



## **Eating disorders in sport: characteristic of the female athlete triad and relative energy deficiency (RED-S)**

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### **ABSTRACT**

Maximizing athletic performance often leads to eating disorders. Women are more vulnerable than men. The interaction of three disorders (nutrition, menstruation, bone decalcification) is defined as the triad of female athletes. The cause of menstrual disorders results from too little supply of energy in the diet. Eating disorders also apply to men. RED-S syndrome refers to a physiological disorder caused by a shortage of energy and involves the release of metabolism disorders, menstrual disorders, musculoskeletal system, reduction of the activity of the immune system, the release of protein synthesis, disorders of the nervous system, poorer recovery and cardiovascular disorders. The etiology of the RED-S syndrome is a result of a relatively low availability of energy, as in the triad. Among the causes of these phenomena we can enumerate psychological, biological and social interactions. To assess the condition, especially in sport, questionnaires are most commonly used and they include questions about height, weight, exercise time, perception, eating disorders and menstrual cycle (women). The nutritional education is very important in the prevention and treatment of eating disorders. It suggests the need for an athlete to increase the energy intake and / or decrease exercise expenditure to treat the condition. This paper presents an analysis of the current state of knowledge of the etymology, incidence and effects of eating disorders in athletes based on the available literature.

**Keywords:** eating disorders; FEMALE athlete triad (Syndrome); menstruation disorders; bone density; food caloric content; Relative Energy Deficiency in Sport (RED-S)

## **1. INTRODUCTION**

Maximizing athletic performance often leads to eating disorders. The interaction of three disorders (nutrition, menstruation, bone decalcification) is defined as the triad of female athletes. The cause of menstrual disorders (defined as the absence of three to six consecutive menstrual cycles) is too low supply of energy in the diet [1]. In particular, this problem concerns a group of athletes engaged in endurance or bodybuilding sports, in which the weight of the body has a strong impact on the performance and the result in competitions. In 2014 The International Olympic Committee introduced a new phenomenon - Relative Energy Deficiency in Sport (RED-S) [2]. Eating disorders also apply to men. RED-S syndrome refers to a physiological disorder caused by a shortage of energy and involves the release of metabolism disorders, menstrual disorders, musculoskeletal system, the reduction of the activity of the immune system, the release of protein synthesis, disorders of the nervous system, a poorer recovery and cardiovascular disorders [3]. The etiology of the RED-S syndrome is a result of relatively low availability of energy, as in the triad. According to the American Medical Society for Sports Medicine (ACSM) an effective tool for the diagnosis of an eating disorder is the LEAF and the DSM V test [4]. Márquez and Molinero recommend a physical examination (PPE), health checks, the analysis of a dietary diary, the analysis of body composition and fat tissue content, mainly by impedance or a dual energy X-ray absorptiometry [5].

## **2. TRIAD ATHLETES**

The triad involves three interrelated components: low energy availability (EA) with or without disordered eating, menstrual disturbances and low bone mineral density (BMD) [6]. The cause of menstrual disturbances and low BMD in women with the triad is likely a low EA. It is quantitatively defined as the difference between the caloric intake and exercise energy expenditure, relative to lean body mass [7]. When it is reduced beneath a threshold of 30 kcal/ kg/LBM, there appears to be a repartitioning of energy in the body, so that essential physiological functions can be maintained, while non-essential functions such as reproduction are diminished or suspended (e.g., estrogen levels decrease) [8].

1-3% of players show the three criteria of the triad. According to Norwegian research professor of sports medicine, Jorunn Sundgot-Borgen [9], 34% of women involved in sport disciplines such as gymnastics and diving show an eating disorder. The problems occur often among women practicing martial arts (27%) or endurance sports (20%). The diagnosis of anorexia or bulimia concern 13% of women involved in technical sports (eg. target shooting) and 11% of team games players. The only group of athletes, in which eating disorders were more frequent than in the control group were women training strength sports. In general, among sportswomen eating disorders reached 20%, while in the control group 5% [9].

In a study of 263 athletes (of different disciplines) symptoms of eating disorders fulfilling the criteria of DSM-IV were observed in 31% of female athletes. In the control group, 5.5%. 6-79% of women showed problems with the menstrual cycle. 78% of runners in this group had no ovulation. 69% of ballerinas, and 65% of runners observed a delayed in their monthly cycles. In runners, there was the occurrence of abnormal increase of 3 to 60%

even in the transition from a distance of less than 13 km to 113 km more than a week. It was connected with a simultaneous decrease in body weight from 60 kg to 50 kg [5].

The concept of a triad does not include a group of recreational athletes and men. The triad involves three interrelated components: low energy availability (EA) with or without disordered eating, menstrual disturbances and low bone mineral density (BMD). This condition has become an initiation to create a new, broader concept. It is the Relative Energy Deficiency in Sport (RED-S) [2].

### **3. RELATIVE ENERGY DEFICIENCY IN SPORT (RED-S)**

The RED-S syndrome refers to an impaired physiological functioning caused by relative energy deficiency, but is not limited to impairments of metabolic rate, menstrual function, bone health, immunity, protein synthesis and cardiovascular health [3].

This phenomenon has been determined in response to emerging eating disorders in men. In comparison to the Triad, in RED-S there are also disturbances in the function of other organs. According to the International Olympic Committee, the RED-S problem refers to 20% of adult female athletes and 8% of the male group. In adolescent athletes, 13% of females and 3% of males [10].

RED-S touches such disciplines as aesthetic sports (eg. aesthetic gymnastics), endurance or ultra-effort (marathons, ultra marathons, cross-country skiing), sports with weight categories (boxing, judo, taekwondo), sports dependent on body weight (Ski Jumping) [2].

#### **3. 1. Etymology**

Triad and RED-S athletes are formed by the interaction of psychological, biological and social factors. The most common cause of eating disorders is too low supply of energy in the diet [11]. This condition is also enhanced by an athlete's character traits such as perfectionism, perseverance, high expectations and independence. Others may be: competitive athlete's self-critical behavior, low self-esteem, depressive symptoms, or achieving /maintaining a low body weight, lean physique, stress fractures without significant change in training, multiple or recurrent stress fractures [12].

According to a study [13], among the causes of eating disorders are: the use of inappropriate diet (37%), change of a trainer (30%), injury and disease (30%) and negative attention (19%). Problems often arise during a startup period, when the low body weight plays a significant role. In a study on fifty two cross country skiers [14], Schubiger indicates a huge family impact on the dysfunction. According to his research, the coach and trainings have less impact. However, these results were inconsistent with the majority of studies. According to Sundgot-Borgen [11] the risk increases during an early specialization, over longer periods of diet, with frequent fluctuations in weight loss, a rapid and significant increase in training load and traumas.

### **4. DIAGNOSTIC CRITERIA**

There are two types of diagnostics criteria in eating disorders: physiological and behavioral-psychological ones [15]. The first category include: significant weight loss,

dehydration, excessive fatigue, gastrointestinal problems, hypothermia, bradycardia, an increased susceptibility to injuries, fractures, muscle weakness, decreased endurance capabilities, low levels of hemoglobin, hematocrit, lipoprotein or estrogen. In the second group may appear anxiety, food avoidance, opposition to the recommended weight, changes in the training plan, performing additional exercises beyond the setpoints, morning warm-ups, depression, insomnia and social withdrawal [25].

One should also pay more attention if unusual behavior in relation to the measurement of body weight occurs, such as too frequent weighing, refusal to carry out measurements, fears or negative reactions to measurements. [16]. In performing a sport, one can notice: a decreased training response, worse coordination, endurance, limited glycogen stores, reduced concentration. Increased parameters involve: depressions markers, injury risk, susceptibility to disease. Changes appear in: menstrual function, bone health, endocrine, metabolic, hematological, immunological, cardiovascular, gastrointestinal and psychological parameters. These disorders can cause anemia, dehydration, erosion of enamel, depression, chronic fatigue, disturbances of acid-base balance and water-electrolyte balance [17].

These elements have strongly influenced the level of sports and exercise capacity of players and their health. The diagnosis of disorders can be based on surveys, consisting of questions about nutrition, injury and reproductive functions. Many validated sources for evaluating disordered eating in athletes exist: the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), the Female Athlete Screening Tool (FAST), the Athletic Milieu Direct Questionnaire (AMDQ), the Low Energy Availability in Females Questionnaire (LEAF-Q and the American Physiological Screening) and test for eating disorders among Female College Athletes (PST) [18].

The prevalence of low energy availability in female athletes is difficult to assess and until recently a validated source for evaluation did not exist. Multiple factors (eg, the difficulty of gathering accurate caloric intake data from athletes, inability to measure energy expenditure, uncertainty regarding which sports to include, which attitude survey to use, and varying definitions of eating disorders) compound the issue. Márquez and Molinero recommend a physical examination (PPE), health checks, analysis of dietary diaries, body composition and fat tissue content mainly by impedance or a dual energy X-ray absorptiometry [5].

## **5. PRACTICAL IMPLICATIONS**

According to the research, the most effective way to prevent and treat these syndromes is the nutritional education. It is an effective means of prevention and treatment. It is also recommended to normalize the eating behavior, weight loss and maintain new, healthy habits. Of course, the therapy involves the athlete, his family, coaches. It should be conducted by qualified doctors, nutritionists and psychologists [19].

Preventive measures include nutrition education, setting realistic and healthy goals of weight loss. Later, the diet should stabilize and promote weight gain [20]. Important are: restoring positive or at least neutral energy balance, exercise intensity decrease of 10-20% and an increase in calories intake. Adequate nutrition will usually resolve menstrual irregularities (calcium 1200 mg daily, Vit D: 1500-200 IU / day) [21].

If exercise does not threaten the health of the athlete, the athlete should not be discontinued from the competition [26]. The desire to improve performance and be competitive, may have a positive impact on the treatment. The American Society of Sports Medicine indicates the need to establish diagnostic indicators, the analysis of eating disorders and checking the indicators eating disorders [22].

The first treatment goal for any component of the triad and RED-S is to increase energy availability by increasing energy intake and reducing energy expenditure. Treatment through pharmacological means is not recommended because there is insufficient evidence that dry interventions restore bone loss or correct metabolic abnormalities that interfere with the athlete's health status and performance capabilities [23]. Nutrition counseling and monitoring should be sufficient for many female athletes; however, disordered eating behaviors most likely require psychotherapy, and stress fractures require physical therapy and a reduction in training volume and intensity [24].

## **6. CONCLUSIONS**

Eating disorders in sports lead to the phenomena of the Triad and RED-S. According to research, the problem concerns 19.4%-training athletes in running, 23.0% experience irregular menstrual periods, and 29.1% show inadequate calcium intake. This group may be larger. According to Macleod 15% to 65% of sportsmen and women may have pathogenic nutrition patterns. This is the output to further complications. Obtaining exact epidemiologic data is difficult because of the lack of reporting or gathering data from athletes. Like individuals with anorexia or bulimia, many athletes with the triad and RED-S try to hide their symptoms or behavior from friends, family, trainers or coaches. This is the main reason why diagnosis is so difficult. In fact, the vast majority of cases are diagnosed only after advanced symptoms become apparent. Milder cases may be extremely difficult to diagnose if the physician does not already have a high degree of suspicion. Among the reasons of disorders are a desire to maximize results, the use of different diets, trainer changes, injuries, illness. Early diagnosis gives a chance to counter the negative effects. So, it is possible to prevent further changes in menstrual function, bone health, endocrine, metabolic, hematological, immunological, cardiovascular, gastrointestinal and psychological parameters.

34% of women involved in sport disciplines such as gymnastic and diving have an eating disorder. These are observed to occur often among women practicing martial arts (27%) or endurance sports (20%). The diagnosis of anorexia or bulimia concerns 13% of women involved in technical sports (eg. target shooting) and 11% of team games players. The only group of athletes, in which eating disorders were more frequent than in the control group were women training strength sports. In general, among sportswomen eating disorders reached 20%, while in the control group 5%.

As it has been mentioned above, the diagnosis of disorders is based on surveys consisting of questions about nutrition, injury and reproductive functions. Many validated sources for evaluating disordered eating in athletes exist: the Athletic Milieu Direct Questionnaire (AMDQ), the Low Energy Availability in Females Questionnaire (LEAF-Q), the Female Athlete Screening Tool (FAST), the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) and the American Physiological Screening Test for eating disorders among Female College Athletes (PST). The prevalence of low energy availability in female

athletes is difficult to assess and until recently a validated source for evaluation did not exist. Multiple factors (eg. the difficulty of gathering accurate caloric intake data from athletes, inability to measure energy expenditure, uncertainty regarding which sports to include, which attitude survey to use, and varying definitions of eating disorders) compound the issue. Márquez and Molinero recommend a physical examination (PPE), health checks, analysis of dietary diaries, checking body composition and body fat using impedance or dual energy X-ray absorptiometry.

The main tool in the fight is a nutritional education. The athletes' awareness of the impact of nutrition on the presented sports level has the strongest influence on their decisions. Further actions involve various treatments.

Prevention of eating disorders in athletes is extremely important. The advent of the new term (RED-S) indicates a growing problem. This applies not only to women but also men.

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