319.

Stoutjesdyk D and Jevne R. Eating Disorders Among High-Performance Athletes. J Youth Adolescence 1993: 22: 271-282.

Strand BH, Dalgard OS, Tambs K, and Rognerud M. Measuring the mental health status of the Norwegian population: A comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). Nord J Psychiatry 2003: 57: 113-118.

Sundgot-Borgen J. Prevalence of eating disorders in elite female athletes. Int J Sport Nutr 1993: 3: 29-40.

Sundgot-Borgen J. Risk and Trigger Factors for the Development of Eating Disorders in Female Elite Athletes. Med Sci Sports Exerc 1994: 26: 414-419.

Sundgot-Borgen J and Larsen S. Pathogenic weight-control methods and self-reported eating disorders in female elite athletes and controls. Scand J Med Sci Spor 1993: 3: 150-155.

Sundgot-Borgen J, Meyer NL, Lohman TG, Ackland TR, Maughan RJ, Stewart AD, and Muller W. How to minimise the health risks to athletes who compete in weight-sensitive sports review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition, Health and Performance, under the auspices of the IOC Medical Commission. Br J Sports Med 2013: 47: 1012-1068.

Sundgot-Borgen J, Skårderud F, and Rodgers S. Athletes and Dancers. Edited by Treasure,J., Schmidt,U., and Van Furth,E.,In: Handbook of Eating Disorders Chichester (England): John Wiley & Sons Inc., 2003 Pp. 385-400.

Sundgot-Borgen J and Torstveit MK. Prevalence of eating disorders in elite athletes is higher than in the general population. Clin J Sport Med 2004: 14: 25-32.

Sundgot-Borgen J and Torstveit MK. Aspects of disordered eating continuum in elite high-intensity sports. Scand J Med Sci Spor 2010: 20: 112-121.

Surgeon General's report on physical activity and health. From the Centers for Disease Control and Prevention. JAMA 1996: 276: 522.

Tambs K and Moum T. How Well Can A Few Questionnaire Items Indicate Anxiety and Depression. Acta Psychiatr Scand 1993: 87: 364-367.

The International Olympic Comittee. Healthy body image. The International Olympic Comittee. 2014. Retrieved April 14 A.D. from http://www.olympic.org/hbi

Thein-Nissenbaum JM, Rauh MJ, Carr KE, Loud KJ, and McGuine TA. Associations Between Disordered Eating, Menstrual Dysfunction, and Musculoskeletal Injury Among High School Athletes. J Orthop Sports Phys Ther 2011: 41: 60-69.

Thelen MH, Farmer J, Wonderlich S, and Smith M. A revision of the Bulimia Test: The BULIT-R. Psychol Assess 1991: 3: 119-124.

Thelen MH, Mintz LB, and VanderWal JS. The bulimia test-revised: Validation with DSM-IV criteria for bulimia nervosa. Psychol Assess 1996: 8: 219-221.

Thiel A, Gottfried H, and Hesse FW. Subclinical eating disorders in male athletes. A study of the low weight category in rowers and wrestlers. Acta Psychiatr Scand 1993: 88: 259-265.

Thomas JJ, Keel PK, and Heatherton TF. Disordered eating attitudes and behaviors in ballet students: Examination of environmental and individual risk factors. Int J Eat Disord 2005: 38: 263-268.

Thompson RA and Sherman RT. Helping athletes with eating disorders. Champaign, III.:Human Kinetics Publishers,1993.

Thompson RA and Sherman RT. Eating disorders in sport. New York: Routledge,2010a.

Thompson RA and Sherman RT. Prevention and Education. Edited by Thompson,R.A. and Sherman,R.T.,In: Eating Disorders in Sport New York: Routledge, 2010b Pp. 183-205.

Toro J, Galilea B, Martinez-Mallen E, Salamero M, Capdevila L, Mari J, Mayolas J, and Toro E. Eating disorders in Spanish female athletes. Int J Sports Med 2005: 26: 693-700.

Torstveit MK, Rosenvinge JH, and Sundgot-Borgen J. Prevalence of eating disorders and the predictive power of risk models in female elite athletes: a controlled study. Scand J Med Sci Spor 2008: 18: 108-118.

Torstveit MK and Sundgot-Borgen J. The female athlete triad exists in both elite athletes and controls. Med Sci Sports Exerc 2005: 37: 1449-1459.

Trzesniewski KH, Donnellan MB, and Robins RW. Stability of self-esteem across the life span. J Pers Soc Psychol 2003: 84: 205-220.

Turk JC, Prentice WE, Chappell S, and Shields EW. Collegiate coaches' knowledge of eating disorders. J Athl Training 1999: 34: 19-24.

UK Sport. Eating disorders in sport: A guideline framework for practioniers working with high performance athletes . UK Sport. 2013. Retrieved March 2013 from http://www.uksport.gov.uk/publications/eating-disorders-in-sport

Van Houwelingen JC and Le Cessie S. Predictive value of statistical models. Stat Med 1990: 9: 1303-1325.

Vincent MA, Mccabe MP, and Ricciardelli LA. Factorial validity of the Bulimia Test-Revised in adolescent boys and girls. Behav Res Ther 1999: 37: 1129-1140.

Williamson DA. Assessment of eating disorders: Obesity, anorexia and bulimia nervosa. New York: Pergamon Press,1990.

Williamson DA, Netemeyer RG, Jackman LP, Anderson DA, Funsch CL, and Rabalais JY. Structural equation modeling of risk factors for the development of eating disorder symptoms in female athletes. Int J Eat Disord 1995: 17: 387-393.

Yager Z and O'Dea JA. Prevention programs for body image and eating disorders on University campuses: a review of large, controlled interventions. Health Promot Int 2008: 23: 173-189.

Paper I-IV

Paper I

Higher Prevalence of Eating Disorders among Adolescent Elite Athletes than Controls

MARIANNE MARTINSEN[1] and JORUNN SUNDGOT-BORGEN[2]

[1]*Oslo Sports Trauma Research Center, Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, NORWAY; and* [2]*Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, NORWAY*

ABSTRACT

MARTINSEN, M., and J. SUNDGOT-BORGEN. Higher Prevalence of Eating Disorders among Adolescent Elite Athletes than Controls. *Med. Sci. Sports Exerc.*, Vol. 45, No. 6, pp. 1188–1197, 2013. **Purpose**: The objective of this study is to examine the prevalence of eating disorders (ED) among female and male adolescent elite athletes and nonathletic controls. **Methods**: This was a two-phase study, including a self-report questionnaire (part I) followed by clinical interviews (part II). The total population of first-year students at 16 Norwegian Elite Sport High Schools (n = 677) and two randomly selected high schools (controls, n = 421) were invited to participate. The questionnaire was completed by 611 (90%) athletes and 355 (84%) controls. The subjects reporting symptoms associated with ED were classified as "at risk" for ED. In part II, all "at-risk" athletes (n = 153), a random sample of not "at risk" (n = 153), and a random sample of 50% of the controls classified as "at risk" (n = 91) and not "at risk" (n = 88) were invited to the clinical interview to screen for ED (i.e., meeting the *Diagnostic and Statistical Manual of Mental Disorders* criteria for anorexia nervosa, bulimia nervosa, or ED not otherwise specified). **Results**: In part I, more controls than athletes were classified as "at risk" for ED (50.7% vs 25.0%, $P < 0.001$). In part II, the prevalence of ED among the total population of athletes and controls was estimated to be 7.0% versus 2.3%, with a difference of 4.7% (95% confidence interval, 3.4–6.0; $P = 0.001$), with the ED prevalence being higher for female than male athletes (14.0% vs 3.2%, $P < 0.001$) and female and male controls (5.1% vs 0%, $P < 0.001$). No difference in the prevalence of ED was detected between the females in weight-sensitive and less weight-sensitive sport groups (19.7% vs 11.9%, $P = 0.136$). **Conclusion**: The prevalence of ED is higher in adolescent elite athletes than controls and higher in female than male athletes. Clinical interview is needed to determine accurate prevalence of ED. **Key Words:** ANOREXIA NERVOSA, BULIMIA NERVOSA, EDNOS, SPORT, ELITE, CLINICAL INTERVIEW

Most elite athletic participation and competition take place during adolescence or early adulthood (6). This is also when eating disorders (ED) often develop, when females, especially, experience a rapid change in the body composition and shape. For athletes, these possible changes might affect not only their attitudes toward weight and shape but also their athletic performance (6).

For high school athletes, most studies do not report a greater risk for the development of an ED than among age-matched controls (15,17,26,29). However, most studies have used only questionnaires to assess symptoms associated with ED rather than clinical interviews. Questionnaires have limitations, and it has been argued that clinical interviews are needed to obtain accurate prevalence data (20,32). The few studies available that have used a two-tiered approach (questionnaire screening followed by clinical interviews) have reported that adult elite athletes tend to underreport ED symptoms to a higher degree than controls, and that when clinical interviews are used, a higher proportion of elite female and male athletes actually have ED than that estimated from questionnaires (*Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*)) (35,38,39).

Among the elite female and male adolescent athletes, no previous study has examined the prevalence of ED using clinical interviews. However, it has been reported that young athletes are at substantial risk for ED (27,29), and 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 (32). Thus, there is a need for a study that includes a representative population of young elite athletes representing a wide range of sports examining the prevalence of athletes classified as "at risk" for ED and then identifying how many meet the diagnostic criteria. Therefore, the aim of this study was to examine the prevalence of clinical ED in adolescent female and male elite athletes and age-matched controls by using a two-tiered approach, including a questionnaire screening followed by clinical interviews.

METHODS

We conducted this study in two phases: self-reported questionnaire (part I) and clinical interview (part II).

Address for correspondence: Marianne Martinsen, MSc, Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, PB 4014 Ullevål Stadion, N-0806 Oslo, Norway; E-mail: marianne.martinsen@nih.no.
Submitted for publication September 2012.
Accepted for publication December 2012.

0195-9131/13/4506-1188/0
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

DOI: 10.1249/MSS.0b013e318281a939

Participants

We invited adolescent elite athletes attending Elite Sport High Schools (n = 16) in Norway and age-matched controls from two randomly selected regular high schools in Buskerud county in Norway to participate. The inclusion criteria for part I of the study were enrollment as a first-year student and a birth date in 1992. Norwegian Elite Sport High Schools are private and public high schools with programs designed for talented athletes. We invited 1211 first-year students, 711 athletes, and 500 controls, to participate in the initial screening during the 2008–2009 school year. Of these, 34 athletes and 79 controls were excluded (because of age: 29 athletes and 60 controls; because of failure to obtain parental consent: 5 athletes and 19 controls). Of the remaining 677 athletes and 421 controls, 66 athletes and 66 controls did not participate because they were not able to attend school during the test day. The reasons reported for the athletes not attending school that day were training camp, competition, or illness. When it comes to the controls, no specific reasons for not attending school were reported. This resulted in a final sample of 611 athletes (response rate, 90%) and 355 controls (84%), representing 50 different sports/disciplines, and for part of the analysis and in accordance with recent research, they were classified into weight-sensitive and less weight-sensitive sports (Table 1) (1).

The Regional Committee for Medical and Health Science 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.

Assessment Procedures

Part I: Screening. We asked the respondents to complete a questionnaire that included a battery of assessment questions regarding training history, physical activity and 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 the standardized questionnaire Eating Disorders Inventory-2 (EDI-2), and the short version of Hopkins Symptom Checklist (SCL-5). The questionnaire has been described in detail previously (17), except for the SCL-5. The SCL-5 is a five-item scale designed to measure symptoms of anxiety and depression. These five items are scored on a four-point scale ranging from 1 = "not at all" to 4 = "extremely." The item score is calculated by dividing the total score of the number of items answered (ranging between 1 and 4), and a cutoff score of 2 indicates psychological distress (30). The SCL-5 has been proven reliable, and it is significantly correlated to the original instrument (37). In addition, a comparison study of several instruments found the reliability of this short version acceptable, with the recommendation to use the short version if included in a comprehensive questionnaire (30).

To be classified as "at risk" for ED, subjects 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 value (8); d) trying to lose weight now; e) tried to lose weight before three times or more; 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). The athletes and controls completed the questionnaire at school during school hours in the presence of one or two members of the research group.

Physical activity was defined as the total hours of physical activity per week, including physical education lessons, recreational sports, and active daily living like walking. We classified those who reported ≥7 h of physical activity per week as physically active (equivalent to the Norwegian physical activity recommendations of 1 $h \cdot d^{-1}$ of moderate activity) (19). Training volume was reported as the number of training hours per week in the following categories: ≤5, 6–10, 11–15, 16–20, or ≥21.

Part II: Clinical interview. Based on the data from part I, 102 female and 51 male athletes (n = 153, 25.0%) and 113 female and 67 male controls (n = 180, 50.7%) were classified as being "at risk" with symptoms associated with ED

TABLE 1. Classification of the 50 different sports into weight-sensitive and less weight-sensitive sports.

Weight-Sensitive Sports (n = 163)				Less Weight-Sensitive Sports (n = 448)			
		Gravitational					
Aesthetic	Weight Class	Technical	Endurance	Ballgames	Power	Technical	High Mass
Dancing	Judo	High jump	Cycling	Table tennis	Sprint	Golf	Alpine skiing
Gymnastics	Karate	Ski jump	Nordic combined	Tennis		Shooting	Ice hockey
	Tae kwon do	Long jump	Cross-country skiing	Basketball		Motocross	Hammer
		Triple jump	Biathlon	Soccer		Snow cross	Discus
		Hurdle	Paddling	Handball		Horse riding	Javelin
		Heptathlon	Orienteering	Floorball		Sailing	
		Decathlon	Middle- and long-distance running	Volleyball		Surfing	
			Dog racing	Beach volleyball		Fencing	
			BMX cycling			Chess	
			Mountain biking			Freestyle	
			Rowing/sculling[a]			Snowboard	
			Swimming				

[a]Light weight.

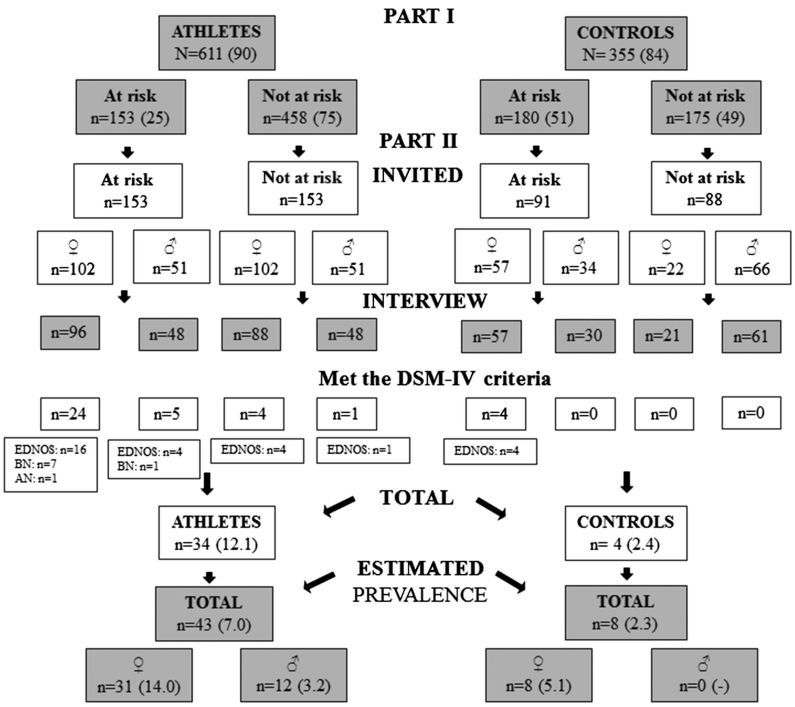


FIGURE 1—Number and percentage of subjects participating in parts I and II of the study.

(Fig. 1). We invited all "at-risk" athletes (n = 153) and a randomly selected sample (50%) of "at-risk" controls (n = 91, 57 girls and 34 boys) to participate in a clinical interview. In addition, to match the "at-risk" subjects, a random sample of athletes (102 girls and 51 boys) and controls (22 girls and 66 boys) not classified as "at risk" after the screening examination was also invited to attend a clinical interview.

The clinical interview was based on the Eating Disorder Examination 16:0 (EDE) (14), including sport-specific questions regarding the suggested predisposing, precipitating, and perpetuating factors related to ED risk, as well as the Eating Disorder Examination Questionnaire 6.0 (EDE-Q) (12). The EDE is an investigator-based interview that assesses ED psychopathology, i.e., undue importance of weight and shape in determining self-worth, as well as key ED behaviors. It is generally considered the best established instrument for assessing ED and is used for diagnostic purposes (7,13,40). The EDE-Q is a 36-item self-report measure derived from EDE focusing on the past 28 d and uses the same seven-point rating scale (0–6). Both EDE and EDE-Q are composed of four scales: restraint, weight concern, shape concern, and eating concern, with higher score representing greater severity of psychopathology. Both EDE and EDE-Q have been translated into Norwegian-language versions and validated (23,25).

We included the clinical interview to determine whether athletes and controls classified as being "at risk" for ED during the screening met the *DSM-IV* criteria for anorexia nervosa (AN), bulimia nervosa (BN), or ED not otherwise specified (EDNOS) (2) and to determine the presence and frequency of core ED symptoms. Four people did the interviews, one psychiatrist and three people trained in using the EDE. All had clinical experience with ED patients and special competence in physical activity and sports. A random selection of the 37 subjects (16 who fulfilled and 21 who did not meet the ED criteria) was interviewed again by a second interviewer. In all cases, there was complete agreement between the two interviewers concerning the diagnostic classification.

Statistical Analysis and Data Presentation

The statistical analyses were carried out using PASW Statistics 18 for Windows (IBM Corporation, Route, Somers, NY). The results are expressed as absolute numbers (N) and percentages (%) for categorical data and mean values with their SD for continuous data. We classified the athletes into weight-sensitive and less weight-sensitive sports as described previously (17). To compare the mean differences, an independent sample t-test was used, whereas we used chi-square tests to compare the categorical frequencies. We calculated the sensitivity as the proportion of the athletes and controls

correctly identified as having ED and specificity as the proportion correctly identified as healthy. The negative predictive value (true negative) was calculated among the proportion of the athletes and controls classified as not "at risk" correctly identified as healthy. We estimated the total prevalence of ED from the prevalence of "at-risk" and healthy subjects participating in the clinical interview, factoring the distribution of "at-risk" and not "at-risk" subjects in the total sample. This was done separately for the athletes and controls with the use of the following formula: $P_{pop} = P_1\ W_1 + P_2\ W_2$, where P_{pop} = estimated prevalence in the total population, P_1 = prevalence of the disorder in "at-risk" subjects in part I, W_1 = weighted distribution of at-risk subjects in part I, P_2 = prevalence of the disorder in subjects classified as not "at-risk" subjects in the clinical interview, W_2 = weighted distribution of not at-risk subjects in part I.

The significance level was set to 0.05.

RESULTS

Part I

Subject characteristics. The athletes were slightly younger than the controls at the time of data collection (16.5 ± 0.3 vs 16.9 ± 0.3, $P < 0.001$). A higher number of female controls than female athletes were classified as overweight according to age- and sex-adjusted BMI criteria ($P = 0.003$) (8). Among the controls, 55% reported being physically active. Among the athletes, 1.5% reported training for ≤5 h·wk^{-1}, 16.5% for 6–10 h·wk^{-1}, 46.2% for 11–15 h·wk^{-1}, 25.7% for 16–20 h·wk^{-1}, and 10.2% for ≥21 h·wk^{-1}. Moreover, 17% of the athletes were selected for the national team (recruit, junior, or senior level). We observed no differences in the anthropometry between the controls participating in part I compared with those in part II.

Prevalence of symptoms associated with ED. A higher proportion of controls than athletes were classified as "at risk" for ED (50.7% vs 25.0%, $P < 0.001$) (Fig. 1). Furthermore, a higher proportion of females compared with males were classified as "at risk" for ED in both groups (athletes: 46.2% vs 13.1%, $P < 0.001$; controls: 72.4% vs 33.7%, $P < 0.001$). We observed no difference in the proportion classified as being "at risk" for ED between weight-sensitive (26.4%) and less weight-sensitive sports (24.6%, $P = 0.65$).

Part II

Prevalence of athletes and nonathletes meeting the *DSM-IV* criteria for ED. Because we gave priority to those classified as being "at risk" based on the questionnaire screening, there was a difference in the time from finishing the data collection from the screening part to attending the interview between those "at risk" and not "at risk" (12.1 ± 4.0 (SD) vs 16.3 ± 3.1 months, $P < 0.0001$). There was no difference between the athletes and nonathletes (14.2. ± 5.0 months vs 14.0 ± 2.2, $P = 0.435$).

The number of the athletes and controls who participated in the clinical interviews and met the *DSM-IV* criteria is shown in Figure 1. As seen, 24 of 96 female athletes and 5 of 48 male athletes classified as "at risk" based on the questionnaire fulfilled the criteria for ED. For the female controls, four of 57 "at risk" who participated in the clinical interview met the criteria (Fig. 1). Among the 34 athletes who met the criteria, 73.5% were diagnosed with EDNOS (20 females, 5 males), 23.5% with BN (7 females, 1 male), and 2.9% with AN (1 female), whereas all the female controls ($n = 4$) diagnosed with an ED were diagnosed with EDNOS.

As part of the analysis, the prevalence of the athletes and controls meeting the criteria for ED was standardized according to the total distribution of "at-risk" and not at-risk subjects for ED in part I of the study (Fig. 1). In this way, we estimated that 7.0% of the athletes and 2.3% of the controls met the criteria for an ED, with a difference of 4.7% (95% confidence interval (CI), 3.4–6.0; $P = 0.001$). The estimated prevalence was higher among the female athletes (14.0%) compared with the female controls (5.1%), with a difference of 8.9% (95% CI, 6.0–11.8; $P = 0.005$). Among the male athletes, 3.2% were estimated to meet the diagnostic criteria, with a difference from the female athletes of 10.8% (95% CI, 8.3–13.3; $P < 0.001$). We detected no difference in the prevalence of ED between the females representing weight-sensitive and less weight-sensitive sport groups (19.7% vs 11.9%, $P = 0.136$). Because of the few cases of ED among the male athletes, no subgroup comparisons were possible.

Five of 136 (3.7%) athletes and no controls classified as healthy from the screening examination were diagnosed with an ED (false negatives). The sensitivity of the screening examination was 0.85 versus 1.00 for the athletes and controls, respectively, whereas the specificity was 0.53 vs 0.50.

Characteristics of athletes meeting the criteria for an ED. Table 2 shows that there were significant differences between the female and male athletes with ED compared with the athletes classified as healthy on several variables reported to be associated with ED. The athletes diagnosed with an ED had higher EDE-Q global score and subscale scores than healthy athletes (Table 3). The shape concern was the subscale with the highest mean score among both the athletes and controls with an ED. As expected, all of the 34 athletes with ED reported current dieting, 25 reported current and/or previous use of pathogenic weight control methods, and among these, 22 reported vomiting regularly at present. However, only eight reported binging and vomiting to such extent that they met the BN criteria (Table 4). Further characteristics of the severity and morbidity among the different athletes and controls with ED are given in Tables 4 and 5.

DISCUSSION

This is the first study to present prevalence data on ED among adolescent male and female athletes representing almost all European sports and a sample of adolescent controls. The novelty of this study is the two-tiered design including both the questionnaire screening and clinical interview and the

TABLE 2. Characteristics of female and male adolescent elite athletes diagnosed with clinical ED or as healthy after the clinical interview.

	Age at Sport Specialization (yr)	Training Volume ($h \cdot wk^{-1}$)	Age at First Dieting Attempt (yr)[a]	Dieting to Enhance Performance[a]	Diet to Improve Appearance[a]	DT	BD	BMI ($kg \cdot m^{-2}$)
Females								
ED (n = 28)	13.0 (1.7)	14.4 (4.2)	13.2 (1.3)[b]	16 (72.7)	22 (95.7)	6.7 (5.3)[c]	13.6 (6.7)[c]	21.5 (2.5)
Healthy (n = 156)	13.4 (1.7)	13.0 (4.4)	14.1 (1.3)	29 (61.7)	44 (86.3)	2.4 (4.0)	6.5 (6.5)	21.2 (2.1)
Males								
ED (n = 6)	12.8 (1.8)	10.5 (4.2)[d]	14.6 (1.1)	5 (100.0)	5 (83.3)	5.5 (7.1)	6.5 (7.0)	24.5 (3.6)[e]
Healthy (n = 90)	12.6 (2.1)	14.7 (3.7)	14.0 (1.5)	28 (90.3)	21 (67.7)	1.4 (2.9)	3.6 (4.5)	21.9 (2.2)

Results are given as means with SD or numbers with percentages, as appropriate. Values are given in absolute numbers and valid percentage when only cases without missing values are considered.
[a]The percentage is based on the number of athletes that had tried to diet.
[b]$P = 0.014$ compared with healthy females.
[c]$P < 0.001$ compared with healthy females.
[d]$P = 0.009$ compared with healthy males.
[e]$P = 0.012$ compared with healthy males.

high prevalence of clinical ED among adolescent elite male and female athletes.

The Prevalence of ED Is High among Adolescent Elite Athletes

Our finding revealed a high prevalence of ED among adolescent elite athletes. The prevalence was higher than among the controls, although more controls than athletes self-reported symptoms associated with ED. In addition, many athletes underreported the use of unhealthy behaviors such as pathogenic weight control methods at the screening compared with the reported use in the clinical interview, which is consistent with previous studies on adult elite athletes (18,31,36).

Among the athletes, it has been reported that some look at their disordered eating (DE) behavior as a natural part of their sport and are not necessarily generally dissatisfied with their body shape or weight (6,21,36), do not realize that they have a problem (4), and thus do not report DE problems. In addition, it has been argued that the DE behavior may reflect a rational response to pressure to achieve a body shape that will ensure optimal performance and reflect dedication to their sport rather than psychopathology (6). Therefore, it seems reasonable that the specific psychological concerns of adolescent elite athletes are somewhat different to those of nonathletes presenting a similar clinical picture, and that prevalence studies based on self-reported questionnaires will not be able to distinguish these differences. Consequently, by using the clinical interview EDE and sport-specific questions, we were able to get more accurate information about the intensity and duration of the most severe symptoms being essential to diagnose ED among both the athletes and the controls. Case number 2 (Tables 4 and 5) is a good illustration of this. This female athlete had BN, but at the screening, she reported no use of pathogenic weight control methods, had scores below the cutoff for "at risk" at the EDI subscales BD and DT, and was only classified as "at risk" because of the present dieting. However, at the clinical interview, it was clear that her dieting behavior primarily was related to sport-specific weight concern. Moreover, her thoughts about weight, shape, and food were at such an intensity that they affected her self-worth and concentration and had resulted in key ED behaviors such as binging and self-induced vomiting. As a result, she met the *DSM-IV* criteria for BN. Subsequently, our use of a two-tiered approach confirms the difficulties that exist when it comes to identifying athletes at risk for ED, or those who already have developed an ED, and explains why it is important to use clinical interviews to assess the specific psychopathology of ED.

Because there are no previous studies that have used a two-tiered approach when investigating ED in adolescent elite athletes, it is difficult to compare the prevalence reported in our study with other studies. In general, comparing prevalence data is difficult because most studies use a variety of methodological approaches. Different populations are investigated (adolescent vs adult, collegiate vs elite vs recreational), and the number of athletes studied (n = size), the number and type of sports included, and which part of the training or competition season the data were collected vary between studies (36). Taking this into account, our findings are in accordance with the studies on older elite athletes using a two-tiered approach (7,35,38). However, the

TABLE 3. EDE-Q subscale scores for healthy and eating disordered elite athletes and controls given as mean ± SD.

	Athletes						Controls			
	Females			Males			Females			Males
	ED n = 28	Healthy n = 154	P	ED n = 6	Healthy n = 90	P	ED n = 4	Healthy n = 74	P	Healthy n = 82
Global score	3.2 ± 1.1	0.8 ± 0.8	<0.001	2.7 ± 0.5	0.5 ± 0.7	<0.001	3.1 ± 1.5	1.0 ± 0.8	0.065	0.4 ± 0.5
Restraint	2.8 ± 1.5	0.6 ± 0.8	<0.001	2.5 ± 0.9	0.5 ± 0.8	<0.001	2.6 ± 2.1	0.7 ± 0.8	0.170	0.4 ± 0.6
Shape concern	4.2 ± 1.3	1.4 ± 1.2	<0.001	3.4 ± 0.8	0.7 ± 0.8	<0.001	4.0 ± 1.2	1.6 ± 1.2	<0.001	0.7 ± 0.9
Weight concern	3.7 ± 1.4	1.1 ± 1.2	<0.001	2.8 ± 0.7	0.5 ± 0.8	<0.001	3.4 ± 1.9	1.3 ± 1.2	0.001	0.6 ± 0.8
Eating concern	2.2 ± 1.4	0.3 ± 0.6	<0.001	2.2 ± 0.6	0.2 ± 0.5	<0.001	2.6 ± 1.4	0.3 ± 0.5	0.045	0.1 ± 0.2

P gives significance level for comparison of ED and healthy.

TABLE 4. BMI, menstrual function, and dieting behavior in subjects meeting the *DSM-IV* criteria for AN, BN, or EDNOS.

ID	Diagnosis	Sex	BMI	Present Dieting	Pathogenic Weight Control Methods[a]	Compulsive Exercise[b] (no.·wk^{-1})	Binge Eating (no.·wk^{-1})	Vomiting (no.·wk^{-1})	Diet Pills	Diuretics	Laxatives	Menstrual Dysfunction
Athletes												
1	AN	F	15.9	+	+			<1				Secondary amenorrhea
2	BN	F	19.0	+	+		2	7				
3	BN	F	21.5	+	+	3	2	2				Oral contraceptives[c]
4	BN	F	21.8	+	+	7	4	2				
5	BN	F	22.9	+	+		7	2				Secondary amenorrhea
6	BN	F	23.8	+	+		7	7	+			Oligomenorrhea
7	BN	F	24.4	+	+	7	7	2	+	+		
8	BN	F	–	+	+	5	2	7				Oral contraceptives[c]
9	BN	M	22.0	+	+		5	4				
10	EDNOS	F	18.3	+	+		1	1				Oral contraceptives[c]
11	EDNOS	F	19.6	+								Secondary amenorrhea
12	EDNOS	F	20.4	+			4					
13	EDNOS	F	21.0	+	+		3					
14	EDNOS	F	21.1	+	+			<1				Oral contraceptives[c]
15	EDNOS	F	21.2	+		5						Oral contraceptives[c]
16	EDNOS	F	21.9	+	+		2	1				Oligomenorrhea
17	EDNOS	F	22.0	+	+		2	<1				
18	EDNOS	F	22.2	+	+			3				
19	EDNOS	F	22.2	+	+	7	2	1				
20	EDNOS	F	22.6	+	+	7	2				+	Oral contraceptives[c]
21	EDNOS	F	23.4	+	+		2	1				Oral contraceptives[c]
22	EDNOS	F	23.6	+	+		3	<1				
23	EDNOS	F	23.7	+	+		2		+			
24	EDNOS	F	23.7	+			2					Oral contraceptives[c]
25	EDNOS	F	23.9	+	+		1	1				
26	EDNOS	F	24.3	+	+	4		3				Oral contraceptives[c]
27	EDNOS	F	26.0	+		7	3					
28	EDNOS	F	27.7	+	+		2	2				
29	EDNOS	F	32.0	+		2	5					
30	EDNOS	M	22.6	+	+			3			+	
31	EDNOS	M	25.7	+								
32	EDNOS	M	26.9	+			3					
33	EDNOS	M	27.3	+		7	3					
34	EDNOS	M	33.5	+	+			4				
Controls												
35	EDNOS	F	21.2	+			2					Oligomenorrhea
36	EDNOS	F	22.1	+	+			<1	+	+	+	Secondary amenorrhea
37	EDNOS	F	22.1	+		2						
38	EDNOS	F	26.3	+			1					

[a]Pathogenic weight control methods (use of diet pills, laxatives, vomiting, or diuretics to lose weight).
[b]Training beyond that required to enhance for the athletes sports to purge their bodies of the effect of eating.
[c]Contraceptives initiated to establish spontaneous bleeding (normalizing menstrual cycle).

prevalence was, as expected, lower than found among older Norwegian elite athletes in 2004 (35). In contrast to our present study, Sundgot-Borgen and Torstveit (35) included the subclinical ED anorexia athletica (AA) in their prevalence study. Still, it may be argued that these athletes would have been diagnosed with EDNOS if AA had not been included. Furthermore, if AA was eliminated as a diagnosis and these athletes were classified as healthy, the percentage of ED would still be higher among both female (16.3%) and male (7.4%) athletes when using the same estimate calculation as we used in this present study. Similarly, Torstveit et al. (38) found a higher percentage of ED among adult female elite athletes as compared with the prevalence among the females in our study. Thus, although adolescence is considered to be the period of greatest vulnerability and the time when ED typically occurs, the prevalence of ED seems to be higher among adult elite athletes.

Several explanations may be relevant for the higher prevalence of ED among the adult elite athletes than the young elite athletes in this study, for example, longer duration of sport-specific demands such as competing in sports with weight class system and where the procedure during competitive events may allow use of extreme weight loss methods, physique-revealing uniforms, or competing in sports in which appearance and performance are being judged. In addition, frequent weight fluctuation has been suggested to be an important trigger factor for the development of ED in athletes (32). In our study, the athletes are in the beginning of their athletic career, whereas in Sundgot-Borgen and Torstveit's study (35) the athletes were older and had been competing at the highest national and international level for years. Furthermore, and in contrast to previous studies on adult elite athletes (7,35,38), we found no difference in the prevalence of ED among athletes in weight-sensitive sports compared with less weight-sensitive sports. Although BD is considered an important symptom of ED (2), 50% of the athletes in our study diagnosed with an ED had BD scores above clinical values, but all reported sport-specific BD. Byrne and

TABLE 5. Psychological and behavioral characteristics of subjects meeting the *DSM-IV* criteria for AN, BN, or EDNOS.

ID	Diagnosis	Sex	BD (0–27)	General Weight Concern	Sport-specific Weight Concern[a]	DT (0–21)	Fear of Weight Gain (0–6)	Loss of Concentration[b] (0–6)	Empty Stomach (0–6)	Shape Concern (0–6)	Anxiety/Depression (SCL-5)[c] (1–4)
Athletes											
1	AN	F	8	+	+	9	6	6	6	6	1.8
2	BN	F	11		+	10	6	4	6	5	2.6
3	BN	F	14	+	+	6	4	5	4	5	3.0
4	BN	F	27	+	+	20	4	6	6	5	3.0
5	BN	F	4	+	+	6	6	5	5	5	1.4
6	BN	F	22	+	+	14	6	6	6	5	2.4
7	BN	F	7	+	+	10	6	5	3	5	2.0
8	BN	F	24	+	+	9	6	3	3	4	1.6
9	BN	M	0	+	+	0	6	5	6	4	1.6
10	EDNOS	F	20	+	+	2	6	2	6	5	1.4
11	EDNOS	F	5	+	+	1	4	4	6	6	1.5
12	EDNOS	F	6	+	+	3	4	3	5	4	2.0
13	EDNOS	F	1		+	3	6	6	5	4	1.0
14	EDNOS	F	15	+	+	0	4	4	4	5	2.8
15	EDNOS	F	16	+	+	14	6	6	6	6	1.2
16	EDNOS	F	13	+	+	2	4	4	5	5	1.8
17	EDNOS	F	8	+	+	8	6	5	4	4	2.2
18	EDNOS	F	6	+	+	0	5	5	4	5	1.4
19	EDNOS	F	16		+	11	6	6	6	5	2.0
20	EDNOS	F	15	+	+	4	4	4	4	5	2.0
21	EDNOS	F	15	+	+	0	6	3	6	6	1.4
22	EDNOS	F	11	+	+	8	6	4	4	5	2.0
23	EDNOS	F	14	+	+	9	6	6	5	4	2.2
24	EDNOS	F	9	+	+	0	4	4	4	5	2.8
25	EDNOS	F	11	+	+	12	5	5	5	4	1.2
26	EDNOS	F	24	+	+	13	6	4	4	4	2.4
27	EDNOS	F	22	+	+	5	6	6	6	5	2.2
28	EDNOS	F	17	+	+	9	6	6	6	6	1.4
29	EDNOS	F	19	+	+	1	6	6	6	5	1.2
30	EDNOS	M	2	+	+	4	6	5	6	5	1.8
31	EDNOS	M	8	+	+	3	3	3	4	5	–
32	EDNOS	M	0	+	+	0	4	5	5	5	1.4
33	EDNOS	M	12	+	+	19	6	5	6	5	2.2
34	EDNOS	M	16	+	+	7	4	4	4	5	2.4
Controls											
35	EDNOS	F	7	+		5	3	2	3	5	2.6
36	EDNOS	F	26	+		20	4	4	4	4	3.2
37	EDNOS	F	7			13	3	3	3	2	4.0
38	EDNOS	F	26	+		13	6	2	4	4	3.2

[a]The dissatisfaction and concern about weight and the desire to lose weight is sports related.
[b]Difficult to concentrate on things that are interested in or after a conversation or reading because of thoughts about weight, shape, food, eating, or calories.
[c]A cutoff point of 2 indicates the presence of a mental disorder (29).

McLean (7) suggest that the demands of a sport to meet a particular body requirement alone, even without a high level of BD, may be enough to lead to the development of an ED. In addition, Torstveit et al. (38) found that even though the prevalence of ED was highest among athletes competing in weight-sensitive sports, fewer were dissatisfied with their bodies compared with athletes in less weight-sensitive sports and controls. This indicate that other factors than general BD may be essential for the development of ED among athletes, and it may be speculated that the higher prevalence among adult elite athletes is due to a longer duration of exposure to sports environment factors that can contribute to heightened concerns regarding weight and promote pathogenic weight control behaviors.

ED Diagnosis and the Severity

As expected, the most frequent ED was EDNOS, which is the most common ED encountered in outpatient (24) and inpatient settings (10). EDNOS is sometimes called the residual category in the *DSM-IV* classification because it is a "catch-all" category for eating problems that are considered to be of clinical severity but do not fulfill the criteria for AN or BN (22). EDNOS is therefore sometimes viewed as a "less severe" form of ED, but a recent study observed a crude mortality of 5.2%, similar to those found in AN (9). However, EDNOS is a residual category, and some of the athletes fulfilling the EDNOS criteria closely resemble cases of AN and BN, whereas others differ in terms of psychopathology and medical condition. As an example, one of the female athletes diagnosed with EDNOS reported fear of weight gain, loss of concentration due to bodyweight and shape and food concern, high BD, binge eating at least twice a week, and daily compulsive exercise (in addition to her planned sport-specific training) (case number 19, Tables 4 and 5). Because she reported vomiting only once a week for the last 3 months, she did not fulfill the criteria for BN. Another athlete (case number 12, Tables 4 and 5) did not

report use of pathogenic weight control methods and had regular menstruation. However, she reported binge eating four times a week and fulfilled the psychological criteria for EDNOS (the binge ED). The many hours of training (16–20 $h \cdot wk^{-1}$) may explain her normal weight for age and height, despite the binge eating. Finally, case number 15 (Tables 4 and 5) fulfilled all the criteria for AN except that she had a normal weight for her age and height, and therefore, the correct diagnosis was EDNOS (partial or subclinical AN). In sum, this means that those who fulfill the EDNOS criteria differ in the degree of psychological and medical severity and chronicity. In addition to this, the characteristics of their competitive sport and the duration and intensity of the symptoms will influence the consequences of their ED behavior on acute and long-term health as well as performance (34).

Frequent binging and vomiting are examples of behavior that can lead to both health and performance consequences on a short- and long-term basis (4). For instance, bingeing generally results in gastric distention where the severity increases with an increase in the amount of food consumed during the binge (4), whereas purging by self-induced vomiting, laxative abuse, or diuretic abuse may lead to dehydration, acid–base and electrolyte imbalances, cardiac arrhythmia as well as different chronic physical problems (4). Furthermore, the combination of binging and compulsive exercise for young athletes will increase the risk of overtraining, chronic fatigue, illness, overuse injuries, and menstrual dysfunction (4).

ED athletes in this study reported use of pathogenic weight control methods ranging from not at all to daily. The same range was found for binge eating. The use of these methods and/or the extreme weight and body shape (related) stress experienced underline the acute need for treatment. Consequently, some athletes should be withdrawn from competition as well as training, whereas others can continue training during treatment (11). These challenge the type of treatment and prevention strategies that should be chosen, as well as the balance between taking risk behavior seriously, but do not morbidly challenge the behavioral or psychological traits that are common and accepted in some sports needed for success. It is therefore essential to determine whether the athletes' abnormal eating and dieting behaviors are transient, safely managed behaviors associated with the specific demands of the sport or if the symptoms are more stable and represent a clinical ED (11,33).

Higher Prevalence of ED among Athletes Than Controls

In our study, we found a higher prevalence of ED among the athletes compared with the controls and general prevalence estimates (28). In addition to the unique pressure athletes face compared with nonathletic controls, the Elite Sport High School setting may be an additional factor that increases the risk for DE and the development of an ED. Some of the factors that may lay a high pressure on these young athletes to perform on the sport field as well as in the classroom are greater personal responsibility and maturation, perceived loss of social support, competing with the best athletes in the country, evaluation by coaches on an almost daily basis, increased training volume, lack of performance, and not being the best anymore. Some might also feel indebted to their family to achieve good results. For some, such sudden changes and high pressure might be experienced as traumatic events and serve as trigger conditions for the onset of ED. In addition, Barker and Galambos (3) found that moving away from home to attend college increased the likelihood of binge eating among young women. Other factors such as loss of coach or an illness or injury might also be conceptualized as traumatic events and trigger conditions (32).

Why more controls than athletes reported symptoms associated with ED without having an ED may be explained by the higher percentage of overweight (BMI), higher percentage with BD, and percentage reporting dieting (17). The fact that more female controls than athletes are classified as overweight in this study, with the focus on the importance of a lean body and the general experienced pressure of a thin ideal body, might have influenced the controls' perception of their bodies and partly explain the high number with BD and DT scores above the cutoff for the "at-risk" criteria. Previous findings also indicate that females especially are dissatisfied with their bodies and tend to report DE or have high scores on the EDI without being actively dieting or using extreme methods to reduce or control weight (32). Also, the questionnaire being used may have had an effect. The EDI subscale BD is for instance not sport specific and assesses dissatisfaction with areas of the body such as stomach and hips that well-trained athletes most likely are generally satisfied with. Furthermore, the reasons for dieting or being dissatisfied with one's own body may be different for males compared with females (16). In male athletes, high BD does not necessarily mean a desire to lose weight and or getting thinner. For instance, only 4 of our 17 male athletes with a BD score over the cutoff ($\geq$10) present dieting, and only two of them were diagnosed with an ED (Table 4). The many false-positive male athletes and one false-negative athlete diagnosed with EDNOS also indicate that the questionnaires being used do not have the sensitivity to differentiate between male athletes who are dissatisfied with their body because they want to be more muscular, athletes who are dissatisfied because of the extra fat, or those with ED.

Methodological Considerations

As expected, the use of a wide range of at-risk criteria for ED led to a high number of false positives, but more strict criteria could have resulted in too many false negatives (38). Because this study is part of an intervention aiming to prevent the development of ED, a high number of false negative would have been less advisable.

A cross-sectional study design has its limitations, but our use of a two-tiered approach by including the clinical interview EDE is considered to be the "gold standard" for diagnosing ED (7,13). Furthermore, all measurements have some weaknesses limiting their validity and reliability, but until more sport-specific measurements are developed, a two-tiered design is a good solution.

Because of ethical consideration, we prioritized to interview those classified as being "at risk" based on the questionnaire screening first. This resulted in a time difference from the screening to attending the interview between those "at risk" and not "at risk" and the athletes and controls. Because certain features of diagnostic importance in the interview are assessed over a 3-month period, and also a random selection of those diagnosed and not diagnosed with an ED was interviewed again by the second interviewer with complete agreement; we believe that this time difference most likely has not had any effect on the results. Because so many of the participants classified as healthy at the screening attended the clinical interview and only 5 of 218 were false negatives (all of them were athletes), we believe answering our questionnaire did not lead to focus more on weight, body shape, and dieting among the participants. Furthermore, when interviewing these five false-negative athletes, they all reported a history of ED, indicating that they were already experiencing ED when they fulfilled the questionnaire at screening.

The causes reported for athletes not attending school at the test day indicate that there are no reasons to believe that those not attending differed from the sample of athletes who participated in the study. Because we have no specific reasons for controls not attending school at the test day, we could speculate that some did not attend because of the test related to DE. However, it could also be due to ordinary reasons for not attending school. Based on this, we believe that the nonresponders did not skew the sample in any direction. Furthermore, the high response rate, the large number of sports included, and the fact that a representative sample of both those classified as "at risk" and healthy attended the clinical interview show that these data are generalizable to other adolescent elite athletes and controls. However, the lack of instruments designed for athletes may have had an effect on the prevalence of athletes classified as "at risk." For instance, the BD scale might not be suited for those who are dissatisfied because they want to gain weight (increase muscle mass), which is of special interest for the male athletes representing ice hockey, team handball, alpine skiing, and some athletic events as well as discriminate between general BD and more sport-specific BD. Furthermore, because dieting is usually seen as the primary precursor to the development of DE and ED, we included the present dieting as one of our at-risk criteria. However, dieting in this special setting should maybe more correctly be considered as a "collection" factor for other symptoms not detected. Finally, it is worth noting that when comparing female athletes with ED in weight-sensitive sports and less weight-sensitive sports, we calculated the lowest detectable difference to 17.1% when the observed was 7.8%. The difference in these populations could only be detected if the number per group had been fourfold if the power had been at least 80%.

PERSPECTIVES

Our results support two previous important statements: 1) a clinical interview is the best available method to identify ED among both elite athletes and controls, and 2) there is a need for further development and validation of screening instruments designed for athletes. A sport-specific instrument should be designed for athletes in different kinds of sports and competition levels. Until this is established, clinical interviews should be used for accurate identification of ED.

Education about health and performance-related nutrition and body composition should be administered at an earlier age than high school. Females should especially be educated on the health and performance consequences of menstrual irregularities and the importance of seeking timely medical intervention at the first sign of abnormalities (5). Coaches as well as other athletic staff members are in a prime position to monitor their athletes' behaviors and reactions, and therefore, mandatory education programs should be implemented on an annual basis. Finally, sports-governing organizations and federations should give support to the coaches and provide education for coaches, athletic staff, and athletes (36).

CONCLUSION

This study is the first to confirm that the prevalence of ED is higher among adolescent elite athletes than controls and higher in female than male adolescent elite athletes. It also confirms the difficulties that exist when it comes to identifying male and female athletes "at risk" for ED and the need for a clinical interview to identify athletes who already have developed an ED.

The authors thank Professor Roald Bahr for his helpful comments on this article and Professor Ingar Holme for his assistance with the statistical analysis. We also thank all the subjects and their coaches for full cooperation and support during this study, and Audun Erikson, Guro Røen, Laila Sundgot Schneider, Runi Børresen and Kristin Brinchman Lundestad with regard to the collection of data. The Oslo Sports Trauma Research Center has been established at the Norwegian School of Sport Sciences through generous grants from the Royal Norwegian Ministry of Culture, the South-Eastern Norway Regional Health Authority, the International Olympic Committee, the Norwegian Olympic Committee and Confederation of Sport, and Norsk Tipping AS. The project has been established through a grant from The Norwegian Olympic Sports Center (Olympiatoppen).

There are no potential conflicts of interest.

The results of the study do not constitute endorsement by the American College of Sports Medicine.

REFERENCES

1. Ackland TR, Lohman TG, Sundgot-Borgen J, et al. Current status of body composition assessment in sport: review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I.o.C. Medical commission. *Sports Med*. 2012;42(3):227–49.
2. APA. *Eating Disorders. Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*. Washington (DC): American Psychiatric Association; 1994. pp. 539–50.
3. Barker ET, Galambos NL. Exploring criterion confounding in the measurement of binge eating symptoms and negative affect. *J Psychopathol Behav Assess*. 2009;31(1):43–50.
4. Beals KA. *Disordered Eating among Athletes: A Comprehensive Guide for Health Professionals*. Champaign (IL): Human Kinetics; 2004. p. 255.
5. Bonci CM, Bonci LJ, Granger LR, et al. National athletic trainers' association position statement: preventing, detecting, and managing disordered eating in athletes. *J Athl Train*. 2008;43(1):80–108.
6. Byrne S, McLean N. Eating disorders in athletes: a review of the literature. *J Sci Med Sport*. 2001;4(2):145–59.
7. Byrne S, McLean N. Elite athletes: effects of the pressure to be thin. *J Sci Med Sport*. 2002;5(2):80–94.
8. Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. *Br Med J*. 2007;335(7612):194–7.
9. Crow SJ, Peterson CB, Swanson SA, et al. Increased mortality in bulimia nervosa and other eating disorders. *Am J Psychiatry*. 2009; 166(12):1342–6.
10. Dalle GR, Calugi S. Eating disorder not otherwise specified in an inpatient unit: the impact of altering the *DSM-IV* criteria for anorexia and bulimia nervosa. *Eur Eat Disord Rev*. 2007;15(5): 340–9.
11. Drinkwater B, Loucks A, Sherman R, Sundgot-Borgen J, Thompson R. International Olympic Committee Medical Commission Working Group Women in Sport: position stand on the female athlete triad. *International Olympic Committee* 2005; [cited 2010 September 4]. Available from: http://www.olympic.org/Documents/Reports/EN/en_report_917.pdf
12. Fairburn CG, Beglin S. Eating Disorder Examination Questionnaire (EDE-Q 6.0). In: Fairburn CG, editor. *Cognitive Behavior Therapy and Eating Disorders*. New York: The Guilford Press; 2008. pp. 309–14.
13. Fairburn CG, Bohn K. Eating disorder NOS (EDNOS): an example of the troublesome "not otherwise specified" (NOS) category in *DSM-IV*. *Behav Res Ther*. 2005;43(6):691–701.
14. Fairburn CG, Cooper Z, O'Connor ME. Eating Disorder Examination (Edition 16.0D). In: Fairburn CG, editor. *Cognitive Behavior Therapy and Eating Disorders*. New York: The Guilford Press; 2008. pp. 265–308.
15. Fulkerson JA, Keel PK, Leon GR, Dorr T. Eating-disordered behaviors and personality characteristics of high school athletes and nonathletes. *Int J Eat Disord*. 1999;26(1):73–9.
16. Glazer JL. Eating disorders among male athletes. *Curr Sports Med Rep*. 2008;7(6):332–7.
17. Martinsen M, Bratland-Sanda S, Eriksson AK, Sundgot-Borgen J. Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. *Br J Sports Med*. 2010;44(1):70–6.
18. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP. American College of Sports Medicine. Position Stand: the female athlete triad. *Med Sci Sports Exerc*. 2007;39(10): 1867–82.
19. Norwegian Directorate for Health and Social Affairs. *Physical Activity and Health. Recommendations*. Oslo: Sosial- og helsedirektoratet; 2000. p. 82.
20. Oppliger RA, Landry GL, Foster SW, Lambrecht AC. Bulimic behaviors among interscholastic wrestlers—a statewide survey. *Pediatrics*. 1993;91(4):826–31.
21. Owens RG, Slade PD. Running and anorexia nervosa—an empirical study. *Int J Eat Disord*. 1987;6(6):771–5.
22. Palmer B, Norring C. EDNOS—the other eating disorders. In: Norring C, Palmer B, editors. *EDNOS: Eating Disorders Not Otherwised Specified*. London: Routledge; 2005. pp. 1–9.
23. Reas DL, Wisting L, Kapstad H, Lask B. Convergent validity of the eating disorder examination and the eating disorder examination-questionnaire among university women in Norway. *Eur Eat Disord Rev*. 2011;19(4):357–61.
24. Ricca V, Mannucci E, Di Bernardo M, et al. Psychopathological and clinical features of outpatients with an eating disorder not otherwise specified. *Eat Weight Disord*. 2001;6(3):157–65.
25. Ro O, Reas DL, Lask B. Norms for the eating disorder examination questionnaire among female university students in Norway. *Nord J Psychiatry*. 2010;64(6):428–32.
26. Rosendahl J, Bormann B, Aschenbrenner K, Aschenbrenner F, Strauss B. Dieting and disordered eating in German high school athletes and non-athletes. *Scand J Med Sci Sports*. 2009;19(5): 731–9.
27. Sigman GS. Eating disorders in children and adolescents. *Pediatr Clin North Am*. 2003;50(5):1139–77.
28. Smink FR, van HD, Hoek HW. Epidemiology of eating disorders: incidence, prevalence and mortality rates. *Curr Psychiatry Rep*. 2012;14(4):406–14.
29. Smolak L, Murnen SK, Ruble AE. Female athletes and eating problems: a meta-analysis. *Int J Eat Disord*. 2000;27(4):371–80.
30. Strand BH, Dalgard OS, Tambs K, Rognerud M. Measuring the mental health status of the Norwegian population: a comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). *Nord J Psychiatry*. 2003;57(2):113–8.
31. Sundgot-Borgen J. Prevalence of eating disorders in elite female athletes. *Int J Sport Nutr*. 1993;3(1):29–40.
32. Sundgot-Borgen J. Risk and trigger factors for the development of eating disorders in female elite athletes. *Med Sci Sports Exerc*. 1994;26(4):414–9.
33. Sundgot-Borgen J. Atypical eating disorders in female athletes. In: Norring C, Palmer B, editors. *EDNOS: Eating Disorders Not Otherwise Specified*. London: Routledge; 2005. pp. 266–76.
34. Sundgot-Borgen J, Garthe I. Elite athletes in aesthetic and Olympic weight-class sports and the challenge of body weight and body composition. *J Sports Sci*. 2011;29:S101–14.
35. Sundgot-Borgen J, Torstveit MK. Prevalence of eating disorders in elite athletes is higher than in the general population. *Clin J Sport Med*. 2004;14(1):25–32.
36. Sundgot-Borgen J, Torstveit MK. Aspects of disordered eating continuum in elite high-intensity sports. *Scand J Med Sci Sports*. 2010;20:112–21.
37. Tambs K, Moum T. How well can a few questionnaire items indicate anxiety and depression. *Acta Psychiatr Scand*. 1993;87(5):364–7.
38. Torstveit MK, Rosenvinge JH, Sundgot-Borgen J. Prevalence of eating disorders and the predictive power of risk models in female elite athletes: a controlled study. *Scand J Med Sci Sports*. 2008; 18(1):108–18.
39. Torstveit MK, Sundgot-Borgen J. The female athlete triad exists in both elite athletes and controls. *Med Sci Sports Exerc*. 2005;37(9): 1449–59.
40. Vrabel KR, Hoffart A, Ro O, Martinsen EW, Rosenvinge JH. Co-occurrence of avoidant personality disorder and child sexual abuse predicts poor outcome in long-standing eating disorder. *J Abnorm Psychol*. 2010;119(3):623–9.

Paper II

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

MARIANNE MARTINSEN[1], ROALD BAHR[1], RUNI BØRRESEN[2], INGAR HOLME[1], ANNE MARTE PENSGAARD[3], and JORUNN SUNDGOT-BORGEN[4]

[1]*Oslo Sports Trauma Research Center, Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, NORWAY;* [2]*Faculty of Teacher Education, Buskerud University College, Drammen, NORWAY;* [3]*Department of Coaching and Psychology, Norwegian School of Sport Sciences, Oslo, NORWAY;* [4]*Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, NORWAY*

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

Address for correspondence: Marianne Martinsen, Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, PB 4014 Ullevål Stadion, N-0806 Oslo, Norway; E-mail: marianne.martinsen@nih.no
Submitted for publication May 2013.
Accepted for publication July 2013.

0195-9131/14/4603-0435/0
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

DOI: 10.1249/MSS.0b013e3182a702fc

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.

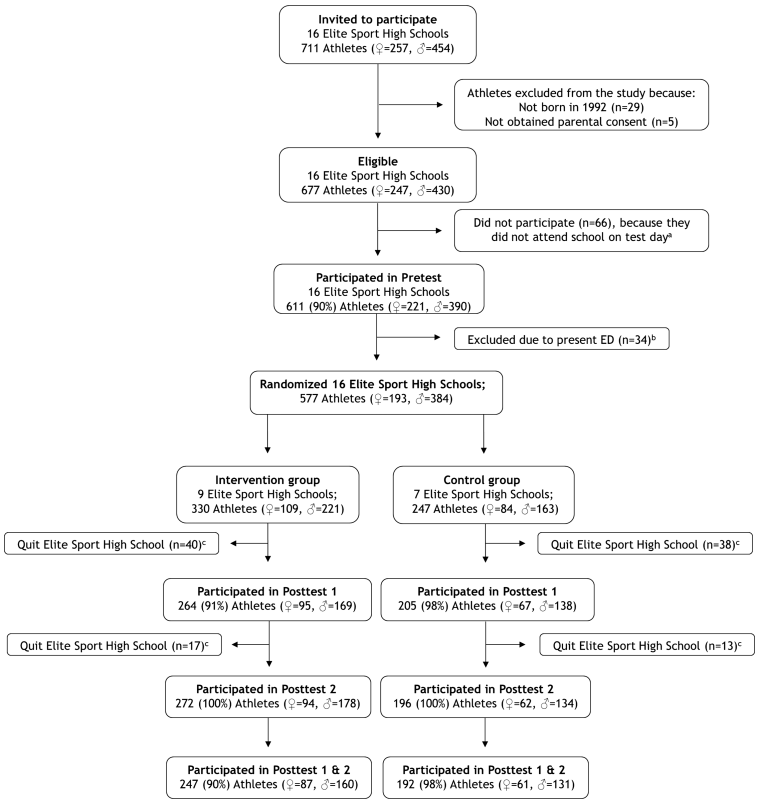


FIGURE 1—Flowchart of the study and participants' movement through high school. a, reasons reported were training camps, competition, and illness. b, six of these changed to regular high school during the study, and one was too ill to continue school. c, changed to regular high school.

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

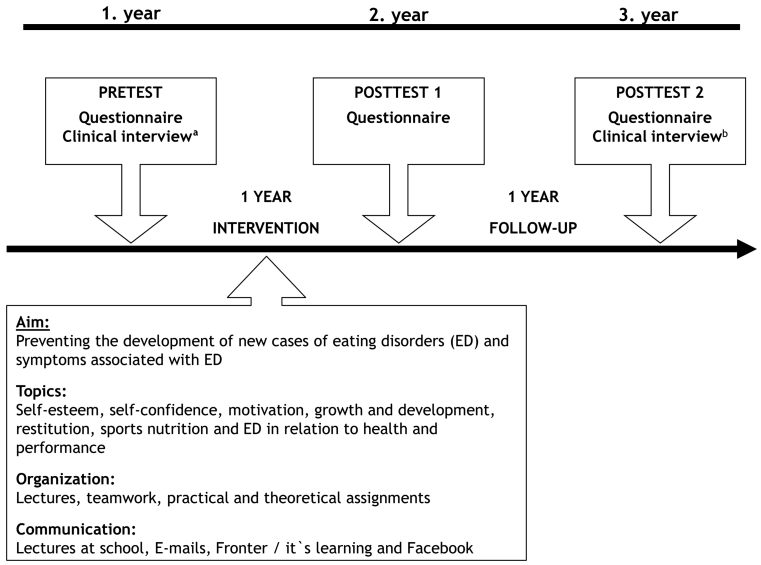


FIGURE 2—Flow of the project design. a, conducted 14.2 ± 5.0 months from finishing the questionnaire screening at baseline (intervention 14.6 ± 4.6 vs control 15.5 ± 4.6, $P = 0.229$). b, conducted 1.8 ± 0.7 months from finishing the data collection (intervention 1.8 ± 0.7 vs 1.8 ± 0.8, $P = 0.343$).

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

(Continued on next page)

TABLE 1. *(Continued)*

Athletes		
Time Point Arena Organization	**Themes**	**Purpose**
	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

(Continued on next page)

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·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·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·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.

Females	Intervention (n = 87)			Control (n = 61)			Intervention vs Control			
							Pre − Post 1		Pre − Post 2	
	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.

CLINICAL SCIENCES

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 vs Control			
	Intervention (n = 160)			Control (n = 131)			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.

The authors would like to thank all the subjects and their coaches for full cooperation and support during this study, and Audun Eriksson, Guro Røen, Laila Sundgot Schneider, and Kristin Brinchman Lundestad with regard to the collection of data. The research reported in this article was supported by Oslo Sports Trauma Research Center and through a grant from the Norwegian Olympic Sports Center (Olympiatoppen). The Oslo Sports Trauma Research Center has been established through generous grants from the Eastern Norway Regional Health Authority, the International Olympic Committee, The Royal Norwegian Ministry of Culture, Norsk Tipping AS, and the Norwegian Olympic Committee & Confederation of Sport.

There are no potential conflicts of interest. The results of the study do not constitute endorsement by the American College of Sports Medicine.

REFERENCES

1. APA. Eating disorders. In: *APA Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*. Washington (DC): American Psychiatric Association; 1994. pp. 539–50.
2. Bandura A. *Social Foundations of Thought and Action—A Social Cognitive Theory*. Englewood Cliffs (NJ): Prentice-Hall. 1986. p. 617.
3. Bandura A, Adams NE, Beyer J. Cognitive processes mediating behavioral change. *J Pers Soc Psychol*. 1977;35(3):125–39.
4. Becker CB, McDaniel L, Bull S, Powell M, McIntyre K. Can we reduce eating disorder risk factors in female college athletes? A randomized exploratory investigation of two peer-led interventions. *Body Image*. 2012;9(1):31–42.
5. Borresen R, Rosenvinge JH. From prevention to health promotion. In: Borresen R, Rosenvinge JH, Treasure J, Schmidt U, Van Furth E, editors. *Handbook of Eating Disorders*. Chichester (England): Wiley; 2003. pp. 455–66.
6. Byrne S, McLean N. Eating disorders in athletes: a review of the literature. *J Sci Med Sport*. 2001;4(2):145–59.
7. Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. *Br Med J*. 2007;335(7612):194–7.
8. Deci EL, Ryan RM. The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*. 2000;11(4):227–68.
9. Drinkwater B, Loucks A, Sherman R, Sundgot-Borgen J, Thompson R. International Olympic Committee Medical Commission Working Group Women in Sport: position stand on the female athlete triad. International Olympic Committee 2005 [cited 2010 Sep 4]. Available from: http://www.olympic.org/Documents/Reports/EN/en_report_917.pdf.
10. Fairburn CG, Bohn K. Eating disorder NOS (EDNOS): an example of the troublesome "not otherwise specified" (NOS) category in *DSM-IV*. *Behav Res Ther*. 2005;43(6):691–701.
11. Fairburn CG, Cooper Z, O'Connor ME. Eating disorder examination. In: Fairburn CG, Cooper Z, O'Connor ME, Fairburn CG, editors. *Cognitive Behavior Therapy and Eating Disorders*. 16th ed. New York (NY): The Guilford Press; 2008. pp. 265–308.
12. Festinger L. *A Theory of Cognitive Dissonance*. Stanford (CA): Stanford University Press; 1957. XI, p. 291.
13. Ghaderi A, Scott B. Prevalence and psychological correlates of eating disorders among females aged 18–30 years in the general population. *Acta Psychiatr Scand*. 1999;99(4):261–6.
14. Hoek HW. Incidence, prevalence and mortality of anorexia nervosa and other eating disorders. *Curr Opin Psychiatry*. 2006;19(4):389–94.
15. Hsu LKG. Epidemiology of the eating disorders. *Psychiatr Clin North Am*. 1996;19(4):681–700.
16. Kernis MH. Toward a conceptualization of optimal self-esteem. *Psychological Inquiry*. 2003;14(1):1–26.
17. Loucks AB, Kiens B, Wright HH. Energy availability in athletes. *J Sports Sci*. 2011;29(Suppl 1):S7–15.
18. Martinsen M, Bratland-Sanda S, Eriksson AK, Sundgot-Borgen J. Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. *Br J Sports Med*. 2010;44(1):70–6.
19. Martinsen M, Sundgot-Borgen J. Higher prevalence of eating disorders among adolescent elite athletes than controls. *Med Sci Sports Exerc*. 2013;45(6):1188–97.
20. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP. American College of Sports Medicine Position Stand: the female athlete triad. *Med Sci Sports Exerc*. 2007;39(10):1867–82.
21. Neumark-Sztainer D, Wall M, Larson NI, Eisenberg ME, Loth K. Dieting and disordered eating behaviors from adolescence to young adulthood: findings from a 10-year longitudinal study. *J Am Diet Assoc*. 2011;111(7):1004–11.
22. Nicholls JG. *The Competitive Ethos and Democratic Education*. Cambridge (MA): Harvard University Press; 1989. p. 261.
23. Pensgaard AM, Roberts GC. Elite athletes' experiences of the motivational climate: the coach matters. *Scand J Med Sci Sports*. 2002;12(1):54–9.
24. Petty RE, Cacioppo JT. *Communication and Persuasion: Central and Peripheral Routes to Attitude Change*. New York (NY): Springer-Verlag; 1986. xiv, p. 262.
25. Piran N. Eating disorders: a trial of prevention in a high risk school setting. *J Prim Prev*. 1999;20(1):75–90.
26. Rosendahl J, Bormann B, Aschenbrenner K, Aschenbrenner F, Strauss B. Dieting and disordered eating in German high school athletes and non-athletes. *Scand J Med Sci Sports*. 2009;19(5):731–9.
27. Stice E. Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol Bull*. 2002;128(5):825–48.
28. Stice E, Marti CN, Spoor S, Presnell K, Shaw H. Dissonance and healthy weight eating disorder prevention programs: long-term effects from a randomized efficacy trial. *J Consult Clin Psychol*. 2008;76(2):329–40.
29. Stice E, Rohde P, Shaw H, Marti CN. Efficacy trial of a selective prevention program targeting both eating disorders and obesity among female college students: 1- and 2-year follow-up effects. *J Consult Clin Psychol*. 2013;81(1):183–9.
30. Stice E, Shaw H, Marti CN. A meta-analytic review of eating disorder prevention programs: encouraging findings. *Ann Rev Clin Psychol*. 2007;3:207–31.
31. Stice E, Shaw H, Marti CN. A meta-analytic review of eating disorder prevention programs: progress at last. *Ann Rev Clin Psychol*. 2007;3:233–57.
32. Stice E, South K, Shaw H. Future directions in etiologic, prevention, and treatment research for eating disorders. *J Clin Child Adolesc Psychol*. 2012;41(6):845–55.
33. Sundgot-Borgen J. Risk and trigger factors for the development of eating disorders in female elite athletes. *Med Sci Sports Exerc*. 1994;26(4):414–9.
34. Sundgot-Borgen J, Skårderud F, Rodgers S. Athletes and dancers. In: Treasure J, Schmidt U, Furth van E, editors. *Handbook of Eating Disorders*. Chichester (England): John Wiley & Sons Inc.; 2003, pp. 385–400.
35. Sundgot-Borgen J, Torstveit MK. Prevalence of eating disorders in elite athletes is higher than in the general population. *Clin J Sport Med*. 2004;14(1):25–32.
36. Thompson RA, Trattner Sherman R. *Eating Disorders in Sport*. New York (NY): Routledge; 2010. p. 284.
37. Torstveit MK, Rosenvinge JH, Sundgot-Borgen J. Prevalence of eating disorders and the predictive power of risk models in female elite athletes: a controlled study. *Scand J Med Sci Sports*. 2008;18(1):108–18.
38. UK Sport. Eating Disorders in Sport: A Guideline Framework for Practitioners Working with High Performance Athletes. UK Sport 2013 [cited 2013 Mar 4]. Available from: http://www.uksport.gov.uk/publications/eating-disorders-in-sport.
39. Wilson GT. The controversy over dieting. In: Fairburn CG, Brownell KD, editors. *Eating Disorders and Obesity: A Comprehensive Handbook*. New York (NY): The Guilford Press; 2002. pp. 93–7.
40. Yager Z, O'Dea JA. Prevention programs for body image and eating disorders on university campuses: a review of large, controlled interventions. *Health Promot Int*. 2008; 23(2):173–89.

Paper III

Coaches' knowledge and management of eating disorders: a randomized controlled trial

Marianne Martinsen[1], Roberta T Sherman[2], Ron A Thompson[2], Jorunn Sundgot-Borgen[3]

[1]Oslo Sports Trauma Research Center, Department of Sports Medicine, Norwegian School of Sport Sciences, PO Box 4014 Ullevaal Stadion, 0806 Oslo, Norway, [2]The Victory Program at McCallum Place, St. Louis, Mo, USA[3]Department of Sports Medicine, Norwegian School of Sport Sciences, PO Box 4014 Ullevaal Stadion, 0806 Oslo, Norway

Corresponding author: Marianne Martinsen, Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, PO Box 4014 Ullevaal Stadion, N-0806 Oslo, Norway. Phone: +47 23 26 22 64. Fax: +47 22 23 42 20. E-mail: marianne.martinsen@nih.no

Running title: COACHES' KNOWLEDGE OF EATING DISORDERS

Funding received for this work:

The research reported in this article was supported by Oslo Sports Trauma Research Center and through a grant from the Norwegian Olympic Sports Center (Olympiatoppen). The Oslo Sports Trauma Research Center has been established through generous grants from the Eastern Norway Regional Health Authority, the International Olympic Committee, The Royal Norwegian Ministry of Culture, Norsk Tipping AS and the Norwegian Olympic Committee & Confederation of Sport.

There are no potential conflicts of interest.

ABSTRACT:

Purpose: It has been suggested that programs regarding early identification and prevention of eating disorders (ED) among athletes is unlikely to succeed without their coaches' endorsement and participation. Therefore, we developed a 1-yr intervention aiming to prevent the development of ED among adolescent elite athletes by targeting athletes and their coaches. The separate part of the intervention targeting the coaches was designed to provide knowledge and strategies regarding healthy nutrition, eating behavior, and ED (symptoms, identification, management and prevention). In this trial, we examined the effect of the educational program on the coaches' knowledge and management index in three content areas (nutrition, weight-regulation, and ED). We also examined their subjective evaluation of their ED knowledge. **Methods:** All Norwegian Elite Sport High Schools were included (intervention group (n=9) and control group (n=7)). Seventy-six coaches employed at and coaching first-year student athletes at the different schools were followed 3-school years (2008-2011). At pretest and posttest (9-months after intervention), they completed a questionnaire regarding nutrition, weight-regulation, and ED. **Results:** Intervention coaches had higher knowledge index scores than control coaches for weight-regulation (6.2±1.7 vs. 4.8±1.3, $p<0.001$), ED (including recognition and management) (19.3±4.4 vs. 16.5±5.0, $p=0.004$), and total knowledge (weight-regulation, ED, and nutrition) (35.0±7.2 vs. 31.6±8.0, $p=0.021$) at posttest. Moreover, the coaches likelihood of describing knowledge of ED as "somewhat good" or better was 7 times higher for intervention- than control coaches at posttest (OR=7.1, 95% CI 2.2 - 23.2, $p=0.001$). **Conclusion:** Intervention coaches had higher index scores on total knowledge, weight-regulation, and ED (including recognition and management) than control coaches. The intervention also was successful in producing effects on the coaches' subjective evaluation of their ED knowledge.

Keywords: disordered eating, elite, Adolescent, athlete, intervention, prevention

INTRODUCTION

Paragraph Number 1 In various sports, body weight and body composition are crucial performance variables, and many athletes use extreme methods to reduce mass rapidly or maintain a low body mass in order to gain a competitive advantage (1). Research indicates that the prevalence of eating disorders (ED) is higher among elite athletes than non-athletes, particularly among those competing in weight-sensitive sports (33, 35). Also, the prevalence of disordered eating (DE) (15, 26) and ED (16) is high among adolescent elite athletes. Early identification decreases possible medical and psychological consequences of the disorder, and perhaps decreases the difficulty and length of treatment (17).

Paragraph Number 2 The International Olympic Committee (IOC) and international sports governing bodies have acknowledged a mandated duty of care to protect the physical and psychological health and safety of all athletes including adolescent elite athletes (8, 11). Consequently, the importance of early detection of ED behavior has been stressed by the IOC, the American College of Sports Medicine (ACSM), the National Collegiate Athletic Association, the Society for Adolescent Medicine, the American Psychiatric Association and the National Athletic Trainers Association (3). More specifically, the IOC Medical Commission and the ACSM recommend that professionals participating in health maintenance and performance enhancement of athletes should be provided with specific knowledge and problem-solving skills to better detect, manage, and prevent extreme dieting, ED, and the triad components (7, 17).

Paragraph Number 3 Due to coaches having daily and intensive contact with their athletes, they can play an important role in their unique position by identifying early signs and symptoms, directing athletes to professional help, and preventing the development of ED (17,

27). Furthermore, based on the importance athletes tend to ascribe to coaches (19), successful prevention programs in the athletic setting are unlikely to succeed without commitment and support from their coaches (32). In addition, in an educational injury prevention (brain and spinal cord injury) study among adolescent ice hockey players in Canada, there was consensus among the coaches that changing coaching behaviors would lead to the greatest impact on player behavior (5). This is supported by well-founded theories suggesting that if people think their significant others want them to perform a behavior, this results in a higher motivation and greater likelihood of action (2, 25). In addition, athletes who are dieting to enhance performance tend to report that their coaches recommended that they lose weight (15, 30).

Paragraph Number 4 It is important for coaches who work with young athletes to address health issues related to ED even before low energy availability leads to consequences severe enough to negatively affect performance and shorten a sport career (6). Unfortunately, it is tempting for coaches to equate performance with health. Beyond knowledge, they need to understand that good sport performance does not always imply good health (31). Some athletes are initially able to perform well despite eating problems. In order to adequately perform a supportive function, many coaches need factual information on nutrition, factors determining weight, risks and causes of DE, menstrual (dys)function, and psychological factors that both negatively and positively affect health and athletic performance (34). To have the potential to behave in a particular way, knowledge is required.

Paragraph Number 5 In an effort to combat the high prevalence of DE and ED in adolescent elite athletes and decrease treatment delay and related complications, we developed the first randomized controlled trial including both athletes and coaches to prevent the development of

ED among adolescent male and female elite athletes (14). In order to use the power and influence of coaches to create supportive environments regarding the prevention of ED, a special educational program was developed for coaches and included as a separate part of the intervention program for athletes and coaches (Table 1). This educational program was developed to provide the coaches with knowledge and strategies regarding identification, management, and prevention of ED. The aim of this trial was to examine the effect of the education program on the coaches' total knowledge and for each of the three knowledge content areas of nutrition, weight-regulation, and ED (including recognition and management). A second aim was to examine the coaches' subjective evaluation of their knowledge of ED.

METHODS

Paragraph Number 6 We invited the total population of coaches employed at, and working with, first-year students at the 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 coaches from each school were randomised to the same treatment arm (intervention or control). The statistician who conducted the randomisation did not take part in the intervention. The Regional Committee for Medical and Health Sciences Research Ethics in Southern Norway, and the Norwegian Social Science Data Service approved the study.

Paragraph Number 7 The Norwegian Elite Sport High Schools are private and public schools with programs designed for talented athletes. The schools were told that those allocated to the intervention condition would receive a 1-yr intervention program aimed at preventing athletes from developing ED. The intervention included both athletes and their coaches at the Elite Sport High Schools. For the purpose of this paper, however, only data concerning the

educational program for the coaches are presented. The results among the athletes were presented previously (14).

Participants

Paragraph Number 8 We invited 125 coaches to participate during the 2008-2009 school year. Of these, 24 did not participate. Other than illness, reasons for not participating included involvement in training camps, competitions, and teaching/working outside the school during that day. This resulted in a sample of 101 coaches participating in the pretest. Of these, 18 quit working at the schools, one retired, one went on sick leave, and five were lost to follow-up for reasons unknown. This resulted in a final sample of 76 coaches participating in both the pretest and posttest. Ninety-three percent were male. The flow of participants through the study can be seen in Figure 1.

Paragraph Number 9 We obtained permission to invite the coaches to participate and to collect data from each principal prior to randomisation. Coaches provided written or oral consent to participate at their school. For coaches not in attendance the day consent was obtained in person, consent was provided by phone or e-mail.

INSERT FIGURE 1

Intervention

Paragraph Number 10 The 1-yr intervention program was devised utilizing current knowledge about possible risk factors, as well as results from existing studies aimed at preventing DE and ED in the general (4, 28, 29, 40) and the athletic populations (7, 21, 30, 35). The intervention was sport-specific in the sense that the program was developed for elite

athletes and their coaches. It included increasing health promoting and possible protective factors while decreasing multiple risk and potentiating factors, which are essential in preventing ED (4). The intervention program targeting the athletes has been described in detail previously (14).

Paragraph Number 11 The education program from the intervention targeting coaches focused on educating them regarding self-esteem, self-efficacy, mental training, sports nutrition, body composition, and weight issues. Additionally, they were provided with knowledge and strategies to identify, manage, and prevent ED among athletes. We organized two seminars (2x3 hours) and provided a Coaches guide to increase knowledge about nutrition, as well as how to identify and manage ED in the sport environment. In the Coaches guide, we also included questions on the last page that the coaches were required to answer and return to the first author. These questions were related to nutrition, dieting, ED, and how to identify and manage ED in the sport environment. All coaches received individual feedback on their assignments. In addition to the seminar lectures, identification and management of clinical and subclinical cases were discussed in the workshop during the seminar at school. Coaches were informed about the intervention program provided for the athletes, and were also encouraged to attend the lectures arranged for the athletes. Additionally they were presented with ideas on how to include, and follow-up with the mental training assignments. This was done based on the assumption that repeated exposure facilitates cognitive elaboration of the message, which, in turn, leads to greater change in attitudes (20). An overview of the educational program for the coaches from the intervention program is presented in Table 1.

INSERT TABLE 1

Assessment Procedures

Questionnaire

Paragraph Number 12 At pretest and posttest (9-months after intervention), the coaches completed a questionnaire including questions regarding educational background, athletic career, coaching experience, and coaching philosophy. The specific topics dealt with in the intervention, such as their knowledge about nutrition (related to health, physical training and performance), growth and development, knowledge and awareness of training principles, weight-regulation, and ED, were assessed with the questionnaire. The questionnaire was tested in a pilot study with five coaches working at high schools with sports specialization (not Elite Sport High Schools). As a result of that pilot study, changes were made to the questions regarding their education.

The questions and the knowledge indexes

Paragraph Number 13 The questions included in the posttest measuring the coaches' knowledge and strategies regarding identification, management, and prevention of ED, were divided into the following sub-indexes: nutrition (10 questions), weight-regulation (5 questions), and ED (15 questions). We also combined the sub-index scores on nutrition, weight-regulation, and ED to create a total knowledge index score consisting of 30 questions with a maximum score of 55 points. In the analysis at posttest, we adjusted for the total knowledge index score at pretest.

Paragraph Number 14 The coaches' nutrition index consisted of 10 questions measuring knowledge about energy and nutrient intake for health and performance (e.g., "Which nutrients are important for strong bones among athletes?"). Questions regarding existing recommendations and sources of protein, fat and carbohydrate, calcium and iron were also included in the index. More practical questions such as; "An athlete of yours will perform a

60-minute running session at 70% of maximum heart rate. What, when and why, do you recommend to him/her to ingest up to two hours before, during and one hour after the training?" The coaches' answers were scored from 0-1 or 0-3 depending on the questions' comprehensiveness. The maximum nutrition index score was 16 points.

Paragraph Number 15 The coaches' weight-regulation index consisted of five questions measuring coaches' ability to manage issues concerning body weight, puberty, and performance (e.g., "One of your female athletes thinks she weighs 4 kg too much to perform well. She wants to lose weight and asks for advice. How will you respond to her?" In addition to the question, there were six suggested answers that the coaches had to answer "yes" or "no". "Which of these method(s) will be most appropriate to use when considering the need for weight regulation/change in body composition in an athlete?" The coaches could choose between six different methods. These include body mass, body composition (using Inbody or dual energy x-ray absorptiometry [DEXA]), body mass index (BMI), hip–to-waist ratio, and skin folds, as well as writing their own suggestion. The coaches' answers were scored from 0-1, 0-2 and 0-3 with a maximum total weight-regulation index score of 10 points.

Paragraph Number 16 The coaches ED index consisted of 15 questions measuring three factors: ability to detect and manage ED (e.g., recognize symptoms and signs, how to show concern and to plan an initial meeting with an athlete), awareness of ED (e.g., understand the nature and course of the ED behavior), and responsibility for the athlete (e.g., the potential pressure coaches and peers can put on an athlete). Examples of questions were: "Can you name some physical signs of ED?" "Can you name some behavioral signs of ED?" "Are you familiar with the female athlete triad (yes/no)?" "Can you please describe the components of the female athlete triad?" "If you get concerned that one of your athletes has an ED, what

would you do?“ “What do you think are the reasons for an athlete developing an ED?” The coaches’ answers were scored from 0-1, 0-2 and 0-3 with a maximum total ED index score of 29 points.

Outcome measures

Paragraph Number 17 The primary outcome was the coaches’ total knowledge index score at posttest adjusted for pretest value, as well as scores for each of the three knowledge indexes content areas; nutrition, weight-regulation and ED (including recognition and management). The secondary outcome was the coaches’ subjective evaluation of their knowledge of ED at posttest.

Statistical Analysis and Data Presentation

Paragraph Number 18 In this study we have not accounted for a clustered design since in the dataset from the primary study we found that the effect of clustering was small (data not shown) (14). In addition, no specific power calculation was made for this study, because the primary study was designed for other purposes.

Paragraph Number 19 Statistical analyses were carried out using SPSS Statistics 21 for Windows (IBM Corporation, Route, Somers, NY, USA). Results are expressed as frequencies (N) and percentages (%) for categorical data and mean values with standard deviations (SD) for continuous data. To compare mean differences, an independent-sample t-test was used. We also used chi-square test and Mann-Whitney U test to compare group differences when appropriate. Fisher’s exact test was used, in cases where expected number of counts per cell was five or less. A binary logistic regression analysis was conducted to test for difference by treatment group of the likelihood of reporting “somewhat good” knowledge or better at

posttest. We used the reported knowledge as the dependent variable and school type (intervention/control) and pretest value as covariates. To compare differences in the coaches' scores on knowledge at posttest, a general linear model was used. We used the knowledge score as the dependent variable with school type (intervention/control) as fixed factor and total knowledge score at pretest as a covariate.

Paragraph Number 20 Odds ratio and regression coefficients are presented with 95% confidence intervals (CI) and *P* values. The significance level was set at 0.05, and both genders are included in all analysis.

RESULTS

Subject characteristics

Characteristics of the coaches are shown in Table 2.

Paragraph Number 21 The majority of the coaches (65.8%) had formal education in sport sciences or PE (Table 2). Among these, 52.0% had a Bachelor's degree and 8.0% a Master's degree and 93.4% had fulfilled or were in the process of fulfilling a specific education program and/or courses targeting coaches (Table 2).

INSERT TABLE 2

Paragraph Number 22 A drop-out analysis was conducted between coaches who completed and those who were excluded due to resignation (n=18), retirement (n=1), long-term sick leave (n=1) and didn't answer the posttest for reasons unknown (n=5). There were no

statistically significant differences in any of the characteristics between coaches fulfilling the trial and the drop-outs.

Knowledge of nutrition, weight-regulation and ED

Paragraph Number 23 At pretest, there was no difference between coaches at intervention and control schools in the total knowledge index (21.7±6.8 vs. 21.7±5.0, p=0.975). Mean score was 57.1% of maximum (maximum=38) for coaches representing both intervention and control schools. Knowledge index scores for the different content areas at posttest adjusted for pretest value are presented in Table 3. The coaches at intervention schools had higher index scores than control school coaches on total knowledge, weight-regulation and ED. On the nutrition index knowledge scores there was no significant difference between the intervention- and control schools coaches.

INSERT TABLE 3

Recognition and management of ED in athletes

Paragraph Number 24 Because we were interested in whether the coaches would be able to have constructive behavior or bring their knowledge to practice, the coaches were asked about how they would behave and manage ED in athletes with the following two questions that also are included in the ED knowledge index score; "If you get concerned that one of your athletes has an ED, what would you do?" which were scored 0 (not correct), 1 (average) and 2 (very good). There were no difference between the coaches' reported management at the intervention schools versus control schools at posttest adjusted for pretest value (mean: 0,892 vs. mean 0.863, difference in mean: 0.29, CI 95% -0.347 to 0.406, p=0.877). However, when the coaches answered the follow-up question: "If you still are concerned that one of your

athletes has an ED after you have had a meeting/conversation, you should?" a higher percentage of the coaches at the intervention schools than control schools reported a correct approach (98.0% vs. 77.8%, p=0.007). In addition, in the weight-regulation knowledge index, two questions measured the coaches' management of athletes wanting to reduce weight. In the first question, the coaches were asked how they would respond if: "One of your female athletes thinks she weighs 4 kg too much to perform well. She wants to lose weight and asks for advice." There were six suggested answers the coaches had to answer "yes" or "no". In the second question they were asked: "One of your athletes contacts you and says she feels heavy and wants to decrease her weight. Without telling her, you agree that her body composition could be improved. How will you respond to her?" There were four suggested answers from which the coaches could choose one. In both questions, the intervention schools coaches scored higher than coaches at the control schools by reporting the most preferred approach (question 1: mean 0.898 vs. 0.185, difference in mean: 0.713, CI 95% 0.359 to 1.066, p<0.001, and question 2: mean 1.857 vs. 1.630, difference in mean: 0.228, CI 95% 0.018 to 0.437). On question two, 85.7% of the intervention schools coaches compared to 66.7% coaches at control schools reported the most preferred approach.

Coaches' experience of perceived knowledge of ED in athletes

Paragraph Number 25 There were no differences between coaches at intervention schools and control schools experience in coaching athletes with an ED (26.1% vs. 18.5%, p=0.460) and previously coached athletes with an ED (48.7% vs. 27.3%, p=0.102). In addition, only 3 of the 49 coaches at the intervention schools and none of the 27 coaches from the control schools reported ED to be prevalent at the school where they coached. Moreover, 18.4% from the intervention schools compared to 25.9% at the control schools did not know if ED were

prevalent at their school, p=0.439. The coaches' own evaluations of their knowledge about ED at pretest and posttest are presented in Table 4.

INSERT TABLE 4

A higher prevalence of coaches at intervention schools than control schools evaluated their knowledge about ED to be "somewhat good" or better at posttest (Table 4). By including the results in a binary logistic regression analysis adjusted for pretest value, the likelihood of reporting "somewhat good" knowledge or better was 7 times higher for coaches at intervention schools compared to control schools (OR=7.1, 95% CI 2.2 to 23.3, p=0.001).

Compliance

Paragraph Number 26 In total, 89.8% of the 49 coaches participating in the intervention completed the questionnaire test included in the Coaches guide. In addition, 71.4% of the coaches at the intervention schools attended the seminar at school. Coaches were required to read and complete the test based on information contained in the Coaches guide. All coaches working at the Elite Sport High Schools the day of the seminars were required to attend. However, some coaches work part time and have other employers, and were not able to be at school on the day of the seminars. In addition, some coaches were away at training camps or competitions. Thus, at some schools, it was impossible to arrange the seminar at a time when every coach was available. However, both coaches participating and those who were unable to be at the seminars in person were sent information about the content of the seminar, the Coaches guide, and the intervention program targeting the athletes by e-mail.

DISCUSSION

Paragraph Number 27 The purpose of this trial was to examine the effectiveness of the specific educational program designed for coaches, who work with adolescent elite athletes. For coaches in the intervention group, the program included information and interactive discussions related to knowledge and strategies regarding identification, management and prevention of ED.

Paragraph Number 28 Overall, coaches at intervention schools had higher index scores on total knowledge, weight-regulation and ED than coaches attending control schools at 9-month follow-up. The intervention included seminars with the opportunity to discuss ED cases, a Coaches guide for self-study, and assignments related to identification and management of ED in the sport environment, as well as individualized feedback to the coaches. These findings suggest that the intervention can be an effective means by which to promote long-term retention of information (at least 9-months). In contrast, Whisenhunt et al., (38) reported that knowledge was not maintained by cheerleading coaches over an 8-11 month follow-up as part of a brief intervention which included verbal and written information about ED and nutrition. Although the increased knowledge from the posttest in that study was not maintained, the coaches from the experimental group self-reported engaging in increased efforts to prevent ED on their squads as compared to control group coaches at the follow-up (38). Little is known about whether short-term increases in knowledge can affect behaviour. In our trial, coaches attending the intervention also subjectively evaluated their knowledge about ED to be higher than the coaches at the control schools at 9-month follow-up. In fact, the likelihood of reporting "somewhat good" knowledge or better was 7 times higher for coaches at intervention schools. However, it appears that knowledge is not the only factor which may have an impact on the coaches' attitudes and behavior; one's confidence in that knowledge also plays an important role (37). Interestingly, Turk et al., (37) found that

although coaches may feel confident about managing or preventing ED, they may give incorrect information if they have low knowledge. Thus, low knowledge in addition to a high level of confidence may pose more threat than the combination of high knowledge and low confidence (37). This may be particularly important among coaches working with young upcoming athletes where the principles of physical growth, biological maturation and behavioural development occur. On the other hand, if coaches in the interventions schools in our study are in fact more knowledgeable about identification, management, and prevention of ED, and believe themselves to be more knowledgeable; they will most likely be more confident in the suggestions they give, the vocabulary they use, and how to appropriately communicate with their athletes. Thus, coaches that are properly educated may feel more assured that they are offering sound advice about nutrition, weight-regulation, body composition while not negatively affecting the health and performance of the athletes.

Paragraph Number 29 The combination of higher knowledge score and higher subjective evaluation of ED knowledge found among the coaches at the intervention schools in our trial is of particular importance. These higher scores are likely due to the fact that coaches during our education-program not only received factual information, but were provided with strategies to identify, manage and prevent ED among athletes. For instance, during the seminar at school, coaches were challenged with different cases of athletes with and without an ED, with the aim of increasing the coaches' confidence in identifying and managing ED problems among their athletes. The reason for teaching coaches' practical skills was to increase the coaches' confidence in their knowledge and enable them to take an active role in the prevention and management of ED (37). We believe the combination of higher knowledge score and higher subjective evaluation of ED knowledge among the coaches at the intervention school compared to the control schools also increased their awareness and

engagement in preventing ED. It is argued that prevention efforts might be more sustainable if programming engages the social systems in which the individuals are embedded. The need to include both specific influential adult figures (e.g. parents, teachers, and coaches) in addition to more global community resources (e.g. school administration) is underlined (22-24). In this connection, we would like to add the fact that none of the athletes at the intervention schools developed an ED during the study-period, while 13% of the female athletes at the control schools did (14). In addition, at the intervention schools a lower frequency of athletes reported symptoms associated with ED compared to the athletes at the control schools. Moreover, there was a significant reduction in dieting behavior observed for the female elite athletes attending the intervention schools with the most pronounced changes 1-yr after the intervention being especially encouraging (14).

Paragraph Number 30 In our trial, coaches attending the intervention also had higher knowledge scores on weight-regulation and ED at posttest than coaches at control schools. Although, the weight-regulation index included fewer questions, this was where the highest difference between coaches at intervention and control schools was found. Thus, it appears coaches increased their knowledge most about weight-regulation. Although dieting is probably not sufficient for the development of an ED (39), it is well established that frequent weight fluctuations can be a precipitating factor for the development of ED (30). Moreover, in a recent study among adolescent elite athletes, one-third of the male athletes and 13% of the female athletes who were dieting reported trying to lose weight as directed by their coach or teacher (15). Losing weight to enhance performance is one of the more common motives for dieting among athletes. Consequently, a number of extreme methods that place the athlete's health at risk are used in an effort to achieve fast weight loss within some sports. Few question the weight loss methods used, as many believe weight loss is a necessary part of the

sport (10, 13). Increased knowledge on both weight-regulation and ED among the coaches as found in our study may thus be an important step in preventing unhealthy behaviour among athletes. The combination of knowledge regarding both weight-regulation and ED seems especially important as athletes can be underweight, normal weight or overweight, regardless of the presence of extreme dieting or ED (36).

Paragraph Number 31 Interestingly, we found no difference between coaches attending intervention schools and control schools regarding their knowledge score on nutrition. However, most of the coaches in this study are highly educated (formally with bachelor degree and or sport specific courses) and have learned some basic sport nutrition during their education in sport sciences and or PE, and other courses (Table 2). Therefore, they might be quite critical in term of reporting "high" knowledge". Whether good nutrition knowledge among coaches and/or athletes prevents ED is not known, but our findings indicate that increased knowledge about weight-regulation, body composition and ED is not necessarily related to increased nutritional knowledge. Still, nutrition is a topic many coaches regard as important and that easily can be self-studied. It is a common misunderstanding that DE or ED are a problem of simply understanding nutrition. For instance, in a recent study among Swedish elite coaches most of them ascribed low priority to ED information compared to nutritional information (18). In fact, many of them stated that solid knowledge of nutrition and weight-regulation precluded the need for increasing athletes' knowledge about ED (18). This suggests they assume ED can be avoided if athletes have the correct nutritional information. This further suggests that they assume ED is more about food than about complex psychological issues. Hopefully, more factual information regarding ED can increase coaches' understanding of ED, which is critical in being able to respond to their athletes in a helpful and appropriate manner.

Paragraph Number 32 It has been reported that dieting athletes who do not receive guidance for weight reduction more often develop ED than those who are supervised during the weight loss period (30). Thus, one might speculate that the increased knowledge about weight-regulation and body composition in the intervention group in our study could be a "preventive" factor in terms of reducing the risk of ED problems in these young athletes by coaches who could presumably more effectively advise them regarding weight-regulation. Many coaches in the trial reported not having coached or did not know if they had coached an athlete with an ED, despite having coached for an average of 11-20 years, some of which involved coaching athletes in weight-sensitive sports. Given the relatively high prevalence of DE and ED in adolescent elite athletes (15, 16), it seems unlikely that these coaches have not had an athlete with an ED. It is more likely that they have coached athletes with ED, but failed to identify their disorders. Coaches who have difficulty identifying athletes with ED need more information about signs and symptoms of ED, which was an aim of the present trial.

Strengths and Limitations of the Study

Paragraph Number 33 Strengths of the trial include randomisation of schools to avoid contamination between intervention and control groups, inclusion of the total population of coaches working with first-year students at all Elite Sport High Schools in Norway, the use of a theory-based intervention, the individual feedback given to all the coaches at the intervention schools on their assignments, and the 9-months follow-up posttest.

Paragraph Number 34 We have considered several limitations with our design and data acquisition. The decision to only measure the interventional effect 9-months after the intervention program provides no information about the knowledge-group scores immediately

after the intervention among the coaches. However, measurement of knowledge following 9-months after intervention may provide a more useful learning measurement. Moreover, given that intervention effects tend to dissipate over time, a long-term follow-up is recommended (29). In addition, Wisenhunt and colleagues (38) found in their study among cheerleading coaches that the increases in knowledge about ED found immediately after intervention were not maintained over an 8-11 month follow-up. We therefore acknowledge that a posttest immediately following the intervention in addition to our 9-month follow-up, would have strengthened our trial. Moreover, we must consider that simply participating in a trial may change the participant's behaviour. In our case, coaches might have positively changed their willingness to incorporate more knowledge about nutrition, weight-regulation and ED. This could artificially increase adherence among the control school coaches. If this bias existed, it would hide differences between the groups, meaning that there may be a greater difference between intervention and control schools than was observed in our trial.

Our drop-out analysis did not show any difference between the coaches that participated in the trial and those who were lost to follow-up. Because 25 coaches did not participate in the posttest, we do not know if this is due to a power problem or that it actually does not represent any differences. Furthermore, because so few female coaches participated, we do not know if our results are generalizable to female coaches. Gender of coach has recently been found to affect how coaches think about and respond to DE in their athletes (12). Finally, our results are based on questionnaire screening, and we do not know if the increased knowledge in the intervention group compared to control group also changed the coaches' behaviour regarding identification, management and prevention of ED. In future trials it will be important to develop evaluation tools that undergo vigorous validity and reliability testing that can be shared among the scientific community along with the constructs of the intervention.

Practical implications

Paragraph Number 35 Coaches need factual information regarding the identification of ED. They also require sufficient confidence in using that information in a timely and appropriate way to increase the likelihood that the athlete will accept a referral for evaluation and treatment, if needed. Providing such information was a major goal of this trial in an effort to combat the high prevalence of DE and ED in adolescent elite athletes and decrease treatment delay and related complications. With the success of the intervention approach employed in this trial, hopefully more coaches will have the opportunity to learn the skills needed to assist and/or prevent ED among their athletes. Future prevention studies should use the power and influence of coaches to create supportive environments regarding the prevention of ED among athletes and include education programming that targets coaches as a separate part of the intervention program for the athletes. However, it is important to remember that only programs that will be adopted by the participants, the coaches, and sporting bodies will succeed in the long run (9).

CONCLUSION

Paragraph Number 36 An intervention program developed to provide coaches with knowledge and strategies regarding identification, management and prevention of ED produced significant long-term effect (at least 9-months). The intervention also shows positive effects on the coaches' subjective evaluation of their ED knowledge.

Acknowledgements

The authors would like to thank Professor Ingar Holme for his assistance with the statistical analysis, Professor Anne Marte Pensgaard for advices with the questionnaires, Audun Erikson with regard to the collection of data, and Anders Meland for his contribution at the coaches' seminars. We also thank all the coaches and administrators at the Elite Sport High Schools for cooperation and support during this study. The research reported in this article was supported by Oslo Sports Trauma Research Center and through a grant from the Norwegian Olympic Sports Center (Olympiatoppen). The Oslo Sports Trauma Research Center has been established through generous grants from the Eastern Norway Regional Health Authority, the International Olympic Committee, The Royal Norwegian Ministry of Culture, Norsk Tipping AS and the Norwegian Olympic Committee & Confederation of Sport. There are no potential conflicts of interest. The results of the study do not constitute endorsement by the American College of Sports Medicine.

REFERENCES

1. Ackland TR, Lohman TG, Sundgot-Borgen J, et al. Current status of body composition assessment in sport: review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I.O.C Medical Commission. *Sports Med*. 2012; 42(3):227-249.

2. Ajzen I. From intention to actions: a theory of planned behavior. In: Ajzen I.J. Kuhl and J. Beckmann (Eds.) *Action-control: from cognition to behavior*. Berlin: Springer; 1980, p. 11-39.

3. Bonci CM, Bonci LJ, Granger LR, et al. National athletic trainers' association position statement: preventing, detecting, and managing disordered eating in athletes. *J Athl Train*. 2008; 43(1):80-108.

4. Borresen R. Rosenvinge JH. From Prevention to Health Promotion. In: Borresen R. Rosenvinge JH.J. Treasure, U. Schmidt, and E. Van Furth (Eds.) *Handbook of Eating Disorders*. Chisester: Wiley; 2003, p. 455-466.

5. Cook DJ, Cusimano MD, Tator CH, Chipman ML. Evaluation of the ThinkFirst Canada, Smart Hockey, brain and spinal cord injury prevention video. *Inj Prev*. 2003; 9(4):361-365.

6. Currie A, Morse ED. Eating disorders in athletes: Managing the risks. *Clin Sports Med*. 2005; 24(4):871-883.

7. Drinkwater B, Loucks A, Sherman R, Sundgot-Borgen J, Thompson R. International Olympic Committee Medical Commission Working Group Women in Sport:position stand on the female athlete triad.*International Olympic Committee* 2005 [cited 2010 September 4]. Available from: http://www.olympic.org/Documents/Reports/EN/en_report_917.pdf

8. Federation Internationale de Gymnastique. FIG Code of Ethics.*Tenerife: Federation International de Gymnastique* 2001 [cited 2014 February 10]. Available from: http://www.fedintgym.com/rules/files/main/Code%20of%20Ethics%20(english).pdf

9. Finch C. A new framework for research leading to sports injury prevention. *J Sci Med Sport*. 2006; 9(1-2):3-9.

10. Hall CJ, Lane AM. Effects of rapid weight loss on mood and performance among amateur boxers. *Br J Sports Med*. 2001; 35(6):390-395.

11. International Olympic Committee. The Olympic movement medical code.*Lausanne: International Olympic Commitee* 2009 [cited 2013 November 10]. Available from: http://www.olympic.org/PageFiles/61597/Olympic_Movement_Medical_Code_eng.pdf

12. Kroshus E, Sherman RT, Thompson RA, Sossin K, Austin SB. Gender Differences in High School Coaches' Knowledge, Attitudes, and Communication About the Female Athlete Triad. *Eating Disorders*. 2014; **DOI:**10.1080/10640266.2013.874827.

13. Marquart LF, Sobal J. Weight-Loss Beliefs, Practices and Support Systems for High-School Wrestlers. *J Adolesc Health*. 1994; 15(5):410-415.

14. Martinsen M, Bahr R, Børresen R, Holme I, Pensgaard AM, Sundgot-Borgen J. Preventing Eating Disorders among Young Elite Athletes: A Randomized Controlled Trial. *Med Sci Sports Exerc*. 2014; 46(3):435-447.

15. Martinsen M, Bratland-Sanda S, Eriksson AK, Sundgot-Borgen J. Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. *Br J Sports Med*. 2010; 44(1):70-76.

16. Martinsen M, Sundgot-Borgen J. Higher Prevalence of Eating Disorders among Adolescent Elite Athletes than Controls. *Med Sci Sports Exerc*. 2013; 45(6):1188-1197.

17. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP. American College of Sports Medicine position stand. The female athlete triad. *Med Sci Sports Exerc*. 2007; 39(10):1867-1882.

18. Nowicka P, Eli K, Ng J, Apitzsch E, Sundgot-Borgen J. Moving from Knowledge to Action: A Qualitative Study of Elite Coaches' Capacity for Early Intervention in Cases of Eating Disorders. *International Journal of Sports Science & Coaching*. 2013; 8(2):343-355.

19. Pensgaard AM, Roberts GC. Elite athletes' experiences of the motivational climate: The coach matters. *Scand J Med Sci Spor*. 2002; 12(1):54-59.

20. Petty RE, Cacioppo JT. *Communication and persuasion : central and peripheral routes to attitude change*. New York: Springer-Verlag; 1986. xiv, 262 p.

21. Piran N. Eating disorders: A trial of prevention in a high risk school setting. *J Prim Prev*. 1999; 20(1):75-90.

22. Piran N. The body logic program: Discussion and reflections. *Cogn Behav Pract*. 2001; 8(3):259-264.

23. Piran N. Prevention of eating disorders: a review of outcome evaluation research. *Isr J Psychiatry Relat Sci*. 2005; 42(3):172-177.

24. Piran N. A Feminist Perspective of Risk Factor Research and the Prevention of Eating Disorders. *Eat Disord*. 2010(18):183-198.

25. Rivis A, Sheeran P, Armitage CJ. Augmenting the theory of planned behaviour with the prototype/willingness model: Predictive validity of actor versus abstainer prototypes for adolescents' health-protective and health-risk intentions. *Brit J Health Psych*. 2006; 11:483-500.

26. Rosendahl J, Bormann B, Aschenbrenner K, Aschenbrenner F, Strauss B. Dieting and disordered eating in German high school athletes and non-athletes. *Scand J Med Sci Sports*. 2009; 19(5):731-739.

27. Sherman R, Thompson R, Dehass D, Wilfert M. NCAA Coaches Survey: The Role of the Coach in Identifying and Managing Athletes with Disordered Eating. *Eat Disord*. 2005; 13(5):447-466.

28. Stice E. Risk and maintenance factors for eating pathology: A meta-analytic review. *Psychol Bull*. 2002; 128(5):825-848.

29. Stice E, Shaw H, Marti CN. A Meta-Analytic Review of Eating Disorder Prevention Programs: Encouraging Findings. *Annual Rev Clin Psycho*. 2007(3):207-231.

30. Sundgot-Borgen J. Risk and Trigger Factors for the Development of Eating Disorders in Female Elite Athletes. *Med Sci Sports Exerc*. 1994; 26(4):414-419.

31. Sundgot-Borgen J, Meyer NL, Lohman TG, et al. How to minimise the health risks to athletes who compete in weight-sensitive sports review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition, Health and Performance, under the auspices of the IOC Medical Commission. *Br J Sports Med*. 2013; 47(16):1012-1068.

32. Sundgot-Borgen J, Skårderud F, Rodgers S. Athletes and Dancers. In: Sundgot-Borgen J, Skårderud F, Rodgers S.J. Treasure, U. Schmidt, and E. Van Furth (Eds.) *Handbook of Eating Disorders*. Chichester (England): John Wiley & Sons Inc.; 2003, p. 385-400.

33. Sundgot-Borgen J, Torstveit MK. Prevalence of eating disorders in elite athletes is higher than in the general population. *Clin J Sport Med*. 2004; 14(1):25-32.

34. Sundgot-Borgen J, Torstveit MK. Aspects of disordered eating continuum in elite high-intensity sports. *Scand J Med Sci Spor*. 2010; 20:112-121.

35. Torstveit MK, Rosenvinge JH, Sundgot-Borgen J. Prevalence of eating disorders and the predictive power of risk models in female elite athletes: a controlled study. *Scand J Med Sci Spor*. 2008; 18(1):108-118.

36. Torstveit MK, Sundgot-Borgen J. Are Under- and Overweight Female Elite Athletes Thin and Fat? A Controlled Study. *Med Sci Sports Exerc*. 2012; 44(5):949-957.

37. Turk JC, Prentice WE, Chappell S, Shields EW. Collegiate coaches' knowledge of eating disorders. *J Athl Training*. 1999; 34(1):19-24.

38. Whisenhunt BL, Williamson DA, Drab-Hudson DL, Walden H. Intervening with coaches to promote awareness and prevention of weight pressures in cheerleaders. *Eating and Weight Disorders-Studies on Anorexia Bulimia and Obesity*. 2008; 13(2):102-110.

39. Wilson GT. The controversy over dieting. In: Wilson GT.C. G. Fairburn and K. D. Brownell (Eds.) *Eating Disorders and Obesity: A Comprehensive Handbook*. New York: The Guilford Press; 2002, p. 93-97.

40. Yager Z, O'Dea JA. Prevention programs for body image and eating disorders on University campuses: a review of large, controlled interventions. *Health Promot Int*. 2008; 23(2):173-189.

TABLE 1. The educational program from the Health, Body and Sports Performance Intervention program given the coaches at the intervention schools.

COACHES		
Time point Arena Organisation	**Themes**	**Purpose**
Winter 2009		
Outside-school Seminar	*Nutrition*: Sports nutrition; Fluid and fuel intake before, during and after training/competition; Health and performance enhancing nutrition *Physiology*: Growth and development; Adolescent athletes health *Prevention*: Detecting and managing ED	• increase knowledge, challenge myths and correct possible misinformation related to nutrition, health and performance • be aware of the physical and psychological challenges related to puberty (e.g. self-appearance, self-esteem), and how they may affect sport performance and become possible stress factors • understand how athletes experience pressure to lose weight from coaches and peers • increase confidence in 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); Manage ED (how to prepare and plan the first consultation/meeting and follow up with athletes "at risk" and athletes who might be suffering)	• be able to recognize signs, symptoms associated with ED in the general population 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
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 in athletes; 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 or optimising the policies for early detection and management of DE and ED

Moderated from Martinsen et al.,(14).

Table 2. Characteristics of the coaches representing the intervention schools and control schools at pretest of the study.

	Intervention N=49	**Control N=27**	***P* value**
Age, years	36.8±8	40.7±10	0.077
Coaching experience, years	11.3±7.87	11.1±8.9	0.935
Coaching experience at high schools with sports specialization, years	5.9±5.3	5.8±5.8	0.924
Coaching sport teams/ athletes in addition to the athletes at the Elite Sport High Schools	40 (81.6)	22 (81.5)	1.000
Competed at national or international level	40 (81.6)	23 (85.2)	0.762
Formal education in sport sciences and or physical education (PE)[a]	35 (71.4)	15 (55.6)	0.209
Specific education program and or courses targeting coaches[b]	47 (95.9)	24 (88.9)	0.340

Values are given in absolute numbers and valid percentage (%), which is the percentage when only cases without missing values are considered. Range of missing: coaching experience, coaching experience at high schools with sport specialization and coaching teams/ athletes in addition to the athletes at the Elite Sport High Schools N (1 to 4).

[a]Defined as having at least one year or 60 credits of sport sciences or PE at university level, a Bachelor's or a Master's degree in these topics.

[b]Reported having or being in process of fulfilling specific education program and or courses targeting coaches.

Table 3. Posttest index values for the various knowledge content areas among the coaches at intervention and control schools. Delta (Δ) values are the difference between intervention and control schools for the various knowledge content areas adjusted for pretest value.

	Intervention	**Control**	**Adjusted difference**	**Intervention vs. Control[a]**	
	N=49	**N=27**	**Δ**	**95% CI**	***P***
Nutrition	9.5±3.5	10.3±3.3	-0.80	-2.2 to 0.61	0.260
Weight-regulation	6.2±1.7	4.8±1.3	1.37	0.65 to 2.1	<0.001
Eating disorders	19.3±4.4	16.5±5.0	2.83	0.90 to 4.7	0.004
Total knowledge score	35.0±7.2	31.6±8.0	3.40	0.51 to 6.2	0.021

[a]General linear model was used with the different knowledge content scores at posttest as the dependent variable, school type (intervention/control) as fixed factor and total knowledge score at pretest as covariate. Maximum score for the different knowledge contents at posttest: nutrition =16, weight-control =10, Eating disorders =29 and total knowledge score =55.

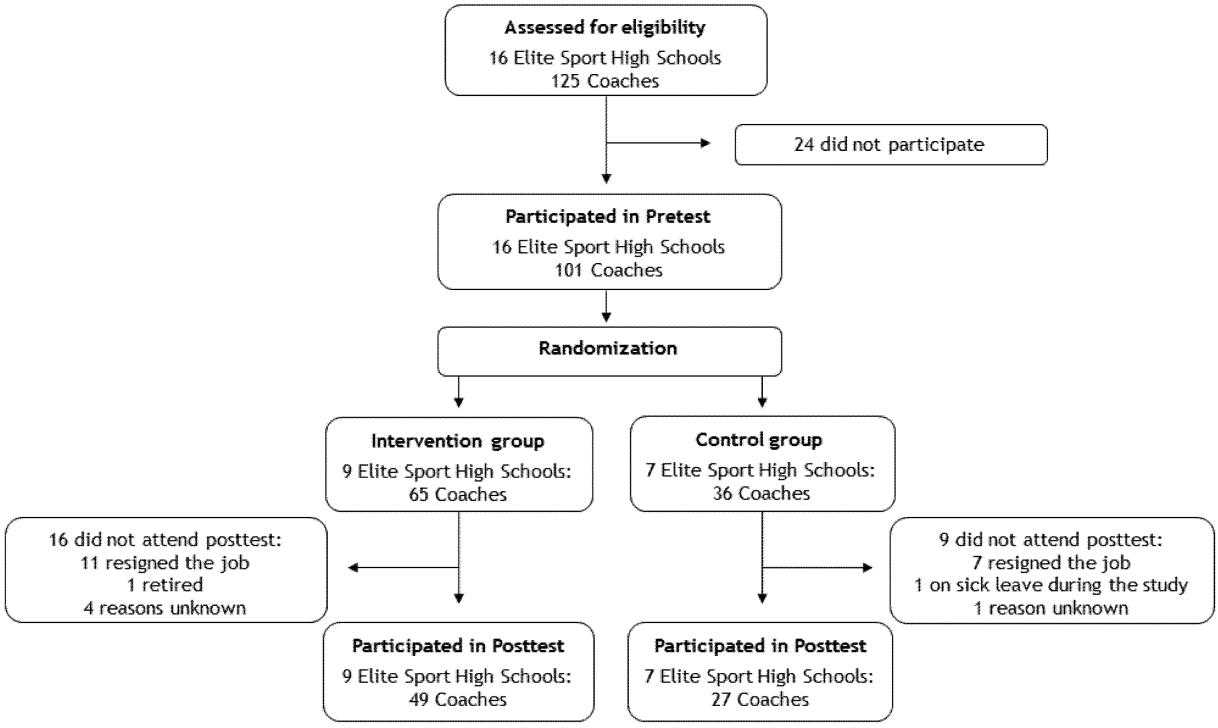
Table 4.The coaches' own description of their knowledge about ED at pretest and posttest.

	Pretest		Posttest	
	Intervention N=45	**Control N=27**	**Intervention N=49**	**Control N=27**
Very poor	1 (2.0)	1 (3.7)	0 (-)	0 (-)
Poor	8 (17,8)	4 (14.8)	2 (4.1)	3 (11.1)
Somewhat poor	16 (35.6)	8 (29.6)	6 (12.2)	11 (40.7)
Somewhat good	17 (37.8)	11 (40.7)	34 (69.4)	12 (44.4)
Good	3 (6.6)	3 (11.1)	7 (14.3)	0 (-)
Very good	0 (-)	0 (-)	0 (-)	1 (3.7)

P value: Pretest between intervention and control =0.556; Posttest between intervention and control =0.002.
Values are given in absolute numbers and valid percentages (%).
*Because of small numbers, no statistical analysis was performed.

Figure captions

Figure 1: Flow chart of the study and participants' movement.


Assessed for eligibility
16 Elite Sport High Schools
125 Coaches
24 did not participate
Participated in Pretest
16 Elite Sport High Schools
101 Coaches
Randomization
Intervention group
9 Elite Sport High Schools:
65 Coaches
Control group
7 Elite Sport High Schools:
36 Coaches
16 did not attend posttest:
11 resigned the job
1 retired
4 reasons unknown
9 did not attend posttest:
7 resigned the job
1 on sick leave during the study
1 reason unknown
Participated in Posttest
9 Elite Sport High Schools:
49 Coaches
Participated in Posttest
7 Elite Sport High Schools:
27 Coaches

Paper IV

The Development of the Brief Eating Disorder in Athletes Questionnaire

MARIANNE MARTINSEN[1], INGAR HOLME[1], ANNE MARTE PENSGAARD[2], MONICA KLUNGLAND TORSTVEIT[3], and JORUNN SUNDGOT-BORGEN[4]

[1]*Oslo Sports Trauma Research Center, Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, NORWAY;* [2]*Department of Coaching and Psychology, Norwegian School of Sport Sciences, Oslo, NORWAY;* [3]*Faculty of Health and Sport Sciences, University of Agder, Kristiansand, NORWAY; and* [4]*Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, NORWAY*

ABSTRACT

MARTINSEN, M., I. HOLME, A. M. PENSGAARD, M. K. TORSTVEIT, and J. SUNDGOT-BORGEN. The Development of the Brief Eating Disorder in Athletes Questionnaire. *Med. Sci. Sports Exerc.*, Vol. 46, No. 8, pp. 1666–1675, 2014. **Purpose**: The objective of this study is to design and validate a brief questionnaire able to discriminate between female elite athletes with and without an eating disorder (ED). **Methods**: In phase I, 221 (89.5%) adolescent athletes participated in a screening including the Eating Disorder Inventory-2 (EDI-2) and questions related to ED. All athletes reporting symptoms associated with ED (n = 96, 94.1%) and a random sample without symptoms (n = 88, 86.3%) attended the ED Examination Interview. On the basis of the screening, we extracted items with good predictive abilities for an ED diagnosis to the Brief ED in Athletes Questionnaire (BEDA-Q) versions 1 and 2. Version 1 consisted of seven items from the EDI-Body dissatisfaction, EDI-Drive for thinness, and questions regarding dieting. In version 2, two items from the EDI-Perfectionism subscale were added. In phase II, external predictive validity of version 1 was tested involving 54 age-matched elite athletes from an external data set. In phase III, predictive ability of posttest assessments was determined among athletes with no ED at pretest (n = 53, 100%). Logistic regression analyses were performed to identify predictors of ED. **Results**: Version 2 showed higher discriminative accuracy than version 1 in distinguishing athletes with and without an ED with a receiver operating characteristics area of 0.86 (95% confidence interval (CI), 0.78–0.93) compared with 0.83 (95% CI, 0.74–0.92). In phase II, the accuracy of version 1 was 0.77 (95% CI, 0.63–0.91). In predicting new cases, version 2 showed higher diagnostic accuracy than version 1 with a receiver operating characteristic area of 0.73 (98% CI, 0.52–0.93) compared with 0.70 (95% CI, 0.48–0.92). **Conclusion**: The BEDA-Q containing nine items reveals good ability to distinguish between female elite athletes with and without an ED. The BEDA-Q's predictive ability should be tested in larger samples. **Key Words:** SCREENING, VALIDATION, INSTRUMENT, SPORTS, DISORDERED EATING

Many female athletes struggle with disordered eating (DE) and eating disorders (ED) as they attempt to conform to demands or competition regulations that might be ill-suited to their physique (36). In this situation, participation in sports may lead to an array of health concerns that may adversely affect the female athlete's short- and long-term health at a variety of performance levels and sports. The peak onset of ED is during adolescence, when females experience a rapid change in body composition and shape (6). It is also during adolescence and young adulthood that most elite athletic participation and competition take place (6), and female adult elite athletes diagnosed with ED report having started dieting and developing ED during puberty or adolescence (35). Recent research shows that the prevalence of ED is higher among adolescent female elite athletes than among nonathletic peers (28).

The importance of early detection of ED behavior has been stressed by the International Olympic Committee, the American College of Sports Medicine, the National Collegiate Athletic Association, the Society for Adolescent Medicine, the American Psychiatric Association, and the National Athletic Trainers' Association (5). Development and modification of instruments for identification of clinically significant ED have been a major research interest for years (16), and instruments designed for screening and diagnostic purposes have been used in the general population (16) as well as among athletes (2,5). Unfortunately, an important limitation among the instruments being used when screening athletes for ED (such as the Eating Disorder Inventory (EDI), the Eating Disorder Examination questionnaire (EDE-Q), and the Eating Attitudes Test) is that they have not been adequately validated in the athletic population and, thus, may not be appropriate screening instruments for athletes (2,5). Moreover, screening questionnaires developed specifically for athletes (such as the Athletic Milieu

Address for correspondence: Marianne Martinsen, MSc, Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, PO Box 4014 Ullevål Stadion, N-0806 Oslo, Norway; E-mail: marianne.martinsen@nih.no.
Submitted for publication October 2013.
Accepted for publication January 2014.

0195-9131/14/4608-1666/0
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

DOI: 10.1249/MSS.0000000000000276

Direct Questionnaire, The Female Athlete Screening Tool, and the College Health Related Information Survey) have not been tested or validated sufficiently in large groups of athletes at different competitive levels (2,5). Furthermore, many of the screening instruments are cumbersome and often require psychometric expertise for administration and data interpretation that seldom is available in most athletic settings (2,5). As a result, most studies among elite athletes, including our studies, have used a combination of standardized questionnaire subscales such as the EDI-Body dissatisfaction (EDI-BD), the EDI-Drive for thinness (EDI-DT), and additional self-developed questions (7,28,34,37,39). Results from these studies show that elite athletes are underreporting and nonathletes are overreporting symptoms associated with ED, resulting in a high percentage of athletes classified as false negative when comparing results from "at risk" screening to a clinical interview for the diagnoses of ED (28,34,39). Therefore, the main objective of this study was to design an accurate yet less comprehensive screening questionnaire with the ability to discriminate between adolescent female elite athletes with an ED from those without an ED. The desired criteria were that the questionnaire should be brief, inexpensive, and easy to understand and yield valid results.

METHODS

We conducted this study in three phases. Phases I and III were based on data from a cluster-randomized controlled trial on adolescent elite athletes attending Elite Sport High Schools in Norway. All the Elite Sport High Schools (n = 16) and the total population of first year male and female athletes during the 2008–2009 school year (born in 1992) were invited to enter the trial (26). The current article includes data from the questionnaire and clinical interviews

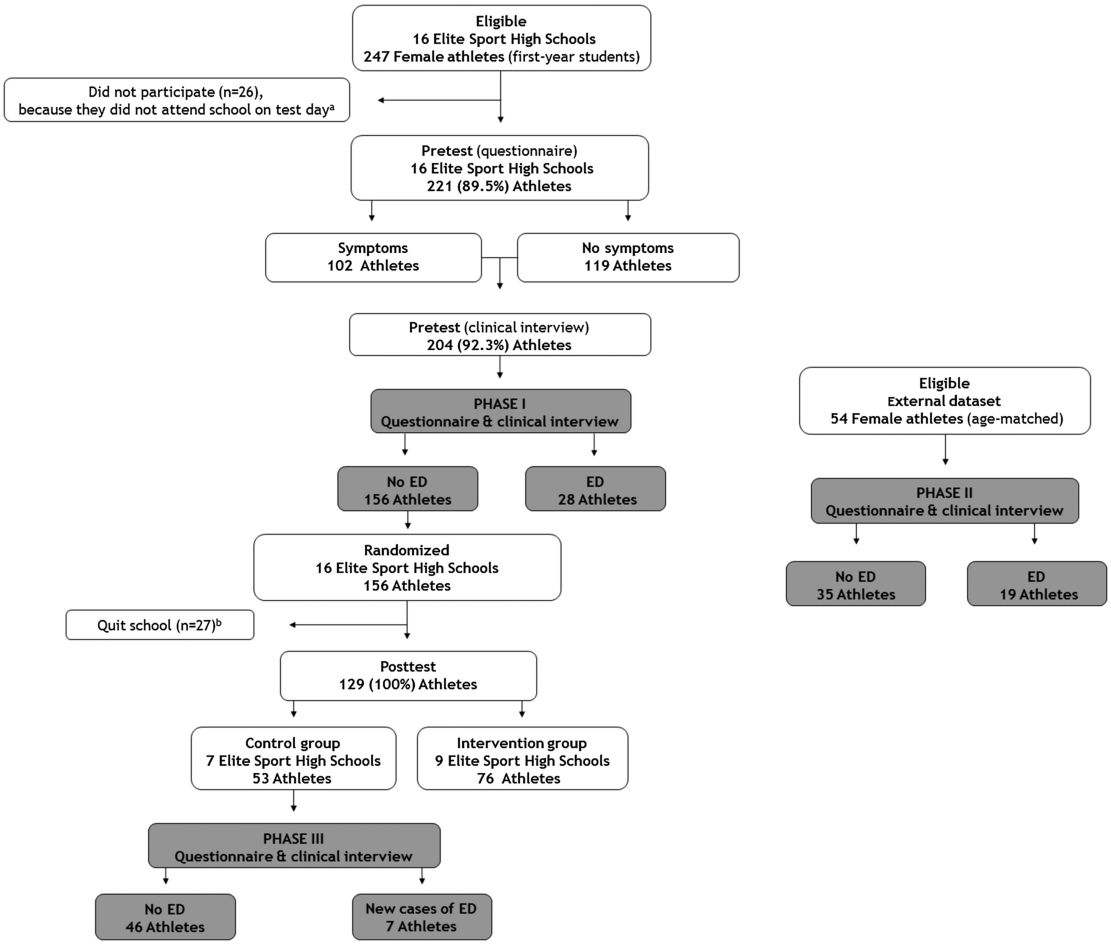


FIGURE 1—Flow chart of the study and participants in phases I, II, and III. [a]Reasons reported were training camps, competition, and illness. [b]Changed to regular school.

conducted at pretest (phase I) and posttest 2 (phase III) (approximately 2 yr after pretest and in the following called posttest) among the female participants only. In phase II, adolescent Norwegian female elite athletes from one of our earlier studies were included as an external validation sample (40). The flow of participants in phases I, II, and III are presented in Figure 1.

In phase I, we extracted items from the comprehensive questionnaire screening at baseline, which revealed good predictive abilities for a diagnosis of ED in female athletes from the Elite Sport High Schools. In phase II, regression coefficients from the derivation samples version 1 were used to estimate logistic scores and estimated probabilities of ED with levels of the predictors found in the external validation data set. Finally, in phase III, we applied the new screening version's (1 and 2) ability to predict new cases of ED among the high school athletes in the control schools (Elite Sport High Schools not given any intervention) classified with no ED diagnosis at pretest (phase I).

Participants

Phase I—the tryout sample. All female first year students (n = 257) were invited to participate. Of these, 10 were excluded (due to age: n = 8; did not obtain parental consent: n = 2). Among the remaining 247 athletes, 26 did not attend school on the test day. Reasons reported were training camps, competition, and illness. This resulted in a sample size of 221 female athletes (89.5%) representing 37 different sport disciplines attending the questionnaire screening at pretest. After the screening, all athletes reporting symptoms associated with ED were classified as "at risk" (attended: n = 96, 94.1%), and a random sample without reported symptoms (attended: n = 88, 86.3%) were invited to attend the clinical interview to determine whether they met the diagnostic criteria for an ED or not. All the 184 athletes (90.2%) attending the clinical interview are included in phase I of this study, and 28 (15.2%) were diagnosed with an ED (Fig. 1).

Phase II—external predictive validity in a different data set. To validate the new ED screening questionnaire, we included 54 gender- and age-matched adolescent elite athletes from one of our previous studies (40). This was the total number of eligible athletes who matched the current sample on age. In this study, an elite athlete was defined as one who qualified for the national team at the junior or senior level or who was a member of a recruiting squad for that team. The 54 athletes included represented 23 different sport disciplines.

Phase III—predictive ability of posttest assessments. In phase III, we wanted to test the new screening questionnaires' ability to predict new cases of ED at posttest among the athletes representing the control schools classified with no ED diagnosis at pretest. Among the 156 athletes attending the clinical interview at pretest without fulfilling the criteria for an ED, 27 left the Elite Sport High School program during the study. Furthermore, 76 of the remaining 129 athletes represented intervention schools. Accordingly, 53 athletes (100%) attending the control schools were included in phase III (Fig. 1).

The Regional Committee for Medical and Health Sciences Research Ethics in Southern Norway and the Norwegian Social Science Data Services approved both studies. The respondents and their parents provided written consent to participate. We also obtained permission to collect data from each Elite Sport High School principal (phases I and III) (26). In addition, the athletes included from the external data set (phase II) had to complete a written consent to participate, and a written parental consent was required for responders younger than 16 yr (40).

Assessment Procedures

Phases I and III (athletes attending the Elite Sport High Schools)

Screening. At pretest and posttest, 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 (PWCM), injuries, self-report of previous and/or current ED, and the EDI-2. The questionnaire has been described in detail elsewhere (27).

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 pretest and posttest based on the self-reported questionnaire. To be classified as "at risk" for ED, the athletes had to meet at least one of the following criteria: (a) EDI-DT score ≥15; (b) EDI-BD score ≥14; (c) body mass index (BMI) corresponding to the underweight value (8); (d) trying to lose weight now; (e) tried to lose weight before ≥3 times; (f) current and/or previous use of PWCM: use of diet pills, laxatives, diuretics, or vomiting to reduce weight; or (g) self-reported menstrual dysfunction: primary amenorrhea or secondary amenorrhea (the previous 6 months). These criteria were chosen and used in our previous studies involving adolescent elite athletes (27,28) and are based on studies of elite athletes (37,39), the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*) diagnostic criteria for an ED (1), as well as on the assumption that DE occurs on a continuum of severity (11).

The EDI-2 is a validated and commonly used self-report instrument to assess the symptoms and psychological features of ED (17). It consists of 91 items and 11 clinically and theoretically subscales measuring 1) EDI-DT, 2) bulimia (EDI-B), 3) EDI-BD, 4) ineffectiveness, 5) perfectionism (EDI-P), 6) interpersonal distrust, 7) interceptive awareness, 8) maturity fears, 9) asceticism, 10) impulse regulation, and 11) social insecurity (17). The items are presented in a six-point format requiring respondents to answer whether each item applies "always," "usually," "often," "sometimes,"

"rarely," or "never." The responses for each item are weighted from 0 to 3, and the subscale scores are computed by summing item scores. Positive scores are weighted as follows: 3 = always, 2 = usually, 1 = often, 0 = sometimes, 0 = rarely, 0 = never. Reverse-scored items are weighted in the opposite manner (17). Three of the subscales measure central ED symptoms: EDI-DT, EDI-B, and EDI-BD. High scores on EDI-DT and EDI-BD, as well as use of PWCM, have been reported to be symptoms of DE and/or ED (3,33). High total scores on EDI-DT and EDI-BD have also been used as selection criteria when screening for athletes "at risk" for ED (34).

Among the additional subscales measuring more psychological correlates associated with ED, the EDI-P subscale has been widely used (25). Besides that perfectionism has been implicated in the development and maintenance of all forms of ED [anorexia nervosa (AN), bulimia nervosa (BN), and ED not otherwise specified (EDNOS)], there is emerging evidence that perfectionism may interact with other risk factors to predict eating disturbances in nonathletes (31). Some have highlighted that perfectionism is an adaptive quality that helps athletes reach their potential (18), whereas others argue its maladaptive nature for achievement pursuit (13). Interestingly, Hopkinson and Lock (23) found by comparing division I collegiate athletes to recreational athletes that perfectionism rather than the level of intensity at which the athletes participated in their sport was the most important factor in predicting DE. Given the high prevalence of ED among adolescent elite athletes (28) and perfectionism's perceived role in the etiology of ED (15), we found it interesting to test two versions of the screening questionnaire: one version with items from the traditionally used EDI-DT and EDI-BD and one where items from the EDI-P were also included.

The EDI-DT reflects an ardent wish to lose weight and fear of weight gain. Items from this subscale assess excessive concern with dieting, preoccupation with weight, and fear of weight gain. In addition, the EDI-BD subscale is related to body image distortions. It measures dissatisfaction with the overall shape and with the size of those regions of the body that are of greatest concern to those with ED (i.e., stomach, hips, thighs, and buttocks) (17). Moreover, the EDI-P subscale measures the extent to which one believes that personal achievements should be superior. Items from this subscale measure the belief that only the highest standards of personal performance are acceptable and the belief that outstanding achievement is expected by others (e.g., parents, teachers) (17).The scale was originally constructed as a one-dimensional measure of perfectionism, but it has been observed that the subscale measures intrapersonal and interpersonal domains corresponding to the "self-oriented" and "socially prescribed" perfectionism dimensions (30). Particularly, three items appear to assess self-oriented perfectionism (the belief that perfectionism is required in personal performance) and three items that appear to measure socially prescribed perfectionism (the belief that perfectionism in personal performance is expected by others) (24). During adolescence, the socially prescribed perfectionism is thought to be of particular importance due to developmental concerns during this phase (14).

Clinical ED was determined by using the ED Examination Interview 16:0 (EDE) (12), also including sport-specific questions regarding suggested predisposing, precipitating, and perpetuating factors related to ED risk. The criteria for AN, BN, or EDNOS from the *DSM-IV* had to be met for being diagnosed with an ED (1). The 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 (7,11).

The clinical interview was conducted after questionnaire screening at pretest and at posttest. Furthermore, a random sample of 20 athletes (12 who fulfilled and 8 who did not fulfill the ED criteria after the first clinical interview) was reinterviewed for reliability assessments. We also reinterviewed 10 athletes (four who fulfilled and six who did not fulfill the ED criteria) after the second clinical interview (26). Complete agreement between the two interviewers concerning the diagnostic classification was found in all cases.

Statistical Methods

Statistical analyses were carried out using SPSS Statistics 21 for Windows (IBM Corporation, Route, Somers, NY). Results are expressed as absolute numbers (*N*) and percentages (%) for categorical data and mean values with their SD for continuous data. Logistic regression models were used with symptoms of ED, or ED as dependent variables and risk factors, such as EDI-DT and trying to lose weight now as a predictor per unit change, in the predictors were calculated with 95% confidence limits.

Receiver operating characteristics (ROC) calculations were used to illustrate the ability of the tests to distinguish athletes with and without an ED, where no discriminatory ability corresponds to an area under the ROC curve of 0.5 and perfect discriminatory ability to an area of 1.0. It is considered acceptable if the area under the curve (AUC) is fair if >0.70, good if >0.80, whereas excellent if >0.90. The predicted probabilities from each regression model were used as the independent variable, and ED (yes/no) was used as the dependent variable for the ROC curve analysis. Optimal cutoff score for versions 1 and 2 defined as the value that maximized product of sensitivity and specificity, the corresponding sensitivity and specificity, and the positive likelihood ratio and negative likelihood ratio for a positive and negative test result was reported. The likelihood ratios were calculated by the following formulas:

$$\text{positive likelihood} = \text{sensitivity}/(1 - \text{specificity})$$

$$\text{negative likelihood} = (1 - \text{sensitivity})/\text{specificity}$$

In phase II, regression coefficients from the tryout sample was used to estimate logistic scores and estimated probabilities

TABLE 1. Baseline characteristics of athletes participating in phases I and II of the study.

	Phase I Pretest			Phase II External Data			Total		
	ED $n = 28$	Non-ED $n = 156$	P	ED $n = 19$	Non-ED $n = 35$	P	Phase I $n = 184$	Phase II $n = 54$	P
Age (yr)	16.4 ± 0.4	16.5 ± 0.3	0.057	16.5 ± 1.0	16.9 ± 0.8	0.145	16.5 ± 0.3	16.7 ± 0.9	0.058
BMI ($kg \cdot m^{-2}$)	21.5 ± 2.5	21.2 ± 2.1	0.425	20.5 ± 1.6	20.8 ± 2.0	0.534	21.2 ± 2.1	20.7 ± 1.9	0.130
Weight-sensitive sports	11 (39.3)	41 (26.3)	0.159	16 (84.2)	9 (25.7)	<0.001	52 (28.3)	25 (46.3)	0.013
Selected for national teams (recruit, junior, or senior level)	11 (39.3)	49 (31.4)	0.413	15 (78.9)	30 (85.7)	0.704	60 (32.6)	45 (83.3)	<0.001

Results are given as means with SD for continuous variables or numbers with percentages for categorical variables. Only cases without missing values are considered.

of ED with levels of the predictors found in the external validation data set. These were then used to calculate ROC areas in the validation data. To correct for overoptimism in the regression model fit in phase I, we adjusted the coefficients according to a method by Van Houwelingen and Le Cessie (equation 77) in the external data set (41).

Internal reliability was assessed with Cronbach α coefficient. The significance level was set to 0.05.

RESULTS

Participant Characteristics

All participants from the Elite Sport High Schools were born in 1992, and there were no differences in age, training background, or BMI between those with and without an ED at pretest (phase I) (Table 1). Among the athletes from the external data set (phase II), a higher percentage of athletes with an ED compared with non-ED athletes competed in weight-sensitive sports (Table 1). Moreover, a higher percentage of the athletes from the external data set compared with the Elite Sport High School athletes at pretest (phase I) competed in weight-sensitive sports and were selected for national teams (Table 1). There were no differences in age or BMI between the athletes from the external data set compared with the athletes attending the Elite Sport High Schools.

Phase I

Developing a new screening questionnaire. Our starting point in developing a new and briefer screening questionnaire was to examine how well our questions previously used (symptoms associated with ED) discriminated between the Elite Sport High School athletes with and without an ED at pretest (Table 2).

In our search for potential predictors among the symptoms associated with ED, we included the three at-risk criteria with the highest sensitivity and specificity that significantly differed between athletes with and without an ED ("trying to lose weight now", "tried to lose weight before ≥3 times", and EDI-BD ≥14) in a logistic regression model as the independent variables and clinical ED (yes or no) as the dependent variable. The significant predictors proved to be "trying to lose weight now" [odds ratio (OR) = 4.0; 95% confidence interval (CI), 1.47–11.2; $P = 0.007$] and "tried to lose weight before ≥3 times" (OR = 3.1; 95% CI, 1.05–8.9; $P = 0.041$), whereas EDI-BD score ≥14 was borderline significant (OR = 2.8; 95% CI, 0.97–8.3; $P = 0.056$). Because frequent weight fluctuations have been suggested as an important trigger factor for the development of an ED in athletes (35), a natural next step in our search for the strongest potential predictors was to combine the variables "trying to lose weight now" and/or "tried to lose weight before ≥3 times" into one variable (dieting) (Table 2). With logistic regression analysis, dieting proved to be a strong significant predictor for ED (OR = 17.4; 95% CI, 5.7–53.2; $P < 0.001$).

Furthermore, because neither the EDI-DT nor the EDI-BD is sport specific or developed for the purpose of screening athletes, we decided to also examine the different items in the subscales independently. In addition, given perfectionism's perceived role in the etiology of ED (15), we also examined the items from the EDI-P. Based on a review

TABLE 2. The different symptoms associated with ED among athletes with and without an ED at pretest (phase I).

	ED $n = 28$	Non-ED[a] $n = 156$	P	Sensitivity	Specificity
Body dissatisfaction ≥14	15 (53.6)	19 (12.2)	<0.001	0.54	0.88
Drive for thinness ≥15	1 (3.6)	4 (2.6)	0.566	0.57	0.92
BMI underweight[b]	1 (4.3)	10 (6.8)	1.000	0.04	0.94
PWCM[c]	12 (42.9)	12 (7.7)	<0.001	0.43	0.92
Vomiting	10 (35.7)	8 (5.1)	<0.001	0.36	0.95
Diet pills	3 (10.7)	3 (1.9)	0.046	0.11	0.98
Diuretics	1 (3.6)	2 (1.3)	0.392	0.04	0.99
Laxatives	1 (3.6)	2 (1.3)	0.392	0.04	0.99
Amenorrhea[d]	4 (14.3)	17 (10.9)	0.533	0.14	0.89
Trying to lose weight now	19 (67.9)	29 (18.6)	<0.001	0.68	0.81
Tried to lose weight before ≥3 times	18 (64.3)	26 (16.8)	<0.001	0.64	0.83
Dieting[e]	24 (85.7)	40 (25.6)	<0.001	0.85	0.74

Results are given as numbers with percentage.
[a]Non-ED (athletes without an ED at the clinical interview at pretest).
[b]BMI underweight [corresponding to the underweight value by Cole et al. (8)].
[c]Total PWCM (vomiting, diet pills, laxatives, and/or diuretics) to lose weight.
[d]Amenorrhea (primary or secondary).
[e]Dieting (trying to lose weight now and/or tried to lose weight before ≥3 times).

TABLE 3. The different items included in the EDI-2 subscales body dissatisfaction, drive for thinness, and perfectionism among athletes with and without an ED at pretest.

Subscale/Item No.	ED $n = 28$	Non-ED $n = 156$	P	Included
EDI-Body dissatisfaction				
2. I think that my stomach is too big[a]	1.9 ± 1.2	0.6 ± 1.1	<0.001	X
9. I think that my thighs are too large	1.3 ± 1.2	0.6 ± 1.0	0.006	
12. I think that my stomach is just the right size[b]	1.5 ± 1.1	0.9 ± 1.0	0.006	
19. I feel satisfied with the shape of my body[a,b]	1.8 ± 0.9	0.8 ± 0.9	<0.001	X
31. I like the shape of my buttocks[b]	1.4 ± 1.2	0.8 ± 1.0	0.040	
45. I think my hips are too big	1.3 ± 1.2	0.4 ± 0.9	0.001	
55. I think that my thighs are just the right size[b]	1.7 ± 1.0	0.9 ± 1.0	<0.001	
59. I think my buttocks are too large	0.9 ± 1.2	0.3 ± 0.9	0.027	
62. I think that my hips are just the right size[b]	1.9 ± 0.9	1.0 ± 1.1	<0.001	
EDI-Drive for thinness				
1. I eat sweets and carbohydrates without feeling nervous[b]	1.3 ± 1.0	0.5 ± 0.8	<0.001	
7. I think about dieting	1.0 ± 1.0	0.3 ± 0.7	0.001	
11. I feel extremely guilty after overeating[a]	1.1 ± 1.3	0.4 ± 0.9	0.008	X
16. I am terrified of gaining weight	1.1 ± 1.2	0.4 ± 0.9	0.006	
25. I exaggerate or magnify the importance of weight	0.3 ± 0.6	0.2 ± 0.6	0.554	
32. I am preoccupied with the desire to be thinner[a]	1.1 ± 1.1	0.3 ± 0.7	0.001	X
49. If I gain a pound, I worry that I will keep gaining	0.8 ± 1.2	0.2 ± 0.7	0.033	
EDI-Perfectionism				
13. Only outstanding performance is good enough in my family	0.6 ± 1.0	0.2 ± 0.6	0.015	
29. As a child, I tried very hard to avoid disappointing my parents and teachers[c]	1.1 ± 1.3	0.4 ± 0.8	<0.001	X
36. I hate being less than best at things	0.9 ± 1.3	0.8 ± 1.1	0.701	
43. My parents have expected excellence of me[c]	0.9 ± 1.1	0.2 ± 0.6	<0.001	X
52. I feel that I must do things perfectly or not do them at all	0.1 ± 0.4	0.05 ± 0.3	0.037	
63. I have extremely high goals	1.8 ± 1.1	1.7 ± 1.2	0.730	

Higher scores indicate greater manifestation of the trait. Results are given as means with SD.
[a]Included in versions 1 and 2.
[b]Reversed scored.
[c]Included in version 2.

of the current evidence and the collective expertise of the authors, items that were not able to discriminate between athletes with ED and no ED at pretest, and items focusing on concerns most likely not being relevant for athletes, were eliminated (Table 3).

The next step was to determine the key items that may predict possible ED among athletes. Through group discussions, we ended up with nine items: two items from each of the EDI-DT, EDI-BD, and EDI-P subscales from the EDI-2, and the questions "Have you tried to lose weight?", "If yes, how many times have you tried to lose weight?", and "Are you trying to lose weight now?" from the symptoms associated with ED at risk criteria. This resulted in the Brief ED in Athletes Questionnaire (BEDA-Q) that we wanted to test further (from version 1 with seven items and version 2 with nine items) (Table 4).

As seen in Table 4, items from the EDI-DT and EDI-BD completed the variable EDI_4 in BEDA-Q version 1, whereas items from the EDI-DT, EDI-BD, and EDI-P completed the variable EDI_6 included in BEDA-Q version 2.

Predictive Ability of Versions 1 and 2 for a Diagnosis of ED

BEDA-Q versions 1 and 2 showed good ability in distinguishing between the female elite athletes with and without an ED at phase I with ROC areas of 0.83 (95% CI, 0.74–0.92) and 0.86 (95% CI, 0.78–0.93), respectively (Table 5). Version 2 improved with approximately 0.03 area units compared with version 1.

For version 1, we calculated the optimal cutoff point by using the probability score from the variables dieting and subscale 1, which maximized the product of sensitivity and specificity. The cutoff was 0.26 with a sensitivity of 85.7% (95% CI, 80.6–90.8) and specificity of 78.8% (95% CI, 73.0–84.7). This gave a positive likelihood ratio of 4.0 and a negative likelihood ratio of 0.2.

The optimal cutoff point for version II was 0.27 with a sensitivity of 82.1% (95% CI, 76.6–87.6) and specificity of 84.6% (95% CI, 79.4–89.8). For version 2, this gave a positive likelihood ratio of 5.3 and a negative likelihood ratio of 0.2.

Finally, we constructed individual predictive scores using the coefficients from the logistic models for versions 1 and 2 to classify athletes at risk for an ED if the score was greater than the optimal cutoff value and not at risk otherwise. The estimated probabilities of ED for versions 1 and 2 were calculated by the following formulas:

$$\text{prob}(\text{ED}) = \exp(\text{score})/[1 + \exp(\text{score})],$$
where the score =
Version 1: $-3.562 + ((0.135\,\text{EDI}_4) + (2.322 \times \text{variable dieting}))$
Version 2: $-3.712 + ((0.152\,\text{EDI}_6) + (2.142 \times \text{variable dieting}))$
Adjusted for over optimism =
Version 1: $-3.488 + ((0.132\,\text{EDI}_4) + (2.276 \times \text{variable dieting}))$
Version 2: $-3.634 + ((0.149\,\text{EDI}_6) + (2.099 \times \text{variable dieting}))$

Phase II

Validating BEDA-Q version 1 versus the external data set. Because no previous studies examining the prevalence of ED among adolescent female elite athletes have included items from the EDI-P subscale, we were only able to carry out an external validation for version 1. We used the regression coefficients from the derivation data set adjusted for overoptimism to estimate logistic scores and estimated probabilities of ED in the validation data by using the adjusted

TABLE 4. The different items included in BEDA-Q versions 1 and 2.

Items	ED $n = 28$	Non-ED $n = 156$	P	Version 1	Version 2
1 I feel extremely guilty after overeating (EDI-DT11)[a,c] □always □usually □ often □ sometimes □ rarely □never	1.1 ± 1.3	0.4 ± 0.9	<0.001	X	X
2 I am preoccupied with the desire to be thinner (EDI-DT32)[a,c] □always □usually □ often □ sometimes □ rarely □never	1.1 ± 1.1	0.3 ± 0.7	<0.001	X	X
3 I think that my stomach is too big (EDI-BD2)[a,c] □always □usually □ often □ sometimes □ rarely □never	1.9 ± 1.2	0.6 ± 1.0	<0.001	X	X
4 I feel satisfied with the shape of my body (EDI-BD19)[a,b] □always □usually □ often □ sometimes □ rarely □never	1.8 ± 0.9	0.8 ± 0.9	<0.001	X	X
5 My parents have expected excellence of me (EDI-P43)[c] □always □usually □ often □ sometimes □ rarely □never	0.9 ± 1.1	0.2 ± 0.6	<0.001		X
6 As a child, I tried very hard to avoid disappointing my parents and teachers (EDI-P29)[c] □always □usually □ often □ sometimes □ rarely □never	1.1 ± 1.3	0.4 ± 0.8	<0.001		X
7 Are you trying to lose weight now? □ Yes □No	19 (67.9)	29 (18.6)	<0.001	X	X
8 Have you tried to lose weight? □ Yes □No				X	X
9 If yes, how many times have you tried to lose weight? □ 1–2 □ 3–5 □ >5 times				X	X
Dieting (trying to lose weight now and/or tried before ≥3 times)	24 (85.7)	40 (25.6)	<0.001		

Results are given as means with SD or numbers with percentages, as appropriate. The responses on the EDI items six-point format are weighted from 0 to 3, and the scores are computed by summing the item scores. Positive scores are weighted as follows: 3 = always, 2 = usually, 1 = often, 0 = sometimes, 0 = rarely, 0 = never, and reverse-scored items are weighted in the opposite manner (17).
[a]Included as EDI_4 in BEDA-Q version 1.
[b]Reversed scored.
[c]Included as EDI_6 in BEDA-Q version 2. Highest possible score for EDI_4 was 12 and 18 for EDI_6.

formula above for version 1. The estimated probabilities were then used in the ROC analysis calculation for ED in version 1. The accuracy of version 1 was measured by the area under the ROC curve of 0.77 (95% CI, 0.63–0.91).

Phase III

The ability of BEDA-Q versions 1 and 2 to predict new cases of ED (posttest assessments). In this phase, we wanted to test the ability of BEDA-Q versions 1 and 2 to predict new cases of ED among the 53 athletes (100%) attending the posttest classified with no ED diagnosis at pretest attending the control schools. Seven of the 53 athletes (13.2%) had developed an ED during these 2 yr and were classified as new cases of ED at posttest. As shown in Table 5, version 2 showed slightly better diagnostic accuracy than version 1 with an area under the ROC curve of 0.73 (95% CI, 0.52–0.93) compared with 0.70 (95% CI, 0.48–0.92), respectively.

DISCUSSION

The main finding in this study was the ability of BEDA-Q versions 1 and 2 to distinguish between adolescent female elite athletes with and without an ED. Even though both versions appear well suited for screening purposes in this population with ROC areas above 80%, it is worth noticing that by adding the two items measuring the socially prescribed perfectionism from the EDI-P, the discriminative accuracy increased with approximately 0.03 area units for version 2 compared with version 1. It is difficult to interpret absolute differences in ROC area, but an improvement above 0.02 area units (more than 4%–5%) is regarded to be clinically important (22). Thus, version 2 consisting of nine items seems to be an even better suited version than version 1 in distinguishing between adolescent female elite athletes with and without an ED. However, both versions are inexpensive, are easy to understand, and showed valid results.

TABLE 5. Results of the logistic regression models of ED presented with OR per unit change of predictor variable, 95% CI, significance level (P), and AUC with 95% CI for BEDA-Q versions 1 and 2 at phases I and III among the athletes attending the Elite Sport High Schools.

Phase I ($n = 184$)	Odds Ratio (95% CI)	P	AUC (95% CI)
Version 1[a]			
Dieting	10.2 (2.9–35.9)	<0.001	
EDI_4	1.14 (0.99–1.33)	0.076	0.83 (0.74–0.92)
Version 2[b]			
Dieting	8.5 (2.5–29.3)	0.001	
EDI_6	1.2 (1.04–1.31)	0.011	0.86 (0.78–0.93)
Phase III ($n = 53$)	**Odds Ratio (95% CI)**	**P**	**AUC (95% CI)**
Version 1			
Dieting	3.8 (0.61–23.2)	0.152	
EDI_4	0.96 (0.67–1.36)	0.800	0.70 (0.48–0.92)
Version 2			
Dieting	4.6 (0.77–27.2)	0.094	
EDI_6	0.87 (0.62–1.24)	0.453	0.73 (0.52–0.93)

[a]Cronbach $\alpha = 0.83$.
[b]Cronbach $\alpha = 0.81$.

The relation between ED and perfectionism has been well established, and it may influence in an indirect manner (24). Among athletes, it is suggested that perfectionism as a personality trait combined with environmental and other factors may increase the risk of developing an ED (15). Both self-oriented perfectionism and socially prescribed perfectionism have been independently and positively related to ED among nonathletes (30), and it has been suggested that women high on socially prescribed and self-oriented perfectionism are especially vulnerable (30). However, few studies have explored this proposed relation in depth (15), and traditionally, EDI-DT and EDI-BD have been included in relation to self-developed questions when screening for symptoms associated with ED among elite athletes (28,37,39).

The increased accuracy found when including the socially prescribed perfectionism items measuring parent's expectations and avoiding disappointing parents and teachers are in line with previous research. Stoeber and Otto (32) reviewed the consequences of perfectionism among athletes and found that dimensions assessing evaluative concerns (e.g., concern over mistakes, perceived parental and coach pressure) are associated with negative consequences, whereas dimensions assessing a commitment to exceptionally high standards are associated with positive consequences. Furthermore, a recent longitudinal study following a large sample of adolescents age 15–19 yr over a period of 7–9 months showed that perceived parental expectations predicted longitudinal increases in socially prescribed perfectionism. In contrast, no such effect was found for self-oriented perfectionism or for parental criticism (9).

On the basis of the importance athletes tend to ascribe to coaches (29), and that the athletes in our study are at the early stages of their athletic career, it seems liable to suggest that those perceiving parental expectations may transfer these perceptions that also coaches have high expectations of them. If this is the case, these athletes will believe that other people's (in this case, coaches) acceptance will be contingent upon meeting these expectations being key characteristics of socially prescribed perfectionism (9).

Furthermore, in our study, most of the first year students attending the Elite Sport High Schools with an ED were diagnosed with EDNOS (n = 20, 71.4%) (28). Additionally, Hewitt et al. (20) found that social dimensions of perfectionism were broadly related to ED as well as self-esteem, whereas self-oriented perfectionism was related only to anorexic tendencies among female university students. In addition to the association between perfectionism and ED, a high level of socially prescribed perfectionism has shown strong and consistent positive correlations with negative affect, anxiety, suicidal ideation (10), and athlete burnout among adolescent elite athletes (21). Thus, the socially prescribed perfectionisms association to negative psychological outcomes (13) and its particular importance during adolescence (14) may explain version 2's higher discriminative accuracy than version 1 in distinguishing athletes with and without an ED. However, due to the cross-sectional nature of this part of the study, it is not possible to interpret causality. Whether the athletes with an ED diagnosis compared with the athletes without an ED diagnosis were more socially prescribed perfectionistic before they developed an ED, or whether this is a consequence or antecedent to the athletic participation itself, needs further investigation.

Concerning the external validity, an important next step in our study was to determine the BEDA-Q efficacy in discriminating between age-matched female elite athletes with and without an ED in the external data set. Unfortunately, there are no previous studies available including items from the EDI-P with a two-tiered approach (questionnaire screening and clinical interview) among female elite athletes. Therefore, we were only able to measure the external validity by using the estimated probabilities from the derivation data set in the ROC analysis calculations for ED in version 1. Version 1 showed high discriminating accuracy with an area under the ROC curve of 77%. Even though we were not able to test the external validity of version 2, there is reason to believe that it would have shown an even better discriminating ability than version 1 as shown in the derivation data set (phase I). This is further supported in phase III where the ability to predict new cases of ED (posttest assessments) increased with 0.03 area units by using version 2 instead of version 1.

The most effective way to reduce the incidence of ED among athletes is to prevent them from occurring in the first place. Thus, a valid screening instrument with the ability to predict new cases of ED among young athletes may be an important step in preventing ED, because treatment and recovery may not occur without identification (38). In the third phase of this study, we therefore wanted to determine the BEDA-Q's ability to predict new cases of ED. Because this is the first study among adolescent elite athletes with a prospective design aiming to determine BEDA-Q's ability to predict new cases of ED by posttest assessments, comparisons with other similar studies are not possible. In accordance with what we found in phase I, version 2 revealed a higher diagnostic accuracy than version 1. However, the number of athletes with an ED diagnosis at posttest was low (n = 7, 13.2%); thus, the CI is wide ranging between excellent and poor distinguishing ability. Our finding that version 2 also showed better diagnostic accuracy than version 1 is an important contribution to our understanding of the role social (parental) expectations play in the development of socially prescribed perfectionism as well as ED. Because the only difference between versions 1 and 2 is the two items measuring the athlete's perception that their parents expect them to be perfect, it implies that these items are probably essential to include in screening questionnaires for adolescent elite athletes.

An important question to answer when developing a new screening questionnaire is how accurate the test should be to be clinically useful. This is related to the prevalence of the disease in the subjects being tested, and in our case, the prevalence of ED among adolescent female elite athletes. For screening tests, negative results are not desirable,

whereas a moderate number of false-positive results are usually accepted. However, when it comes to diseases with high morbidity and mortality, the sensitivity of the test (detection of ED) is more important than the specificity (detection of healthy cases). In our study, we calculated the optimal cutoff value for BEDA-Q at which optimal balance between sensitivity and specificity is achieved. In phase I, BEDA-Q showed a high ability in both detecting athletes with an ED as well as athletes without an ED with sensitivity and specificity of 82.1% and 84.6%. In addition, the sensitivity and specificity of the symptoms associated with an ED previously used to classify the athletes in this article "at risk" and not "at risk" for an ED in our previous study (28) were 85.7% and 53.8%. This gave a positive likelihood ratio of 1.9 and a negative likelihood ratio of 0.3. Thus, an athlete with a positive score on the symptoms associated with an ED actually having an ED increases approximately 1.9 times, whereas the likelihood of having an ED with a score at or above the BEDA-Q cutoff is more than fivefold.

Methodological Considerations

The main strengths of this study are (a) recruitment of a large, nationally representative sample of female adolescent elite athletes representing a wide range of sport events, (b) that the clinical interview EDE considered to be the "gold standard" for diagnosing ED was used, and (c) that the tests' external predictive validity was measured to distinguish adolescent female elite athletes with and without an ED. This study does, however, also have some limitations that should be considered when interpreting the results, such as (a) the athletic groups included consist of adolescent female elite athletes exclusively and we do not know if the results can be generalized to male athletes or other age groups, (b) we were not able to carry out an external validation of BEDA-Q version 2, and (c) due to few new cases of athletes diagnosed with an ED, the test's prognostic ability need to be tested in a larger sample. Finally, referring to the purpose of this study (to design an accurate yet less comprehensive screening questionnaire with the ability to discriminate between adolescent female elite athletes with an ED from those without an ED), we carefully evaluated BEDA-Q against the 10 questions suggested by Greenhalgh (19) to evaluate the validation of different diagnostic and screening tests. The BEDA-Q fulfilled a total of nine out of these 10 questions. The only question we were not able to fulfill was the following: "Was the test shown to be reproducible?" Because the aim of our study was to develop and validate BEDA-Q as a possible new screening questionnaire among adolescent elite athletes, its reproducibility has not yet been assessed between observers. However, BEDA-Q had high internal consistency, with a Cronbach α of 0.81.

Implications and Applicability

It is well known that even though coaches are in a prime position to monitor their athletes' behavior and reactions, it may be challenging to determine whether the athletes' DE and dieting behaviors are transient, safely managed behaviors associated with the specific demands of the sport, or if the symptoms are more stable and signify a clinical ED. To facilitate early identification and treatment, we present in this study a brief and easy administrated screening questionnaire appearing well suited as a first step to identify adolescent elite athletes that may have an ED and are in need of further medical and psychological examination. For professionals working with athletes, BEDA-Q may be an important contribution in making it easier to identify those athletes in need for further examination.

In our study, most of the athletes diagnosed with an ED fulfilled the criteria for EDNOS, which is the most common ED encountered among athletes (28,39). This indicates that the athletes included are representative of the athletic population in which BEDA-Q is meant being used. However, it should be noted that the diagnostic criteria used in this study is based on the *DSM-IV* (1). The recent revision of the *DSM-V* has changed the distribution because it entails a lowering of thresholds for AN and BN, making binge eating (BED) a formal ED diagnosis and renaming EDNOS "feeding and eating conditions not elsewhere classified" along with some specifications for subtypes (4). Because we avoided evaluating our screening questionnaire in a sample in which the proportion of cases is artificially high, and the items included from the EDI in our screening questionnaire ask for psychological concepts rather than ED symptoms, we expect BEDA-Q to work equally good in distinguishing athletes with and without an ED in the *DSM-V* as in the *DSM-IV*.

BEDA-Q has revealed very promising psychometric and predictive features when it comes to distinguishing adolescent elite athletes with and without ED. However, more studies are needed including larger samples, athletes with different competitive levels and both gender represented, to further confirm these results and also to test the predictive ability of BEDA-Q.

CONCLUSION

This study shows that BEDA-Q containing nine items is a well-suited screening questionnaire to distinguish between adolescent female elite athletes with and without an ED. This new screening questionnaire (BEDA-Q) may also be a useful instrument for predicting new cases of ED. Socially prescribed perfectionism among athletes and its relation to ED should be further investigated.

The research reported in this article was supported by Oslo Sports Trauma Research Center and through a grant from the Norwegian Olympic Sports Center (Olympiatoppen). The Oslo Sports Trauma Research Center has been established through generous grants from the Eastern Norway Regional Health Authority, the International Olympic Committee, The Royal Norwegian Ministry of Culture, Norsk Tipping AS, and the Norwegian Olympic Committee and Confederation of Sport. There are no potential conflicts of interest.

The research reported in this article was supported by Oslo Sports Trauma Research Center and through a grant from the Norwegian Olympic Sports Center (Olympiatoppen). The Oslo Sports Trauma Research Center has been established through generous grants from the Eastern Norway Regional Health Authority, the International Olympic Committee, The Royal Norwegian Ministry of Culture, Norsk Tipping AS, and the Norwegian Olympic Committee and Confederation of Sport.

There are no potential conflicts of interest.

The results of the study do not constitute endorsement by the American College of Sports Medicine.

REFERENCES

1. American Psychiatric Association. Eating Disorders. *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*. Washington (DC): American Psychiatric Association; 1994. p. 539–50.
2. Beals KA. *Disordered eating among athletes: a comprehensive guide for health professionals*. Champaign (IL): Human Kinetics; 2004. p. 255.
3. Beals KA, Manore MM. Disorders of the female athlete triad among collegiate athletes. *Int J Sport Nutr Exerc Metab*. 2002;12(3):281–93.
4. Birgegard A, Norring C, Clinton D. DSM-IV versus DSM-5: implementation of proposed DSM-5 criteria in a large naturalistic database. *Int J Eat Disord*. 2012;45(3):353–61.
5. Bonci CM, Bonci LJ, Granger LR, et al. National athletic trainers' association position statement: preventing, detecting, and managing disordered eating in athletes. *J Athl Train*. 2008;43(1):80–108.
6. Byrne S, McLean N. Eating disorders in athletes: a review of the literature. *J Sci Med Sport*. 2001;4(2):145–59.
7. Byrne S, McLean N. Elite athletes: effects of the pressure to be thin. *J Sci Med Sport*. 2002;5(2):80–94.
8. Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. *Br Med J*. 2007;335(7612):194–7.
9. Damian LE, Stoeber J, Negru O, B-âban A. On the development of perfectionism in adolescence: perceived parental expectations predict longitudinal increases in socially prescribed perfectionism. *Pers Individ Dif*. 2013;55(6):688–93.
10. Enns MW, Cox BJ. The nature and assessment of perfectionism: a critical analysis. In: Flett GL, Hewitt PL, editors. *Perfectionism*. Washington (DC): American Psychological Association; 2002. p. 33–62.
11. Fairburn CG, Bohn K. Eating disorder NOS (EDNOS): an example of the troublesome "not otherwise specified" (NOS) category in DSM-IV. *Behav Res Ther*. 2005;43(6):691–701.
12. Fairburn CG, Cooper Z, O'Connor ME. Eating disorder examination (Edition 16.0D). In: Fairburn CG, editors. *Cognitive Behavior Therapy and Eating Disorders*. New York: The Guilford Press; 2008. p. 265–308.
13. Flett GL, Hewitt PL. The perils of perfectionism in sports and exercise. *Curr Dir Psychol Sci*. 2005;14(1):14–8.
14. Flett GL, Hewitt PL, Oliver JM, Macdonald S. Perfectionism in children and their parents: a developmental analysis. In: Flett GL, Hewitt PL, editors. *Perfectionism: Theory, Research, and Treatment*. Washington (DC): American Psychological Association; 2002. p. 88–132.
15. Forsberg S, Lock J. The relationship between perfectionism, eating disorders and athletes: a review. *Minerva Pediatr*. 2006;58(6):525–36.
16. Friborg O, Clausen L, Rosenvinge JH. A five-item screening version of the Eating Disorder Inventory (EDI-3). *Compr Psychiatry*. 2013;54(8):1222–8.
17. Garner DM. *Eating Disorder Inventory-2: Professional Manual*. Odessa (FL): Psychological Assessment Resources; 1991. IV, 70 p.
18. Gould D, Dieffenbach K, Moffett A. Psychological characteristics and their development in Olympic champions. *J Appl Sport Psychol*. 2002;14(3):172–204.
19. Greenhalgh T. How to read a paper—papers that report diagnostic or screening tests. *Br Med J*. 1997;315(7107):540–3.
20. Hewitt PL, Flett GL, Ediger E. Perfectionism traits and perfectionistic self-presentation in eating disorder attitudes, characteristics, and symptoms. *Int J Eat Disord*. 1995;18:317–26.
21. Hill AP, Hall HK, Appleton PR. Perfectionism and athlete burnout in junior elite athletes: the mediating role of coping tendencies. *Anxiety Stress Coping*. 2010;23(4):415–30.
22. Holme I, Pedersen TR, Boman K, et al. A risk score for predicting mortality in patients with asymptomatic mild to moderate aortic stenosis. *Heart*. 2012;98(5):377–83.
23. Hopkinson R, Lock J. Athletics, perfectionism, and disordered eating. *Eat Weight Disord*. 2004;(9):99–106.
24. Keel PK, Forney KJ. Psychosocial risk factors for eating disorders. *Int J Eat Disord*. 2013;46(5):433–9.
25. Lampard AM, Byrne SM, McLean N, Fursland A. The Eating Disorder Inventory-2 Perfectionism scale: factor structure and associations with dietary restraint and weight and shape concern in eating disorders. *Eat Behav*. 2012;13(1):49–53.
26. Martinsen M, Bahr R, Børresen R, Holme I, Pensgaard AM, Sundgot-Borgen J. Preventing eating disorders among young athletes: a randomized controlled trial. *Med Sci Sports Exerc*. 2014; 46(3):435–47.
27. Martinsen M, Bratland-Sanda S, Eriksson AK, Sundgot-Borgen J. Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. *Br J Sports Med*. 2010;44(1):70–6.
28. Martinsen M, Sundgot-Borgen J. Higher prevalence of eating disorders among adolescent elite athletes than controls. *Med Sci Sports Exerc*. 2013;45(6):1188–97.
29. Pensgaard AM, Roberts GC. Elite athletes' experiences of the motivational climate: the coach matters. *Scand J Med Sci Sports*. 2002;12(1):54–9.
30. Sherry SB, Hewitt PL, Besser A, Mcgee BJ, Flett GL. Self-oriented and socially prescribed perfectionism in the Eating Disorder Inventory Perfectionism Subscale. *Int J Eat Disord*. 2004;35(1):69–79.
31. Stice E. Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol Bull*. 2002;128(5):825–48.
32. Stoeber J, Otto K. Positive conceptions of perfectionism: approaches, evidence, challenges. *Pers Soc Psychol Rev*. 2006;10(4):295–319.
33. Sundgot-Borgen J, Larsen S. Pathogenic weight-control methods and self-reported eating disorders in female elite athletes and controls. *Scand J Med Sci Sports*. 1993;3:150–5.
34. Sundgot-Borgen J. Prevalence of eating disorders in elite female athletes. *Int J Sport Nutr*. 1993;3(1):29–40.
35. Sundgot-Borgen J. Risk and trigger factors for the development of eating disorders in female elite athletes. *Med Sci Sports Exerc*. 1994;26(4):414–9.
36. Sundgot-Borgen J, Meyer NL, Lohman TG, Ackland TR, Maughan RJ, Muller W. How to minimize the health risks to athletes who compete in weight-sensitive sports. Review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition Health and Performance, under the auspices of the I.O.C. Medical Commission. *Br J Sports Med*. 2013;47:1012–22.
37. Sundgot-Borgen J, Torstveit MK. Prevalence of eating disorders in elite athletes is higher than in the general population. *Clin J Sport Med*. 2004;14(1):25–32.
38. Thompson RA, Trattner Sherman R. *Eating Disorders in Sport*. New York: Routledge; 2010. p. 284.
39. Torstveit MK, Rosenvinge JH, Sundgot-Borgen J. Prevalence of eating disorders and the predictive power of risk models in female elite athletes: a controlled study. *Scand J Med Sci Sports*. 2008; 18(1):108–18.
40. Torstveit MK, Sundgot-Borgen J. The female athlete triad exists in both elite athletes and controls. *Med Sci Sports Exerc*. 2005;37(9): 1449–59.
41. Van Houwelingen JC, Le Cessie S. Predictive value of statistical models. *Stat Med*. 1990;9(11):1303–25.

Appendix 1

Approval from the Regional Committees for Medical Research Ethics

UNIVERSITETET I OSLO

DET MEDISINSKE FAKULTET

Professor Jorunn Sundgot-Borgen
Norges Idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 Oslo

Regional komité for medisinsk og helsefaglig forskningsetikk Sør-Øst D (REK Sør-Øst D)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 22 85 05 93
Telefaks: 22 85 05 90
E-post: i.m.middelthon@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 17.09.08
Deres ref.:
Vår ref.: S-08442d. 1008/10620

Vedr. svar på merknader for studien "Er det mulig å forebygge spiseforstyrrelser i idretten?"

Komiteen behandlet søknaden 04.09.08. Prosjektet er vurdert etter lov om behandling av etikk og redelighet i forskning av 30. juni 2006, jfr. Kunnskapsdepartementets forskrift av 8. juni 2007 og retningslinjer av 27. juni 2007 for de regionale komiteer for medisinsk og helsefaglig forskningsetikk.

Komiteen har følgende merknader til informasjonsskrivene:
I informasjonsskrivet gis det forhåpninger om at intervju kan gjøres for dem som måtte ha behov for det. I og med at det på dette tidspunkt er uklart om denne delen av studien skal gjennomføres, bør man la være å ta det med. Det korrekte vil være å be om samtykke til at deltakerne kan kontaktes for intervju i en annen studie. Dette meldes REK som en endring av gjeldende studie.

Infoskrivet til ungdommene gir etter komiteens vurdering ikke deltakerne god nok informasjon om egne rettigheter ved deltakelse i studien. Det bes om at skrivene revideres og at REKs mal for informasjonsskriv benyttes. Malen forefinnes på http://www.etikkom.no/REK/skjemaer/forskerportal/infoskriv

Informasjonsskrivet har mange skrivefeil og må korrekturleses.

Vedtak:
Prosjektet godkjennes under forutsetning av at merknadene som er anført ovenfor blir innarbeidet før prosjektet settes i gang.

Vedtaket var enstemmig

Komiteenes vedtak etter Forskningsetikklovens § 4 kan påklages (jfr. forvaltningsloven § 28) til Den nasjonale forskningsetiske komité for medisin og helsefag. Klagen skal sendes REK Sør-Øst D(jfr. forvaltningsloven § 32). Klagefristen er tre uker fra den dagen du

mottar dette brevet (jfr. forvaltningsloven § 29).

Med vennlig hilsen

Stein A. Evensen (sign.)
Professor dr.med.
Leder

Ingrid Middelthon
Komitésekretær

UNIVERSITETET I OSLO

DET MEDISINSKE FAKULTET

Professor Jorunn Sundgot-Borgen
Norges Idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 Oslo

Regional komité for medisinsk og helsefaglig forskningsetikk Sør-Øst D (REK Sør-Øst D)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 22 85 05 93
Telefaks: 22 85 05 90
E-post: i.m.middelthon@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 26.01.09
Deres ref.:
Vår ref.: S-08442d, 2008/10620

Vedr. endringssøknad for studien "Er det mulig å forebygge spiseforstyrrelser i idretten?"

Vi viser til e-post og endringssøknad av 16.01.09.

Komiteen behandlet endringssøknaden 19.01.09. Prosjektet er vurdert etter lov om behandling av etikk og redelighet i forskning av 30. juni 2006, jfr. Kunnskapsdepartementets forskrift av 8. juni 2007 og retningslinjer av 27. juni 2007 for de regionale komiteer for medisinsk og helsefaglig forskningsetikk.

Komiteen har ingen innvendinger mot endret sammensetning av kontrollgruppen, men kan ikke støtte at man skal unnlate å forespørre foreldrene til personer i kontrollgruppen. Dette kunne bl.a. føre til rekrutteringen til kontrollgruppen avviker fra rekrutteringen til studiegruppen. Komiteen kan heller ikke se at dette byr på særlige praktiske problemer på denne måte å sikre at rekrutteringsgrunnlaget blir likt.

Vedtak
Prosjektet godkjennes slik det nå fremstår under forutsetning av at merknaden som er anført ovenfor blir innarbeidet før prosjektet settes i gang.

Komiteenes vedtak etter Forskningsetikklovens § 4 kan påklages (jfr. forvaltningsloven § 28) til Den nasjonale forskningsetiske komité for medisin og helsefag. Klagen skal sendes REK Sør-Øst D(jfr. forvaltningsloven § 32). Klagefristen er tre uker fra den dagen du mottar dette brevet (jfr. forvaltningsloven § 29).

Med vennlig hilsen

Stein A. Evensen (sign.)
Professor dr.med.
leder

Ingrid Middelthon
komitésekretær

UNIVERSITETET I OSLO

DET MEDISINSKE FAKULTET

Marianne Martinsen
Dampsagveien 9
2004 Lillestrøm

Regional komité for medisinsk og helsefaglig forskningsetikk Sør-Øst D (REK Sør-Øst D)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 22 85 05 93
Telefaks: 22 85 05 90
E-post: i.m.middelthon@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 11.08.10
Deres ref.:
Vår ref.: S-08442d, 2009/618

"Er det mulig å forebygge spiseforstyrrelser i idretten?"

Det vises til endringssøknad av 11.08.10 for det ovenfor nevnte forskningsprosjekt.

Prosjektleder er stipendiat Marianne Martinsen.

Forskningsansvarlig er Norges Idrettshøgskole, ved øverste administrative ledelse.

Det vises til endringene som er gjort i prosjektet i forhold til intervju av prosjektdeltakerne, jf. beskrivelsen i endringssøknaden.

Vedtak:
Komiteen har vurdert endringssøknaden og godkjenner prosjektet slik det foreligger med hjemmel i helseforskningsloven § 11.

Komiteen ber imidlertid om å få tilsendt de informasjonsskrivene som benyttes i prosjektet til orientering.

Tillatelsen er gitt under forutsetninga av at prosjektet gjennomføres slik det er beskrevet i søknaden, oppdatert protokoll og de bestemmelser som følger av helseforskningsloven med forskrifter.

Dersom det skal gjøres endringer i prosjektet i forhold til de opplysninger som er gitt i søknaden må prosjektleder sende endringsmelding til REK. Vi gjør oppmerksom på at hvis endringene er vesentlige må prosjektleder sende ny søknad, eller REK kan pålegge at dette gjøres.

For øvrig gjelder de vilkår som er satt i forbindelse med tidligere godkjenning av prosjektet.

REK har gått over til elektronisk saksbehandling og fått ny saksportal: http://helseforskning.etikkom.no. Vi ber om at svar på merknader og henvendelser til REK

sendes inn via denne portalen eller på epost: post@helseforskning.etikkom.no. Vennligst oppgi REKs saksnummer.

Med vennlig hilsen

Stein A. Evensen (sign.)
Professor dr.med.
leder

Ingrid Middelthon
seniorrådgiver

Kopi;
- Norges idrettshøgskole ved øverste administrative ledelse.

Appendix 2

Approval from the Norwegian Social Science Data Services

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Jorunn Sundgot-Borgen
Seksjon for idrettsmedisinske fag
Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 OSLO

Vår dato: 19.08.2008	Vår ref: 19426 / 2 / AMS	Deres dato:	Deres ref:

TILRÅDING AV BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 10.06.2008. Meldingen gjelder prosjektet:

19426	*Er det mulig å forebygge spiseforstyrrelser i idretten?*
Behandlingsansvarlig	*Norges idrettshøgskole, ved institusjonens øverste leder*
Daglig ansvarlig	*Jorunn Sundgot-Borgen*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/-helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://www.nsd.uib.no/personvern/prosjektoversikt.jsp.

Personvernombudet vil ved prosjektets avslutning, 01.01.2012, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Bjørn Henrichsen

Anne-Mette Somby

Kontaktperson: Anne-Mette Somby tlf: 55 58 33 48
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

19426

Personvernombudet finner at behandlingen kan finne sted med hjemmel i personopplysningsloven §§ 8 første ledd (samtykke) og 9 a.

I tillegg til prosjektleder skal Laila Schneider, psykiater (Olympiatoppen) og Marianne Martinsen, mastergradstudent ved Norges idrettshøgskole ha tilgang til datamaterialet på lik linje med prosjektleder.

Utvalget består av : 1. Unge utøvere på høyt nivå. Totalpopulasjonen (n=700) er elever ved gymnaser med toppidrett og toppidrettslinjer i Norge(n=16) som starter i 1. klasse høsten 2008. De er i alderen 16-17 år ved inklusjon. 2. Lærere og trenere på de ulike gymnasene med toppidrett: Alle trenere og lærere i idrett - og aktivitetsfag på de ulike gymnasene med toppidrett, vil bli forespurt om å delta i prosjektet (n=150).

Det skal registreres sensitive opplysninger om helseforhold jf. personopplysningsloven § 2 pkt. 8 c.

Lærere, elever og foreldre får skriftlig informasjon om prosjektet. Informasjonsskrivene er tilfredstillende utformet i henhold til personopplysningsloven etter revisjon, jf. e-post mottatt 18.08.2008. Ombudet finner at opplegget for informasjon og innhenting av samtykke er godt ivaretatt ved at foreldrene skal avgi aktivt samtykke til at eleven kan delta ved å signere samtykkeskjemaet. Lærere og elever skal på samme måte avgi aktivt samtykke til deltakelse i prosjektet.

Det kan bli aktuelt å gjennomføre intervjuer med deltakerne på et senere tidspunkt. Det vil da bli innhentet nytt samtykke, og ombudet ber om at informasjonsskriv sendes til ombudet for gjennomlesing før det tas kontakt med deltakerne på nytt.

Ved prosjektslutt 01.01.2012 skal datamaterialet anonymiseres. Det innebærer at direkte og indirekte personidentifiserende opplysninger skal slettes, grovkategoriseres eller omskrives. Navneliste/koplingsnøkkel skal slettes.

Ombudet legger til grunn at prosjektet godkjennes av Regional komité for medisinsk og helsefaglig forskningsetikk (REK) og ber om at godkjenningen ettersendes.

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Marianne Martinsen
Seksjon for idrettsmedisinske fag
Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 OSLO

Vår dato: 11.03.2013 Vår ref: 19426 HIT/LR Deres dato: Deres ref:

AVSLUTTET SAKSBEHANDLING

Personvernombudet for forskning viser til statusrapport mottatt 18.01.2013 for prosjektet:

19426 *Er det mulig å forebygge spiseforstyrrelser i idretten?*

Jf. brev fra REK sør-øst datert 30.04.2010 faller prosjektet inn under helseforskningslovens bestemmelser. Søknad om aktuelle endringer dermed skal behandles av REK.

Personvernombudet avslutter dermed saksbehandlingen av statusrapporten uten realitetsbehandling.

Vi gjør samtidig oppmerksom på at vi avslutter all videre oppfølging av prosjektet.

Personvernombudet minner om at endringene i prosjektet ikke kan iverksettes før nødvendige tillatelser fra rette instanser foreligger. Dersom endringene vurderes av REK til å falle utenfor helseforskningsloven, må det gis melding til personvernombudet om dette, slik at vi kan vurdere endringene etter personopplysningsloven.

Ta gjerne kontakt dersom noe er uklart.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Hildur Thorarensen

Kontaktperson: Hildur Thorarensen tlf: 55 58 26 54

Appendix 3

Study information and consent forms (examples from the Elite Sport High Schools)

NORGES IDRETTSHØGSKOLE

Jorunn Sundgot-Borgen
Norges Idrettshøgskole
Pb 4014 Ullevål Stadion
0806 Oslo

NIH, 31.07. 2008

xxx vgs v/ Rektor xx
xxxxx

Prosjekt som har til hensikt å forebygge spiseforstyrrelser blant elever som utøver toppidrett

Jeg ønsker med dette prosjektet, sammen med min masterstudent Marianne Martinsen, å undersøke elevenes forhold til kropp, vekt, ernæring og relasjoner. Inkludert i denne delen er også en kartlegging av forekomst av spiseforstyrrelser. Primært vil det dreie seg om en spørreskjemaundersøkelse i forkant av intervensjonsdelen. Men, dersom det skulle vise seg at det er en høy forekomst av elever/utøvere som viser risiko i forhold til at en kan mistenke spiseforstyrrelser og dersom vi får bevilget mer midler til studien vil det bli foretatt klinisk intervju av et utvalg av elevene etter at foreldrene og elevene eventuelt har samtykket.

Videre vil vi teste ut et undervisningsopplegg som er forventet å ha en forebyggende effekt i forhold til utvikling av forstyrret spiseatferd.

I forbindelse med kartleggingsdelen kan det dukke opp elever/utøvere som ønsker snakke med en voksen fordi de opplever å ha et problem. Vi ber derfor om at du på din skole utnevner en kontaktperson (sosiallærer, helsesøster, skolelege eller idrettslærer) som vi kan informere foreldre og elever om at er tilgjengelig for en samtale/telefon. I neste omgang vil prosjektleder være behjelpelig med en viderehenvising til profesjonelt hjelpeapparat dersom det skulle være behov for det.
Norges idrettshøgskole og Olympiatoppen vil stille med forelesere/workshops som kan byttes ut med ulike deltema dere allerede har på timeplanen. Vi vil være fleksible i forhold til Deres timeplaner.

Din skole er trukket ut som aktiv deltaker/kontrollskole.
For aktiv skole vil det innebære totalt 16 sesjoner for lærere og 16 sesjoner for elever i første og neste års andre klasser. Det samme gjelder for lærerne/trenerne. Elever og lærere blir også forespurt om å besvare et batteri av spørreskjema før start og 3 påfølgende ganger. Det tar ca 30 min hver gang.
For kontrollskoler innebærer undersøkelsen kun besvarelse av spørreskjema fire ganger.

Vi håper på velvillig respons på forespørselen om deltagelse. Prosjektet søkes til rått av Etisk Komité, og resultatene vil bli publisert nasjonalt og internasjonalt.

For å få svar på problemstillingene, har vi tilfeldig valgt ut alle skoler med toppidrett som fag og dernest tilfeldig trukket skoler til aktive deltakere og kontroller.
En høy svarprosent er viktig for å sikre kvaliteten i studien, den enkleste måten å få til det er at en av oss møter opp på skolen og lar elevene fylle ut skjemaene der og da.

Elevene svarer anonymt og data vil oppbevares avidentifisert, men prosjektleder kan spore opp til deres identitet. Dette for å kunne kontakte de av elevene som i spørreskjemaet gir uttrykk for at de trenger/ønsker hjelp til et spiseproblem. Det er helt frivillig for hver elev om han/hun vil delta i undersøkelsen, og for elever under 18 år vil foreldre/foresatte motta et informasjonsskriv om undersøkelsen. Foreldrene må samtykke skriftlig i deltagelse.

Vi vet av erfaring at noen vil oppsøke hjelpeapparatet etter en spørreskjemaundersøkelse som denne, og vil av den grunn gi elevene forslag om hvor de kan henvende seg. I den sammenheng ønsker vi

også å innlemme helse- og sosialtjenesten ved skolen. Vi beklager at vi dessverre ikke har kapasitet til å ta oss av elever med problematiske forhold til mat eller vekt, men vi vil bidra til at de blir henvist videre i helsevesenet dersom det skulle være behov.
Vi vil også tilby en temadag om fysisk aktivitet, kosthold og spiseforstyrrelser i samarbeid med og arrangert på Deres skole.

Vi håper med dette skrivet å få til et positivt samarbeid med Deres skole, og at vi får anledning til å kontakte kontaktlærerne i hver av de aktuelle 1. klassene. Vi ønsker at Dere tar kontakt med oss på; tlf; 918 13 348 eller e-post marianne.martinsen@student.nih.no innen 25.08.08. Har vi ikke hørt fra Dere innen denne datoen, tar en av oss direkte kontakt.

På forhånd takk!
Med vennlig hilsen

Jorunn Sundgot-Borgen
Professor

Marianne Martinsen
Masterstudent

NORGES IDRETTSHØGSKOLE

Jorunn Sundgot-Borgen
Norges Idrettshøgskole
Pb 4014 Ullevål Stadion
0806 Oslo

NIH, xxxx

Hei xxxx

Da skjønner vi at dere ønsker å være med på vår kartlegging av elever og trenere/læreres forhold til idrett, helse, kropp og prestasjon.

Vi vil nå komme med en del praktisk informasjon rundt selve spørreundersøkelsen og foredraget dere nå har takket ja til.

Spørreskjemaet er beregnet på alle 1.klassingene og alle trenere/lærere som underviser i idrettsfag, treningslærefag og naturfag.
Selve spørreundersøkelsen vil ta ca 60 minutter iberegnet praktisk informasjon om undersøkelsen og selve utfyllingen. Foredraget tar i utgangspunktet 1.5 time, men dette kan tilpasses etter ønske. Vi vil starte med spørreundersøkelsen og avslutte med foredraget.

Det mest praktiske er om alle fyller ut spørreskjemaet samtidig mens vi er tilstedet. Da vil vi kunne være tilgjengelig ved eventuelle spørsmål og lignende. Dersom det er vanskelig å få samlet alle aktuelle lærere/trenere på trinnet til dette, kan de eventuelt gjøre dette elektronisk. Det beste for oss vil være om alle kan fylle ut undersøkelsen den dagen vi er tilstedet.

For å kunne gjennomføre spørreundersøkelsen trenger vi før vi kommer til skolen aktiv tilbakemelding fra elevene og trenere/lærere om de ønsker å delta. Elever som er under 18 år må også ha tillatelse fra foreldre/foresatte. Dersom dere ønsker det, kan vi tilby oss å sende informasjon om kartleggingen med tilbud om deltakelse direkte til elevenes foresatte og lærere/trenere på 1.trinn. Hvis dette er ønskelig, trenger vi en oversikt over foresatte, elever under 18 år og lærere/treneres mailadresser.

Uavhengig av dette vil vi også trenge en oversikt over antall elever og trenere/lærere som er aktuelle for undersøkelsen og deres fulle navn. Elevene og trenerne/lærerne er sikret full anonymitet, men av etiske grunner er jeg (Sundgot-Borgen) som prosjektleder forpliktet til å kunne spore opp til deltakernes identitet dersom deltakeren gir uttrykk for at han/hun trenger eller ønsker hjelp til et eventuelt spiseproblem. På selve spørreskjemaet vil navnet være erstattet av en kode, slik at det kun vil være jeg som prosjektleder som kan spore opp identiteten. Som forskere er vi underlagt taushetsplikt.

I forbindelse med kartleggingsdelen kan det dukke opp elever/utøvere som ønsker å snakke med en voksen, fordi de opplever å ha et problem. Vi ber derfor om at dere utnevner en kontaktperson (sosiallærer, helsesøster, skolelege eller idrettslærer), som vi kan informere foreldre og elever om at er tilgjengelig for en samtale/telefon. I neste omgang vil prosjektleder være behjelpelig med en samtale, veiledning og eller en videre henvisning til profesjonelt hjelpeapparat dersom det skulle være behov for det.

Dette er del av et større forskningsarbeid og resultatene skal publiseres internasjonalt og anvendes. Ved slik publisering vil ikke resultatene kunne spores i forhold til personer og/eller hvilken skole de eventuelt går/jobber på. I dagens mediehverdag driver journalister aktiv research i de internasjonale tidskriftene og finner resultatene og vil ofte ha kommentarer på

dette, men, som nevnt vil da resultatene ikke kunne knyttes direkte opp til Deres skole eller Deres elever og/eller trenere/lærere.

I etterkant av at vi var i kontakt med dere sist, har vi allikevel fått tildelt midler til å kunne gjennomføre tidligere nevnte intervensjonsprosjekt som har til hensikt å kartlegge hvordan et sett med undervisningsopplegg/workshops vedrørende temaer som; treningslære, kroppssammensetning, idrettsernæring og kommunikasjon påvirker elevenes og trenerne/lærernes forhold til egen kropp, mat, selvfølelse og relasjoner. Dette prosjektet vil ikke settes i gang før i januar, og vi vil komme tilbake med en ny henvendelse i desember på om deres skole også ønsker å delta i del to av dette prosjektet (intervensjon).

Ut ifra deres ønsker og vår logistikk kan vi tilby dere følgende tidspunkt for spørreskjemaundersøkelse og foredrag; xxxxx. Vi trenger en tilbakemelding på om dette passer innen xxxxx.
Dersom det ikke skulle passe er det tidsbesparende om dere gir oss noen alternativer innen denne fristen.

NB! Husk også navneliste og mailadressene til elever, lærere/trenere og elevenes foresatte innen xxxx.

Med vennlig hilsen

Jorunn Sundgot – Borgen

Marianne Martinsen
(masterstudent)

NORGES IDRETTSHØGSKOLE

Til: Foreldre/foresatte med elever under 18 år

Fra: Professor Jorunn Sundgot-Borgen, Stipendiat Audun Eriksson og Masterstudent Marianne Martinsen

Dato: xxxxxxx

Forespørsel til Ditt barn om deltagelse i spørreundersøkelse om idrett, helse, kropp og prestasjon.

Vi ønsker å kartlegge hvilket forhold elever og trenere/lærere i 1. klasse på toppidrettsgymnas/videregående med toppidrett har til: idrett, helse, kropp og prestasjon. Via denne spørreskjemaundersøkelsen vil vi også undersøke treningsmengde, kostholdsvaner, helse, skader og spiseatferd.

Skolen hvor Deres barn er elev har allerede takket ja til å delta på spørreskjemaundersøkelsen, og vil legge til rette for gjennomføringen. Vi vil være tilstede under selve gjennomføringen, og det vil bli gitt et første foredrag om idrett, helse, ernæring og prestasjon. Dette fordi vi vet at mange av de unge elevene har noen utfordringer i forhold til å gjøre smarte valg i en hektisk skole og treningshverdag.

Dersom det skulle vise seg at en høy andel av elevene via spørreskjema viser symptomer på forstyrret spiseatferd, vil et tilfeldig utvalg av elever med og uten symptomer på spiseforstyrrelser bli forespurt om å være med på et intervju. Det vil i så fall komme en ny henvendelse til Dere som foreldre/foresatte dersom dette blir aktuelt. Det betyr at det å samtykke til deltagelse i denne spørreskjemaundersøkelsen ikke inkluderer et samtykke til et intervju.

I tillegg til kartleggingen vil vi teste ut et undervisningsopplegg som totalt skal ha den hensikt at elevene får kunnskap knyttet til tema hvor det er forventet at økt kunnskap vil kunne bidra til blant annet helse- og prestasjonsfremmende vaner når det gjelder kosthold og trening, og redusere risiko for utvikling av spiseforstyrrelser.

Vi gjør oppmerksom på at det er helt frivillig å delta i spørreskjemaundersøkelsen, og at elevene kan trekke seg når som helst. Elevene er sikret full anonymitet, men som prosjektleder er jeg (Jorunn Sundgot-Borgen) forpliktet til å kunne spore opp til deltakerens identitet dersom han/hun gir uttrykk for at han/hun ønsker hjelp til et eventuelt spiseproblem. På selve spørreskjema vil navnet derfor være erstattet av en kode, slik at det kun vil være jeg som prosjektleder som kan spore opp identiteten. Som forskere er vi underlagt taushetsplikt.

Elever som i spørreskjema krysser av for at han/hun ønsker samtale/veiledning fordi han/hun har et problematisk forhold til mat, vil få tilbud om dette av prosjektledelsen.

Prosjektleder kan ikke ta ansvar for langvarig behandling om så skulle være av behov, men vil bidra til å henvise eleven videre for hjelp.
Skolen vil i tillegg i forbindelse med undersøkelsen utnevne en kontaktperson, som vil være tilgjengelig for en samtale ved behov.

Alle opplysningene som er samlet inn vil bli anonymisert ved prosjektets avslutning. Oversikten over deltakere i prosjektet vil bli slettet.

Prosjektet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste (NSD) og det er godkjent av Regional komité for medisinsk og helsefaglig forskningsetikk (REK).

Fra Dere foreldre/foresatte må vi ha en aktiv tilbakemelding om at det er i orden at Ditt barn deltar i undersøkelsen eller ikke. Dersom ditt barn ikke ønsker delta vil han/hun ikke få tildelt skjema. Denne tilbakemeldingen ønsker vi at Dere sender oss som retur på denne mailen så raskt som mulig og innen tirsdag xxxxxx, da undersøkelsen skal gjennomføres xxxxxxxxxx.

Dersom vi ikke har hørt noe fra Dere innen denne fristen, tillater vi oss å ta ny kontakt.

På forhånd takk.

Vennlig hilsen

Jorunn Sundgot-Borgen	Audun Eriksson	Marianne Martinsen
Professor	Stipendiat	Masterstudent
Jorunn.Sundgot-Borgen@nih.no	audun.eriksson@nih.no	marianne.martinsen@student.nih.no

NORGES IDRETTSHØGSKOLE

Til deg som er idrettsutøver

Kan du tenke deg å delta i et prosjekt om idrett, helse, kropp og prestasjon?

Du og alle førsteklassinger på Toppidrettsgymnas/videregående skoler med toppidrett inviteres til å bli med i en spørreundersøkelse om idrett, helse, kropp og prestasjon.
Vi ønsker å kartlegge hvilket forhold elever og trenere/lærere i 1. klasse på toppidrettsgymnas/videregående med toppidrett har til: idrett, helse, kropp og prestasjon.
Via denne spørreskjemaundersøkelsen vil vi også undersøke forhold som treningsmengde, kostholdsvaner, helse, skader og spiseforstyrrelser.
Videre er hensikten å kartlegge hvordan et sett med undervisningsopplegg/workshops vedrørende temaer som: treningslære, kroppssammensetning, idrettsernæring og kommunikasjon eventuelt påvirker ditt og de andre elevenes forhold til egen kropp, ernæring, selvfølelse og relasjoner.

Dersom det skulle vise seg at en høy andel av dere utøvere via spørreskjema viser symptomer på at dere har et problematisk forhold til mat og kropp, vil et tilfeldig utvalg av elever med og uten problemer bli forespurt om å være med på et intervju. Det vil i så fall komme en ny henvendelse til deg dersom dette blir aktuelt. Det betyr at det å samtykke til deltagelse i denne spørreskjemaundersøkelsen ikke inkluderer et samtykke til et intervju.

Skolen hvor du er elev har allerede takket ja til å delta på spørreskjemaundersøkelsen, og vil legge til rette for gjennomføringen. Vi vil være tilstede under selve gjennomføringen, og det vil bli gitt et første foredrag om idrett, helse, ernæring og prestasjon. Dette fordi vi vet at mange av dere unge idrettsutøvere har noen utfordringer i forhold til smarte løsninger i en hektisk skole og treningshverdag.

Vi gjør oppmerksom på at det er helt frivillig å delta i spørreskjemaundersøkelsen, og at du kan trekke deg når som helst. Du er sikret full anonymitet, men som prosjektleder er jeg (Jorunn Sundgot-Borgen) forpliktet til å kunne spore opp til din identitet, dersom du gir uttrykk for at du ønsker hjelp til et eventuelt spiseproblem. På selve spørreskjema vil navnet ditt derfor være erstattet av en kode, slik at det kun vil være jeg som prosjektleder som kan spore opp identiteten. Dersom du på spørreskjema krysser av for at du ønsker hjelp/veiledning for et problem knyttet til mat og eller følelser, vil du få tilbud om dette av prosjektledelsen. Som forskere er vi underlagt taushetsplikt.

Prosjektleder kan ikke ta ansvar for langvarig behandling om så skulle være av behov, men vil bidra til å henvise deg videre for hjelp.
Skolen hvor du er elev vil i tillegg i forbindelse med undersøkelsen utnevne en kontaktperson som vil være tilgjengelig for en samtale/telefon med deg, dersom du ønsker det.

Alle opplysningene som er samlet inn vil bli anonymisert ved prosjektets avslutning. Oversikten over deltakere i prosjektet vil bli slettet.

Prosjektet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste (NSD) og det er godkjent av Regional komité for medisinsk og helsefaglig forskningsetikk (REK).

Dersom du er under 18 år er det dine foresatte som må gi tilbakemelding til oss om du ønsker å delta eller ikke. Det vil derfor også bli sendt et eget informasjonsbrev til dine foresatte om denne undersøkelsen. Hvis du imidlertid er over 18 år, ønsker vi at du gir oss en aktiv tilbakemelding på om du ønsker å delta eller ikke.

På forhånd takk.

Vennlig hilsen

Jorunn Sundgot-Borgen
Professor
Jorunn.Sundgot-Borgen@nih.no

Audun Eriksson
Stipendiat
audun.eriksson@nih.no

Marianne Martinsen
Masterstudent
marianne.martinsen@student.nih.no

Til deg som er trener eller lærer for unge idrettsutøvere på toppidrettsnivå

Kan du tenke deg å delta i et prosjekt om idrett, helse, kropp og prestasjon?

Forespørselen om deltagelse går til alle trenere/lærere som underviser årets 1. klassinger i idrett, treningslære og/eller naturfag ved toppidrettsgymnas eller videregående skoler med toppidrett. Skolen du jobber på har sagt ja til deltagelse i undersøkelsen og sendt oss en liste over lærere/trenere som underviser i disse fagene, og du er en av de som er oppgitt på denne listen. Vi henvender oss derfor nå til deg og alle andre trenere/lærere som dette gjelder på din skole, med forespørsel om deltakelse i en spørreskjemaundersøkelse der hensikten er å undersøke ditt forhold til; trening, kropp, kosthold, spiseatferd og relasjoner knyttet til elevene. Det vil samtidig bli foretatt en spørreundersøkelse blant alle 1.klasseelevene (med toppidrett) ved skolen du arbeider.

Din skole har sagt seg villig til å legge til rette for gjennomføringen av undersøkelsen. Vi vil være tilstede under selve gjennomføringen, og det vil bli gitt et første foredrag om idrett, helse, ernæring og prestasjon i etterkant av spørreskjema utfyllingen. Det er frivillig å delta og du kan trekke deg når som helst uten å gi en begrunnelse for det. Siden vi vet lite om lærere og trenere som underviser unge utøvere på så høyt idrettslig nivå, vil dine svar imidlertid være av stor betydning. Dersom du ikke ønsker å delta, vil det ikke få noen konsekvenser for ditt forhold til arbeidsplassen.

I tillegg til kartleggingen vil vi teste ut et undervisningsopplegg som totalt skal ha den hensikt at elevene får kunnskap knyttet til tema som: ernæring, vekst og utvikling, treningslære, restitusjon og kommunikasjon. Det er forventet at økt kunnskap vil kunne bidra til å redusere risiko for utvikling av forstyrret spiseadferd.
Du som trener/lærer vil også få tilbud om foredrag/workshops i prosjektperioden.

Dersom du velger og delta vil det spørreskjemaet du skal svare på være merket med et ID nummer, da du vil bli spurt om du ønsker ekstra veiledning/hjelp i forhold til enkeltelever. Dersom du i spørreskjema krysser av for at du ønsker dette, er det viktig at prosjektleder (Jorunn Sundgot-Borgen) via ID nummer kan identifisere deg. Det vil kun være prosjektleder som kan spore opp identiteten din via en separat liste. Som forskere er vi underlagt taushetsplikt. Svarene dine vil på ingen måte bli brukt mot deg.

Alle opplysningene som er samlet inn vil bli anonymisert ved prosjektets avslutning. Prosjektet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste (NSD) og det er godkjent av Regional komité for medisinsk og helsefaglig forskningsetikk (REK).

Fra deg som trener/lærer må vi ha en aktiv tilbakemelding på om du ønsker å delta i undersøkelsen eller ikke.

På forhånd takk for hjelpen.

Vennlig hilsen

Jorunn Sundgot-Borgen	Audun Eriksson	Marianne Martinsen
Professor	Stipendiat	Masterstudent
Jorunn.Sundgot-Borgen@nih.no	audun.eriksson@nih.no	marianne.martinsen@student.nih.no

NORGES IDRETTSHØGSKOLE

Til: Foreldre/foresatte med elever under 18 år

Fra: Professor Jorunn Sundgot-Borgen og Stipendiat Marianne Martinsen

Forespørsel til Ditt barn om intervju tilknyttet prosjektet "Idrett, helse, kropp og prestasjon" ved Norges idrettshøgskole.

Etter kartleggingsundersøkelsen i prosjektet "Idrett, helse, kropp og prestasjon" som vi gjennomførte høsten 2008, har vi nå trukket et tilfeldig utvalg elever til intervju. Din sønn/datter er en av disse.

Intervjuet vil primært foregå på Norges idrettshøgskole. Vi er imidlertid klar over at elevene har en hektisk hverdag med skole og trening. Derfor vil vi kunne legge til rette for at intervjuet gjennomføres på skolen der eleven går, dersom det skulle bli umulig for eleven å møte på Norges idrettshøgskole. Samtykke av eleven selv og avtale om sted og tid for intervjuet gjøres direkte med hver enkelt elev, etter at vi har mottatt svar fra dere som foreldre/foresatte. Dersom deres barn ønsker å være med, vil alle reiseutgifter i forbindelse med intervjuet bli dekket av prosjektet.

Intervjuet vil inneholde tema knyttet til treningshistorie, vekst og utvikling, kosthold, og forhold til trenere og ledere i idretten.

Intervjuet vil bli gjennomført av fagpersoner med spesialkompetanse innen de ulike tema og disse er underlagt taushetsplikt.

Fra Dere foreldre/foresatte må vi ha en aktiv tilbakemelding om at det er i orden at Ditt barn deltar i intervjuet eller ikke. Vi gjør oppmerksom på at det er helt frivillig å delta, så dersom Ditt barn ikke ønsker å delta vil han/hun ikke bli intervjuet.

Dersom du godkjenner at Ditt barn kan delta, vil vi sette pris på om Dere som foreldre/foresatte kan gjøre Deres barn oppmerksom på at han/hun etter hvert vil motta en henvendelse fra oss med forespørsel om deltakelse.

På forhånd takk.

Vennlig hilsen

Jorunn Sundgot-Borgen
Professor
Jorunn.Sundgot-Borgen@nih.no

Marianne Martinsen
Stipendiat
marianne.martinsen@nih.no

NORGES IDRETTSHØGSKOLE

Forespørsel til Deg om intervju tilknyttet prosjektet om idrett, helse, kropp og prestasjon.

Viser til telefonsamtale, og det intervjuet du ønsket å delta i og sender deg som avtalt litt mer informasjon om intervjuet, tidspunkt og sted vi ble enig om.

Etter kartleggingsundersøkelsen i prosjektet "Idrett, helse, kropp og prestasjon" som vi gjennomførte høsten 2008, er det nå trukket ut et tilfeldig utvalg av de som deltok. Du er en av disse og får derfor denne forespørselen. Dette intervjuet vil inneholde tema knyttet til treningshistorie, vekst og utvikling, kosthold, og forhold til trenere og ledere i idretten.

Intervjuet vil bli gjennomført av xxxxxxxxxx og xxxxxxxxxxx, hvor disse er underlagt taushetsplikt!

Vi gjør oppmerksom på at det er helt frivillig å delta på dette intervjuet.

Du har som avtalt blitt satt opp til intervju **mandag xxxxx Kl. 14**. Intervjuet vil vare ca. en halvtime. Du **møter opp på Norges Idrettshøgskole**, der en fra prosjektgruppen vil møte deg i resepsjonen. Vi minner om at alle reiseutgifter vil bli dekket av prosjektet*. Husk å ta vare på kvitteringer.

Vennligst bekreft at mailen er mottatt, at du ønsker å delta på intervjuet og at tidspunktet passer.

NB: Dersom du ikke skulle ønske å delta allikevel eller det oppstår noe som gjør at du ikke kan møte til oppsatt tid, vennligst gi beskjed så fort som mulig og til xxxxxxxxx på telefon xxxxxxxxxx eller mail xxxxxxxxx.

På forhånd takk.

Vennlig hilsen

Jorunn Sundgot-Borgen
Professor
Jorunn.Sundgot-Borgen@nih.no

Marianne Martinsen
Stipendiat
marianne.martinsen@nih.no

Praktisk info:

* Alle reiseutgifter vil bli dekket av oss, og vi ber deg om å velge billigste reisealternativ (husk studentpris) og retur-reise samme dag, om det lar seg gjøre. Dersom du må overnatte og ikke har mulighet til å bo hos venner/familie, gi oss beskjed, så ordner vi overnatting for deg. Vi gjør også oppmerksom på at vi kun dekker reiseutgiftene til deg som utøver. Ta vare på kvitteringer, du vil motta reiseregning og vil få hjelp til å fylle ut denne når du kommer til NIH. Husk å informere dine foresatte om din reiserute.

* Gardermoen til Oslo S: Ta flytoget - Tar ca 25 min. Nettsted for rutetider: www.flytoget.no <file://www.flytoget.no/> . Fra Oslo S til Sognsvann (Norges idrettshøgskole): Følg skilt til T-bane på Oslo S, ta bane 3 (Sognsvann) og sitt på til endestasjonen (Sognsvann), ca 20 min - NIH ligger da på venstre side av veien.