

Review

Aspects of disordered eating continuum in elite high-intensity sports

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Dieting is an important risk factor for disordered eating and eating disorders. Disordered eating occurs on a continuum from dieting and restrictive eating, abnormal eating behavior, and finally clinical eating disorders. The prevalence of eating disorders is increased in elite athletes and for this group the cause of starting to diet is related to (a) perception of the paradigm of appearance in the specific sport, (b) perceived performance improvements, and (c) sociocultural pressures for thinness or an “ideal” body. Athletes most at risk for disordered eating are those involved in sports emphasizing a thin body size/shape, a high power-to-weight ratio, and/or sports utilizing weight categories,

such as in some high-intensity sports. In addition to dieting, personality factors, pressure to lose weight, frequent weight cycling, early start of sport-specific training, overtraining, injuries, and unfortunate coaching behavior, are important risk factors. To prevent disordered eating and eating disorders, the athletes have to practice healthy eating, and the medical staff of teams and parents must be able to recognize symptoms indicating risk for eating disorders. Coaches and leaders must accept that disordered eating can be a problem in the athletic community and that openness regarding this challenge is important.

The data related to the relationship between sports participation, dieting, and eating problems in athletes appear inconsistent, varying by sport, athletic performance level, and methodology of the studies. Consequently, it is difficult to draw comprehensive conclusions that can be adapted in elite sports as a whole. However, relationships between athletes, abnormal eating behaviors, and eating problems have been demonstrated through the development of specific terms including weight cycling, anorexia athletica, and the female athlete triad (Sundgot-Borgen, 1994; Sundgot-Borgen & Torstveit, 2004; Drinkwater et al., 2005; Torstveit & Sundgot-Borgen, 2005b; O'Connor et al., 2006; Rosendahl et al., 2009; Nattiv et al., 2007; Holm-Denoma et al., 2009).

Elite athletes often embody the concept of physical perfection. However, not all athletes *de facto* have, or have a subjective feeling, that their bodies are adapted to the optimal paradigm of their specific sport. Those athletes often experience pressure to achieve this “ideal” body type (Sundgot-Borgen, 1994; Drinkwater et al., 2005). In addition to the sociocultural demands placed on male and females to achieve and maintain an ideal body shape, elite athletes are also under pressure to improve perfor-

mance and conform to the specific requirements of their sport. They are also evaluated by coaches and officials such as judges on an almost daily basis (Sundgot-Borgen, 1994; Nattiv et al., 2007). These factors may lead to unfortunate dieting, use of disordered eating behaviors, and the development of severe eating disorders. The prevalence of the continuum of disordered eating has only to some degree been evaluated and individual and group data related to prevalence over time in the athletic population are lacking. The consequences of disordered eating continuum can be severe both in terms of health and performance, and proper prevention and treatment strategies are therefore necessary.

Thus, the aims of this paper are to present an overview of the following aspects of disordered eating and eating disorders: (1) the disordered eating continuum, its model and definitions, (2) the prevalence and trends in the prevalence over time, (3) risk factors, (4) health and performance consequences, (5) how to approach athletes with symptoms of disordered eating, and finally (6) preventive strategies. The main focus group in the paper is high-intensity sport (HIS) athletes.

The disordered eating continuum

Why are athletes dieting and practicing abnormal eating behaviors?

For elite athletes, the cause of starting to diet are related to (a) a perception of the paradigm of body appearance in his or her specific sport, (b) perceived performance improvement benefits, and (c) socio-cultural pressures for thinness or an “ideal” body composition or shape (Sundgot-Borgen, 1994; Rosendahl et al., 2008). For many athletes, it is desirable to have a high lean body mass and low body fat mass to achieve a high power-to-weight ratio (O'Connor et al., 2006). There are sports that require horizontal (e.g., running and long jump) or vertical (e.g., high jump, gymnastics, and ski jumping) movements of the body where excessive fat mass is considered a disadvantage. A high fat mass has also been shown to increase energy demands and could therefore affect performance negatively (Olds et al., 1993). Furthermore, in sports where aerodynamics and reduced resistance or drag is important (e.g., cycling, swimming) body composition plays an important role (although not always associated with low body fat). A high lean body to fat mass ratio is also desirable in sports for esthetic reasons (e.g., figure skating, rhythmic gymnastics, diving, bodybuilding, and sports dance). Finally, in sports with weight categories such as wrestling, judo, karate, and rowing, athletes wish to get a competitive advantage by obtaining the lowest possible body weight with greatest possible strength. Thus, they often compete in a weight class below their natural body weight (Steen & Brownell, 1990; O'Connor et al., 2006), and therefore start dieting due to their experience of the specific bodyweight/composition demands in their sport. It is also possible that, especially female athletes competing in HIS such as sprinting, speed skating, and cycling, experience that their sport-specific muscular body type do not fit the socio-cultural ideal body shape characterized by thinness. Therefore, these athletes try to change their body composition by dieting despite of the fact that they might abandon the paradigm of body composition of their sport. Thus, for many athletes who start dieting, weight concerns, dieting, and use of abnormal eating behaviors become a focus of their athletic existence and some may be diagnosed with a clinical eating disorder according to the DSM-IV criteria (Sundgot-Borgen, 1993; American Psychiatric Association (APA), 1994; Matejek et al., 1999; Torstveit et al., 2008).

Definitions

There is a continuum model of disordered eating ranging from energy balance and healthy body image

to clinical eating disorders such as anorexia nervosa (AN), bulimia nervosa (BN), and Eating Disorder not Otherwise Specified (EDNOS) (Shisslak et al., 1995). For the purpose of this review, we define relevant terms in the following. *Dieting* may be included on a continuum ranging from excessive energy intake via energy balance to energy deficiency, including healthy dieting (such as lowering caloric intake by a modest number of calories per day to achieve slow and steady weight loss), harmful dieting, and disordered eating (various abnormal eating behaviors such as restrictive eating, fasting, frequent skipping meals, diet pills, laxatives, diuretics, enemas, overeating, binge-eating, and purging) (Nattiv et al., 2007). *The female athlete triad* refers to the interrelationship between energy availability, menstrual function, and bone mineral density (BMD). This triad may have clinical manifestation including eating disorders, functional hypothalamic amenorrhea, and osteoporosis (Nattiv et al., 2007).

However, 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 eating disorder (Drinkwater et al., 2005). *Energy availability* can be defined as dietary energy intake minus exercise energy expenditure and thus the amount of dietary energy remaining for other body functions after exercise training (Nattiv et al., 2007). A *negative energy balance* is a result of consuming fewer calories than needed to meet the energy costs of daily living, plus those expended in exercise. In addition, young athletes must also meet the energy costs of growth (Manore, 2002). In AN, the athlete believes he/she is overweight even though being 15% or more below ideal body weight. Amenorrhea is one of the DSM-IV diagnostic criteria in females (APA, 1994). *Individuals with BN*, on the other hand, follow a cycle of food restriction or fasting leading to overeating or binge eating followed by purging. Purging may include vomiting, the use of laxatives, diuretics, enemas, and excessive exercise (APA, 1994). For athletes, excessive exercise means more exercise than originally planned to achieve the desired performance level. It is therefore easy for coaches and/or team medical staff to detect this indicator of disordered eating. It is important to observe that athletes suffering from BN also usually have a “normal” body weight. In both AN and BN, there are restricting- and binge/purging categories. Athletes who meet the criteria for EDNOS often have a “normal” body weight, but they are focused on body image, weight, and guilt surrounding eating (APA, 1994). If someone does not meet all the strict criteria for AN or BN, but their eating behaviors or eating symptoms compromise the individual's physical or psychological health, and/or interfere with

everyday activities, they might meet the criteria for EDNOS (APA, 1994). A subclinical eating disorder termed *anorexia athletica* has also been introduced in the sports medicine field (Sundgot-Borgen, 1993); however, most athletes meeting the criteria for anorexia athletica also fulfill the EDNOS criteria. Thus, on this continuum going from excessive energy intake via energy balance to clinical eating disorders athletes are struggling with body image, eating behaviors, and performance issues.

For the purpose of the consensus conference "Performance of Top Sports Involving Intense Exercise" in Copenhagen 2009, the sports/events in which athletes are competing at high intensity for a duration of 30 s to 8 min were named high intensity sports (HIS). For parts of the analysis in this paper, the authors classification of HIS are listed in Table 1.

Prevalence

Up to 70% of elite athletes competing in weight class sports are dieting and have abnormal eating behaviors to reduce weight before competition (Oppliger et al., 1996; Torstveit & Sundgot-Borgen, 2005a). A number of studies have also reported a higher frequency of disordered eating in athletes competing in sports that emphasize leanness or a low body weight (Sundgot-Borgen & Larsen, 1993; Hausenblas & Carron, 1999; Smolak et al., 2000; Rosendahl et al., 2009; Holm-Denoma et al., 2009). In contrast, some studies on high-school athletes report no greater risk for the development of an eating disorder than controls (Fulkerson et al., 1999; Smolak et al., 2000; Rosendahl et al., 2009). In a recent study by

Rosendahl et al. (2009), 59% of the young male elite athletes were dissatisfied with their body, 19% were dieting, and 11% had disordered eating. The prevalence of disordered eating was 10%, 17%, and 42% for endurance, weight class, and anti-gravitations sports, respectively. In a Norwegian study on adolescent male elite athletes, 13% reported symptoms associated with eating disorders (Martinsen et al., 2011).

A controlled study (Sundgot-Borgen & Torstveit, 2004) showed that the prevalence of eating disorders is significantly higher in Norwegian male and female elite athletes (8% and 22%) than in non-athletic male and female controls (0.5% and 10%) ($P < 0.001$, both men and women), and more common among those competing in sports in which leanness, high power-to-weight ratio, and/or weight classes are important, such as in HIS. The prevalence of eating disorders was higher among male (17.2%) ($P < 0.05$) and female (32%) ($P < 0.05$) athletes in HIS sports (Table 2) than among those athletes competing at the similar level in ball-game sports (5% and 16%, respectively) and technical sports (4% and 17%, respectively) (Sundgot-Borgen & Torstveit, 2004). A later study, including the total population of female elite athletes in Norway, found a prevalence of eating disorders among HIS athletes at 47.8% (Torstveit et al., 2008). However, some studies suggest a similar risk for eating disorders for female gymnasts and endurance runners compared with controls (Davis & Cowles, 1989; Wilmore, 1991; O'Connor et al., 1995). The differences in prevalence between different studies can be attributed to different methodological issues, such as different sports, different competitive level, different screening instruments, different investigators (coaches, researchers), different periods (on-off-season), and different age groups.

Table 1. Overview of the different sports/events included as high-intensity sports in this paper

High-intensity sports
Alpine skiing
Badminton
Figure skating
Freestyle skiing
Gymnastics
Judo
Karate
Kickboxing
Middle distance running
Paddling
Rhythmic gymnastics
Rowing
Squash
Speed skating
Sports dance
Swimming
Taekwondo
Telemark skiing
Wrestling

Trends in the prevalence of eating disorders over time – the Norwegian experience

Because the authors have examined health-related issues in female elite athletes and matched non-athletic controls in Norway since the beginning of

Table 2. Prevalence of clinical eating disorders (EDs) in high-intensity sports among male ($n = 134$) and female elite athletes ($n = 149$)

Female athletes ($n = 149$)				Male athletes ($n = 134$)			
AN	BN	EDNOS	Total EDs	AN	BN	EDNOS	Total EDs
$N = 10$	$N = 18$	$N = 20$	$N = 48$	–	$N = 10$	$N = 13$	$N = 23$
6.7%	12.1%	13.4%	32.2%*		7.5%	9.7%	17.2%

* $P < 0.05$ compared with male athletes.

AN, anorexia nervosa; BN, bulimia nervosa; EDNOS, Eating Disorder not Otherwise specified.

Table 3. Overview of at-risk criteria, percentage of females at risk for eating disorders, and percentage of females meeting the DSM-IV criteria for eating disorders, in the three studies (Sundgot-Borgen, 1993; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008)

	1990/1991 (<i>n</i> = 522 A and <i>n</i> = 448 C)	1997/1998 (<i>n</i> = 572 A and <i>n</i> = 574 C)	2001/2002 (<i>n</i> = 669 A and <i>n</i> = 607 C)
At-risk criteria	High-EDI-DT (> 15) and EDI-BD (> 14) score	High-EDI-DT (> 15) and EDI-BD (> 14) score Positive response to two or more of questions related to the DSM-IV criteria Self-reported EDs	High-EDI-DT (> 15) or EDI-BD (> 14) score Self-reported EDs Pathogenic weight control methods Underweight Menstrual dysfunction Stress fractures
At-risk subjects after the screening part	22.4% of the athletes and 25.9% of the controls	21.2% of the athletes and 14.1% of the controls	60.4% of the athletes and 69.2% of the controls
Percentage diagnosed with EDs*	20.0% of the athletes and 5.2% of the controls	21.5% of the athletes and 9.6% of the controls	28.1% of the athletes and 20.8% of the controls

*The results from the clinical part were standardized according to the distribution of at risk and not at risk subjects in the screening part using the same method in all three studies.

EDs, eating disorders; A, athletes; C, controls.

the 1990s, it is possible to follow the changes over time in prevalence of eating disorders in the Norwegian population. To our knowledge, this type of long-term follow-up studies has not been performed elsewhere. During the period from 1990 to 2002, new groups of elite athletes were included. However, in all studies (Sundgot-Borgen, 1993; Sundgot-Borgen & Larsen, 1993; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008) (in the two studies published in 1993, the data collection was conducted in 1990/1991, in the study published in 2004, the data collection was conducted in 1997/1998 and finally, in the latest study published in 2008, the data collection was conducted in 2001/2002. In this section, the studies are referred to the year of the data collection), the total population of female elite athletes, in an almost identical age range (12–39 years), has been included. The definition of an elite athlete is a member of the national team at the junior or senior level, or a member of a recruiting squad for the national team. The same definitions of eating disorders have been used in all these studies. Thus, the athletic groups are comparable. The control groups, however, differ in that the controls were age and home-community matched, and not a representative sample of the general population, in the first two studies, and a national representative sample selected to be in the same age range as the athletes in the last study. In this review paper, the main focus will be on athletes and especially female athletes, because our results on trends represent data from female elite athletes only. The same two-stage study design has been used in all studies. Stage one included an initial screening by a questionnaire to identify athletes and controls “at-risk” for eating disorders, followed by stage two including a detailed standardized clinical interview of randomly selected samples of athletes and controls in order to diagnose eating disorders

according to the DSM-IV criteria (APA, 1994). Because of the fact that somewhat different at-risk criteria were used when inviting the subjects for participation in the clinical part of these studies (Table 3), a direct comparison of the prevalence of eating disorders is challenging. However, due to the similar inclusion criteria and methodological design, it was possible to standardize the percentage of athletes and controls diagnosed with eating disorders in the clinical part of the studies to the original distribution of at risk and not at risk subjects participating in the screening part of the studies. By performing this, a direct comparison of the prevalence of eating disorders in the three different studies is possible (Table 3).

Based on these three Norwegian studies (Sundgot-Borgen, 1993; Sundgot-Borgen & Torstveit, 2004; Torstveit et al., 2008), an increase in the prevalence of clinical eating disorders is observed during the investigated period for female elite athletes as a group ($P < 0.0001$).

The prevalence of eating disorders has increased gradually from the beginning of the 1990s to 2002 in both female athletes and non-athletes, with the largest increase observed during the last 5 years of the period. In the athletes, the prevalence of eating disorders had increased from 20% to 28% ($P = 0.0007$) and in the controls from 5% to 21% ($P < 0.001$) in this period (Table 3).

The higher prevalence observed in 2001/2002 (Torstveit et al., 2008) as compared with the prevalence reported in the previous Norwegian studies could be explained by a number of factors. Firstly, it could be due to a higher number of at-risk variables included in the screening part in the latest study (Torstveit et al., 2008), leading to a higher probability for detecting more females at risk for eating disorders and thus reduce the number of false-nega-

tive subjects. In the latest study (Torstveit et al., 2008), the at-risk criteria were used based on investigation of at-risk for the female athlete triad, and not only at risk for eating disorders as used in the previous studies. The criteria for the Eating Disorder Inventory (EDI) subtests (Garner et al., 1984) and self-reported eating disorders are the same, but in the study based on data from 1997/1998, questions related to the DSM-IV criteria were also included. These were, however, replaced by somewhat less strict criteria, such as the use of abnormal eating behaviors, when investigating at-risk behavior for the female athlete triad in the latest study. The greatest difference between the athletes and the controls was observed in the reported use of abnormal eating behaviors – a criterion that was not included in the study from 1997/1998. This is also supported in other studies on non-athletes (Hay et al., 2008). It is probably easier to respond positively to a number of lenient criteria related to disordered eating behavior than the more strict criteria, such as the questions related to the DSM-IV criteria. Results from Torstveit et al. (2008) support the use of asking additional questions, such as prevalence of menstrual dysfunction, especially in leanness athletes, when screening for eating disorders. It may be easier for some females to report menstrual dysfunction as compared with reporting disordered eating behavior and/or eating disorders, as questions about menstrual dysfunction may feel less sensitive. This further supports the assumption that an increased number of at-risk subjects may have been identified in the present study compared with the two previous studies, resulting in fewer false-negative subjects and an increased prevalence of eating disorders. On the other hand, it should be noted that the prevalence of eating disorders has not only increased in the athletes at-risk for eating disorders but also among those athletes classified as not at risk (from 0% in 1990/1991 to 3.4% in 2001/2002, $P < 0.001$). This indicates that the number of at-risk criteria is perhaps not the only reason for the observed increase in prevalence.

Secondly, the inclusion of the EDNOS category as a part of the eating disorder criteria may also explain the increased prevalence when comparing the latest results with the earliest Norwegian study only focusing on AN, BN, and anorexia athletica (Sundgot-Borgen, 1993). In the latest study, a total of 61% and 66% of those athletes and controls diagnosed with an eating disorder, respectively, had EDNOS. In comparison, 47% and 17% of the athletes and controls, respectively, in the 1990/1991 study when anorexia athletica, and not EDNOS, was included, were diagnosed with subclinical eating disorders. On the other hand, the further increased prevalence in the last 5 years of the study period does not appear to be

explained by the inclusion of the EDNOS category, because in the study from 1997/1998, the percentages diagnosed with EDNOS were quite similar (59% and 65%, respectively) compared with the present results. This is further supported by the fact that an increase in clinical eating disorders (AN) was observed in the same period.

Thirdly, despite the fact that the subjects included in all three studies were in the same age range (12–35, 15–39, and 13–39 years), the mean age increased slightly during the period, especially in the control groups ($P = 0.2$ for the athletes, and $P < 0.001$ for the controls). Consequently, the increased mean age might lead to a longer period for exposure to risk factors for the development of eating disorders. On the other hand, most females who develop eating disorders do so during the adolescent years (Van Hoeken et al., 2003). Thus, the increasing mean age may not necessarily be the reason for the increased prevalence of eating disorders. The body mass index (BMI) was almost identical in the athletes in the three studies; however, an increase was observed in the control group during the last decade (from 21.5 to 23.4 kg/m²). A higher BMI may result in a higher dissatisfaction with own body. This idea is supported when comparing the percentage with high EDI subscale scores (drive for thinness ≥ 14 or body dissatisfaction ≥ 15) in the three studies over time. The control groups, with a higher mean BMI, had a higher percentage of high EDI subscale scores over time with 25.9% in 1990/1991, 27.4% in 1997/1998, and 25.9% 2001/2002. For the athletes, the corresponding percentage of high-EDI subscale scores was slightly lower, 22.4%, 21.4%, and 19.6%, respectively.

Fourthly, the observed difference in prevalence of eating disorders for both athletes and controls could be due to a true increased prevalence caused by an increased focus on body composition and health in general and/or optimal body composition for the specific sport performance. Finally, due to the increased focus upon disordered eating/eating disorders in the society in general and/or among athletes specifically, it is probably easier for athletes to report eating problems today. Furthermore, prevalence of disordered eating behavior and eating disorders may have changed the last 5–10 years due to the increasing attention on dieting and eating behaviors as reflected by trends in society and reports in media. Moreover, the Norwegian public authorities and Norwegian Ministry of Health have focused on risk factors for and consequences related to overweight. This political message encourages the general population to watch and try to decrease their body weight. One possible consequence of this political message can be an increased prevalence of eating disorders.

The Norwegian studies conducted over a 12-year period have added new knowledge to this scientific field and elucidated the need for preventive work in order to reduce the prevalence of eating disorders in athletes. More individual- and group-based longitudinal studies over time are needed to increase the knowledge related to risk factors and the true trend in the prevalence of eating disorders. Evidence for an increase in the prevalence of eating disorders in the general population is inconsistent (Hay et al., 2008). However, some recent studies (from Sydney and London) indicate that eating disorder behaviors are increasing (Hay et al., 2008; Currin et al., 2005).

Risk factors

Garfinkel and Garner (1982) suggested that the cause of eating disorders is multifactorial and that different factors predispose, precipitate, and perpetuate the disorder. In sports, predisposing factors (e.g., individual, family, and culture) can be triggered by a precipitating factor (e.g., comment on body weight), and then maintained by perpetuating factors (e.g., initial success, approval by coach) (Drinkwater et al., 2005). With regard to the disordered eating continuum as a whole, it is not known whether the risk or causative factors are the same as the different included eating disorders. Athletes restricting caloric intake, whether inadvertent or by intent, could be considered at risk for disordered eating (Drinkwater et al., 2005). As indicated above, risk factors can be divided into two categories. The first category involves general factors that place an individual, athlete or non-athlete, at risk to develop disordered eating. The second category involves factors specific to athletes (Wilson, 2002). These include personality factors, pressure to lose weight leading to restricted eating and/or frequent weight cycling, early start of sport-specific training, injuries, symptoms of overtraining, and the impact of coaching behavior (Sundgot-Borgen, 1994; Smolak et al., 2000). Another risk factor in the athletic environment is the fact that in some sports, such as HIS, a decrease in body fat/weight can enhance performance. Often, an initial loss of weight leads to a better performance and this initial success can force the athlete (and other athletes observing this) to continue efforts to lose weight and unknowingly slip into an eating disorder. Thompson and Sherman (1999) have suggested that some traits desired by coaches in their athletes (referred to as “good athlete” traits) are similar to traits found in individuals with eating disorders, such as excessive exercise, perfectionism, and (over-) compliance. Leon (1991) suggested that these athletes also may have evidence of psychological traits such as high achievement orientation and obsessive-com-

pulsive tendencies commonly associated with clinical eating disorders, which is also essential for successful competitions. Therefore, such athletes should be considered as at an increased risk for eating disorders. Such attitudes and behaviors are apt to be rewarded in the sport environment. Thus, rather than identifying an individual who is in need of treatment, sport personnel are, without knowing, apt to increase the frequency of eating disorders through their reinforcement of attitudes and behaviors (Drinkwater et al., 2005). Most sports have appearance and body paradigms. For example, distance runners are “thin,” and female elite rhythmic gymnasts are “tiny.” Thus, it is often a challenge to identify athletes with eating disorders who fits the paradigm. That is, a rhythmic gymnast (RSG) who is heavier than the majority of RSGs is easier to identify than one who might be too thin. In this case, the athlete who does not fit the paradigm (i.e., the heavier one) is more apt to be referred for treatment, while the “thinner” one, who may be too thin because of disordered eating, may go unnoticed and as a result untreated.

Health and performance consequences

Longer periods with low energy availability, with or without disordered eating, can impair health and physical performance (Nattiv et al., 2007). Medical complications involve the cardiovascular, endocrine, reproductive, gastrointestinal, renal, and central nervous systems (Nattiv et al., 2007). In several studies, the negative effects of rapid weight loss (e.g., fasting, dehydration) and longer periods of restricted energy intake on performance, growth, cognitive function, and health, have been discussed (O'Connor & Caterston, 2006). Dieting athletes may slip into disordered eating, which in turn can lead to a serious eating disorder, disruption of the normal menstrual cycle, and eventually an imbalance in bone remodeling leading to osteopenia or osteoporosis. Although any one of these problems can occur in isolation, the emphasis on weight loss in risk individuals can start a cycle in which all three diseases occur in sequence – hence the term “the female athlete triad” (Nattiv et al., 2007). However, a controlled study of the entire population of female elite athletes in Norway demonstrated that 4.3% of female elite athletes met the criteria for the female athlete triad. When evaluating the presence of two of the components of the triad, prevalence ranged from 5% to as high as 27% in elite athletes (Torstveit & Sundgot-Borgen, 2005b). Similar results have been shown in lower level athletes such as high-school athletes (Nichols et al., 2006) and collegiate athletes (Beals & Hill, 2006).

Also, in male competitive (Hetland et al., 1993; Smathers et al., 2009) and recreational (Rector et al., 2008) cyclists and long-distance runners with a low-percent body fat, low BMD values have been found. As many as 63% of male cyclists were diagnosed with osteopenia (Rector et al., 2008) and in a recent study, 25% and 9% of male cyclists were diagnosed with osteopenia and osteoporosis, respectively (Smathers et al., 2009).

Psychological problems associated with eating disorders include low self-esteem, depression, and anxiety disorders (Nattiv et al., 2007). For athletes, the stress of constantly denying hunger, obsessing about food, agonizing over body weight, and fearing high body weight is mentally exhausting. Moreover, this preoccupation interferes with the athlete's daily activities as well as his or her training and competition (Steen & Brownell, 1990). Mortality rates in athletes with eating disorders are not known, but 5.4% ($n = 5$) of those diagnosed in one study reported suicide attempts (Sundgot-Borgen, 1994).

Recommendations for management and treatment

Athletes and especially elite athletes constitute a unique population, and special diagnostic considerations should be made when working with this group (Thompson & Sherman, 1993; Beals & Manore, 1994; Sundgot-Borgen, 1996). Identifying disordered eating among elite athletes must go beyond focusing on those who meet diagnoses for eating disorders to include those who have too low energy availability and/or are practicing pathogenic weight control behaviors. Because no controlled longitudinal studies, treatment studies or controlled prevention studies on elite HIS athletes or elite athletes in general have been published, the presented recommendations are based on the latest Position Stand Papers on the Triad (Drinkwater et al., 2005; Nattiv et al., 2007) and expert experience from 20 years of work with elite athletes and eating disorders.

It is important to determine whether the athlete's abnormal eating and dieting behaviors are transient behaviors associated with the specific demands of the sport ("anorexia athletica") or whether the symptoms are more stable and part of a clinical eating disorder (Sundgot-Borgen, 1996; Drinkwater et al., 2005). It is not enough to document behaviors; the emotional and psychological state of the athlete must also be examined. If an athlete has been identified as engaged in a disordered eating or is believed to be "at risk" for abnormal eating behaviors or an eating disorder by medical staff, athletic trainer, coaching staff, and/or team-members, the following procedures are based on recommendations by Drinkwater et al. (2005).

The athlete should be referred to a sports nutritionist, for nutritional assessment, and meal planning. The focus should be educational with the aim of helping the athlete to understand the nutritional needs for good health and performance. The nutritionist should ask questions needed to determine whether the athlete has an optimal energy intake or not. If the HIS athlete is not able to improve the intake by guidance, the athlete should be referred to the team physician or general practitioner where appropriate. The physician shall take a detailed medical history review and perform a physical examination and take blood and biochemical tests as well as dual energy x-ray absorptiometry (to determine body fat and bone health). The physician shall also determine whether further medical specialist consultations are necessary (e.g., psychiatry, endocrinology, gynecology, and others). The importance of this procedure can be illustrated by recent data indicating the importance to screen female elite athletes with menstrual dysfunction for underlying disorders such as eating disorders, low BMD or polycystic ovary syndrome (Torstveit et al., 2008; Hagmar et al., 2009).

A special attention should be paid to male athletes who exhibit signs and symptoms of disordered eating because men have no diagnostic hallmark such as amenorrhea for detecting eating disorders.

Athletes diagnosed with disordered eating, but no other underlying medical disorder, who are unable or unwilling to follow the eating recommendations made by the nutritionist and/or physician shall be referred to an eating disorder treatment specialist experienced in working with athletes.

If the physician and/or eating disorder specialist recommends treatment, the athlete shall be considered "unfit" and agree to treatment in order to later be allowed to return to training and competition.

For athletes who agree to treatment, eligibility to continue training and competing while symptomatic would be determined on an individual basis by treatment staff. At the minimum, the athlete would have to be cleared medically and psychologically, his/her training/competition shall not be used as a means to diet or control his/her weight, and he/she would be required to follow a prescribed set of health maintenance criteria. These criteria are individual and would generally include, but not be limited to: (a) being in treatment, complying with the treatment plan, and progressing toward therapeutic goals, (b) maintaining a weight of at least 90% of expected, and in accordance with Behnke's theoretical concept of minimal body mass (Behnke, 1969), a body fat $>6\%$ for male athletes and $>12\%$ for female athletes, or more if prescribed by the treatment team, and (c) eating enough to comply with the treatment plan regarding weight gain or weight

maintenance. In some cases, it is important to be able to negotiate with the athletes when it comes to energy intake and return to training and competition. However, it must be clear that the eating disorder treatment team makes the decisions and that the athletes' health has priority. For athletes, who are willing to follow the recommended treatment, and who include their coach (if the athlete and the coach have a positive relationship) in the treatment, and if appropriate, the parents also, the compliance and prognosis are expected to be good (Beals, 2004).

To be allowed to train the athlete must be able to maintaining a weight of at least 90% of therapeutic goal. The body weight must gradually increase during the training period and any indication of decreased body weight will discontinue the training.

The athlete may return to competition when the goal weight or body composition is reached. As stated above, any indication of decreased body weight or return to disordered eating will withdraw the athlete from competitions as well as training.

For athletes who refuse treatment, training, and competition should be withheld until they agree to participate in treatment (Drinkwater et al., 2005).

Finally, maintaining open lines of communication between the coaches and members of the eating disorder team is important. Coaches are in a prime position to monitor their athletes' behaviors and reactions. It should be noted that coaches may have difficulty discussing sensitive issues related to disordered eating disorder either with treatment team members or athletes. This sensitivity generally arises from the coaches "feeling of culpability" for athletes disordered eating behaviors. While there are probably still some instances in which a coach directly contributes to an athletes' disordered eating, most coaches are aware of the liabilities involved and are careful not to overstep their boundaries regarding weight and dieting issues. Thus, it is important to avoid placing blame. Coaches need to be held accountable for their athletes in a way that is not threatening. The best way to do this is to make disordered eating a "health and safety issue" and not a coaching issue.

Prevention

Because disordered eating is so prevalent among young female athletes and because clinical and sub-clinical levels may result in extreme distress, researchers have recognized the need to reduce risk factors and protect against the development of clinical concerns (e.g., Lewinsohn et al., 2000). However, to our knowledge, no controlled intervention studies aiming toward preventing eating disorders in elite athletes have been published.

Because dieting is a risk factor for eating disorders, unnecessary dieting (dieting that is performed without having excess fat and unaccompanied by professional guiding) should be prevented. Coaches should avoid putting pressure and/or telling an athlete to lose weight. This is especially important when it comes to the HIS athletes representing weight class sports. Most of the weight class athletes are fit and lean, but want to reduce body weight to compete in a lower weight class. In such a case, the coach and health care team should rather motivate the athlete to improve strength and compete in a higher weight class.

1. If the coach is concerned about an athletes' weight or body fat level, he/she should be referred to a sports nutritionist for further evaluation and consultation. A thorough evaluation of the athletes' physical and mental health, training regimen, and athletic goal is required. Athletes that are still growing should not be allowed to use unnecessary dieting. Thus, physicians and other health care providers should educate the HIS athletes and coaches that weight loss does not necessarily lead to improved athletic performance. Furthermore, because athletes are eager to perform, it is important to inform about the side effects of under-eating and abnormal eating behavior, such as fatigue, anemia, electrolyte abnormalities, and depression. It should be noted, however, that athletes who are significantly overweight or obese, and need a weight reduction for health reasons and performance issues, should get professional guidance to change eating behavior and reduce body fat.

2. The best way to de-emphasize weight is to avoid weighing athletes for non-health-related issues and to avoid verbal and non-verbal comments regarding body composition and/or body weight. Dieting and weight issues should never be a theme from the coach, but be presented according to the athletes wish. In such cases, the coach should take the athlete's initiative serious and refer to professional help. The focus should be on performance enhancement via non-dieting strategies: improved nutrition, improved health, mental and psychological approaches (i.e., positive imagery, concentration, anxiety management), and physical aspects (i.e., enhancement of speed, quickness, and endurance, such as in middle-distance running and speed skating).

3. In order for coaches to adequately perform a supportive function, many need factual information on nutrition, factors determining weight, risks and causes of disordered eating, menstrual (dys) function, and psychological factors that both negatively and positively affect health and athletic performance. Female athletes with menstrual dysfunction are at increased risk for injuries (Nattiv et al., 2007) and

Table 4. Preventive key points for the development of disordered eating and/or eating disorders

Preventive key points
Advocate health and well-being
De-emphasize body weight
Use role models with normal body weight
Reinforce sensible body composition
Educate athletes about the 24-h athlete*
Refer athletes at risk for disordered eating to eating disorder specialists
Dispel the myths that "thinner is better" and that "amenorrhea is a normal sign of training"
Make disordered eating a "health and safety issue" and not a "coaching issue"

*The performance in the athletes' specific sport is not only dependent on the athletes' achievement on training and in competition but also on other non-exercise-related activities during the day, the recovery efforts, and the total pressure on the athlete in general.

athletes and coaches should be aware of this. It also appears that athletes are more willing to report menstrual dysfunction than disordered eating behaviors and eating disorders. Thus, one could talk about the menstrual status before eating-behavior-related questions (Torstveit et al., 2008).

4. Sports governing organizations and federations should give support to the coaches and provide education regarding disordered eating for coaches and athletes. Each federation should have position statements with guidelines, and support to make the difficult decisions with respect to affected athletes as whether they will be in treatment or be allowed to train and compete. Preventive key points are summarized in Table 4.

5. The main goal in secondary prevention should be to identify better athletes with disordered eating to introduce earlier education and treatment. Earlier treatment results in fewer health risks for the athlete and also an earlier return to training and competition. Finally, identification could be facilitated through the de-stigmatization of receiving a diagnosis of disordered eating, as well as through proper and supportive management of the athlete following identification. Regarding disordered eating stigmatization, coaches have to accept that disordered eating

and eating disorders is a problem in many sports and not deny it, and furthermore be able to talk about this and other psychiatric disorders. The sport environment is dependent on increased openness regarding psychiatric challenges among athletes competing in different sports. This would make it easier for an affected athlete to come forward and seek treatment rather than feeling as though he/she must "hide" in order to avoid detection, embarrassment, and removal from training and competition (Drinkwater et al., 2005).

Perspectives

Because dieting is the primary precursor to the development of disordered eating and eating disorders, unnecessary dieting should be prevented. The team staff and parents must be able to recognize the physical symptoms and psychological characteristics that indicate a risk for eating disorders. The sport environment must focus on increased openness regarding psychiatric challenges, such as eating disorders, among both male and female athletes. This is especially true for those involved in the HIS sports (such as gymnastics, middle-distance running, rowing, and weight class sports) because a high prevalence of eating disorders has been reported in these sports. We are in need of longitudinal controlled studies to determine risk factors associated with the development of eating disorders and large-scale intervention studies examining effective intervention and prevention strategies. This is especially important based on data indicating an increase in the prevalence of eating disorders since the beginning of the 1990s.

Key words: anorexia nervosa, bulimia nervosa, EDNOS, the female athlete triad, prevalence.

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