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Editorial Open Access

Low Energy Availability-A Missing Piece in Injury Risk Screening: Female Athlete Triad (Triad)/Relative Energy Deficiency in Sport (Red-S)

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Editorial

American College of Sports Medicine defines the term "energy availability" as the amount of energy left over and available for normal body functions after the energy expended for training is subtracted from the energy taken in from food (1). Low energy availability in athletes may result from eating disorders which may have a metabolic and health consequences associated with the Female Athlete Triad (FAT) [1,2].

The FAT is the condition where menstrual dysfunction, low energy availability and decreased bone mineral density are present [3]. All those factors may contribute to increased risk of injury [4]. The FAT are most popular in athletes involved in sport disciplines which promote weight loss and leanness e.g., gymnastics, figure skating, ballet, diving, swimming, and long distance runners. Clinical symptoms of FAT may include disordered eating, fatigue, hair loss, cold hands and feet, dry skin, rapid weight loss, increased tissues healing time, increased incidence of bone fracture, amenorrhea, anemia, orthostatic hypotension, electrolyte irregularities and bradycardia [3,4]. The main problem in FAT it is the low energy availability which decrease the appropriate bone mineral density (BMD) and may affect the hypothalamus's output of gonadotropic hormones decreasing the amount of estrogen and disrupt the menstrual cycle [5,6]. It was reported that in women who participate in sports that emphasize leanness, the prevalence of secondary amenorrhea reaches 69%, compared with 2% to 5% in the general population. Also low estrogen levels and malnutrition can promote the osteoporosis which may lead to stress fractures and other injuries [6,7]. It was reported that athletes with low BMD and with menstrual irregularity more often are exposed to stress fractures especially at the tibia.

Recently, the International Olympic Committee expert working group introduced a more comprehensive term for Female Athlete Triad named Relative Energy Deficiency in Sports (RED-S). What is important they have underlined the fact, that male athletes are also affected. The syndrome of RED-S due to relative energy deficiency may impair many physiological functions like metabolic rate, menstrual cycle, bone health, immunity, protein synthesis and cardiovascular health [8]. RED-S may lead to a gradual disruption of performance by decreased endurance, increased risk of injury, poor response to training, impaired cognitive function, decreased coordination, decreased concentration, irritability, depression and decreased muscle strength [3,8,9].

Growing evidence have suggested that FAT and RED-S may place an athlete at greater risk for musculoskeletal injury and bone stress fractures, therefore the early detection and prevention are especially important. The main symptoms like decline in performance, changes in mood, rapid weight loss, frequent injury should be detected at pre-participation physical examinations or at annual health checkups [3,10]. Clinical assessment should start with a detailed history, including questions regarding physical activity, past injuries, menstrual history, diet and eating behaviours [11]. The musculoskeletal examination should also include palpation, vibratory pain evaluation and radiological imaging of the spine and shins what may detect the presence of bone fractures.

It was reported that in FAT and in RED-S the symptoms of impaired endocrine-metabolic function and bone health in both male and female athletes may be evaluated with qualitative screening tools (e.g., Low Energy Availability in Females questionnaire) and with quantitative measurements (metabolic hormones rate, BMD, resting metabolic rate) [12]. The most popular screening toll it is Low Energy Availability in Females questionnaire which determines risk of low energy availability by assessing symptoms associated with energy deficiency, such as menstrual and gastrointestinal function and injury history [12,13]. The quantitative methods for FAT and RED-S symptoms screening are multifactorial. Bone density can be quantified by dual-energy X-ray absorptiometry (DXA) and measurement of resting metabolic rate via indirect calorimetry may provide confirmation of suppressed metabolism [14].

Because the FAT and RED-S are common in athletes they appear as important factors influencing overall athletes performance and increasing risk of injury. Therefore, it should be considered and carefully evaluated during the return to sport (RTS) after injury. The potential presence of FAT and RED-S should be assessed as well during athletes regular monitoring as after injury during return to sport.

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