NUTRITIONAL CHALLENGES FOR GIRLS AND WOMEN IN SPORT

AN EXPERT REFRESHER

This resource was created by Faye Townsend, Registered Sports Nutritionist (AfN & SENr) in collaboration with the GetPRO Professional team

Female athletes face distinct nutritional challenges due to physiological, metabolic, and hormonal differences compared to male athletes. However, much of the research in sports nutrition has historically focused on male athletes, resulting in generalised recommendations that may not adequately address female-specific needs. This expert refresher highlights key considerations for sports nutritionists working with female athletes, focusing on nutritional priorities and the risks of Relative Energy Deficiency in Sport (RED-S).

PHYSIOLOGICAL DIFFERENCES BETWEEN FEMALE AND MALE ATHLETES

Women's bodies differ from men's in several key physiological ways that may affect nutrition and performance. Female athletes, on average, have a higher percentage of body fat and a lower proportion of muscle mass than males, influencing both energy expenditure and nutrient requirements. Women also experience unique hormonal changes, such as fluctuations during the menstrual cycle and throughout different life stages such as menopause, which may affect metabolism, energy utilisation, and recovery demands. These differences necessitate tailored nutritional strategies to support optimal performance and health.

Despite these key differences, only 6% of sports science research from 2014 to 2020 concentrated exclusively on women[1]. Female athletes must rely on generalised advice that often fails to address their specific needs.

HORMONAL FLUCTUATIONS AND THEIR IMPACT ON NUTRITIONAL NEEDS

The menstrual cycle introduces significant hormonal fluctuations that affect female athletes' metabolism, energy utilisation, and recovery needs. The menstrual cycle lasts 28 days in a "textbook" example, but it can vary, with a cycle length of 21–35 days classified as eumenorrheic. It is divided into two distinct phases: follicular and luteal. These phases involve shifting levels of two key hormones, oestrogen and progesterone. Whilst the primary role of these hormones is related to reproduction, their effects extend to multiple systems, including cardiovascular, metabolic, and muscular functions, all of which can have a direct effect on performance outcomes.

Oestrogen may enhance insulin sensitivity, promoting glycogen uptake and glycogen sparing, and may offer protection against muscle damage and inflammation. It is also linked to improved muscle strength, bone density, and cardiovascular efficiency[2].

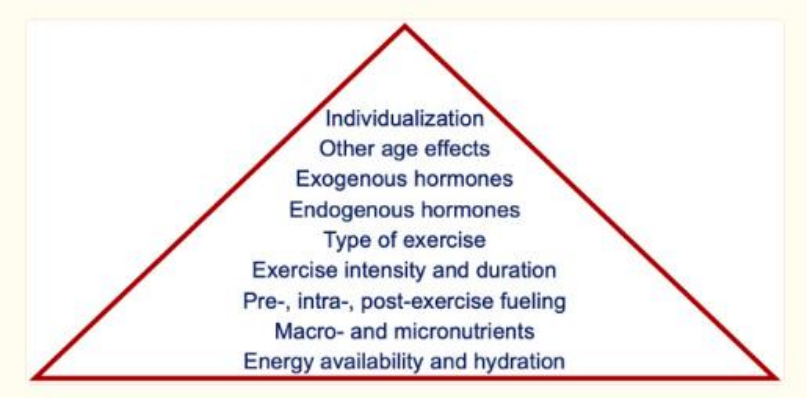
Progesterone, acts as a counterbalance to oestrogen, promoting insulin resistance and resulting in a greater reliance on carbohydrates during exercise. It also raises body temperature and promotes fluid retention[3]. Additionally, progesterone can influence neuromuscular control and emotional states[2].

While oestrogen and progesterone may theoretically influence these systems, evidence remains conflicting on the impact on performance, with many studies showing no significant effect[2,3]. Despite this, it's been reported that between 36-93% of active women perceive that their menstrual cycle or hormonal contraceptive use influences their ability to perform or train[4]. One plausible reason could be the impact of cycle-related symptoms such as period pain, mood changes, bloating, cravings, disturbed sleep and breast pain. Symptoms are reported to be most severe during menstruation, coinciding with a perceived decline in exercise performance and prolonged recovery time post-training[4].

Recommendations: Encourage athletes to log their menstrual cycles and track symptoms such as changes in workout performance, recovery times, energy levels, and menstrual symptoms. This data can be collected through apps and used to make informed adjustments to their nutrition and training regimens.

NUTRITIONAL PRIORITIES FOR FEMALE ATHLETES

To effectively tailor nutrition for female athletes, a hierarchical approach is recommended (Figure 1)[5]. Start by ensuring sufficient energy availability and hydration, as optimising nutrient intake based on menstrual cycle phases is pointless without meeting basic energy needs. Next, address the three core macronutrients (carbohydrates, proteins, fats) and essential micronutrients (vitamins and minerals). After establishing these fundamentals, refine the plan by considering the timing of intake around exercise, the type, duration, and intensity of workouts, and any hormonal influences from the menstrual cycle or contraceptive use. Additional age-related factors can then be incorporated. Finally, individualise the plan to the athlete's specific needs. Since high-quality research on cycle-specific or hormonal nutrition guidelines is limited, prioritise energy and sport-specific nutrition first before delving into more detailed menstrual related adjustments.



(Figure 1) Caption: Potential hierarchy of nutritional considerations and needs for female athletes. When designing nutrition plans, athletes should ensure that all lower components are achieved when stepping up the pyramid. (Credit: Holtzman & Ackerman, 2021, reproduced under the Creative Commons license CC BY 4.0)

CARBOHYDRATES

Female athletes may experience reduced glycogen storage during the luteal phase (high progesterone) compared to the follicular phase (rising oestrogen levels and low progesterone). As such, during the luteal phase, changes in metabolism could theoretically impact performance. Consuming a high-carbohydrate snack 3–4 hours prior to exercise can help counteract these effects[6]. However current evidence does not support substantial variations in carbohydrate needs across cycle phases with current recommendations still largely based on males[6].

PROTEIN

The International Society of Sports Nutrition recommends a daily protein intake of 1.4-2.2 g/kg/day, depending on training intensity, with special emphasis on ensuring adequate intake during the luteal phase, when recovery demands may be higher due to increased protein breakdown[7].

THE RISK OF INADEQUATE NUTRITION (RED-S)

One of the biggest risks for female athletes is Relative Energy Deficiency in Sport (RED-S), which occurs when energy intake is insufficient to meet both training demands and essential bodily functions. This state of Low Energy Availability (LEA) can result from intentional calorie restriction, overtraining, or unintentional under-fuelling.

RED-S (Relative Energy Deficiency in Sport) is an expanded concept that evolved from the former Female Athlete Triad. While the Female Athlete Triad focused specifically on female athletes and the interrelationship between low energy availability, menstrual dysfunction, and bone health, RED-S broadens the scope to include athletes of all genders and recognises the systemic effects of energy deficiency. The effects of REDS can span reproductive, bone, cardiovascular, gastrointestinal, immune, and psychological health. Performance-wise, RED-S is linked to fatigue, slower recovery, reduced endurance, and muscle

weakness, which can hinder training intensity and impact performance[8,9].

An energy availability (EA) of less than 30 kcal/kg of fat-free mass (FFM) per day is considered the clinical threshold LEA in females. However, athletes may experience subclinical LEA even when their EA is above this value but still below optimal levels. For healthy adults, an EA of 45 kcal/kg/FFM/day is deemed sufficient to meet energy requirements[10].

DIAGNOSING AND IDENTIFYING RED-S

Diagnosing Relative Energy Deficiency in Sport (RED-S) is challenging due to its subtle and varied symptoms. Common signs include menstrual irregularities like missed (amenorrhea) or irregular periods, recurrent stress fractures, persistent fatigue and stagnation or declines in performance. These symptoms often overlap with other conditions or may be dismissed as part of the demands of athletic training, further complicating diagnosis.

The RED-S Clinical Assessment Tool (RED-S CAT)[11] provides a structured framework for identifying RED-S by examining clinical signs, performance issues, and health markers. For example, hormonal imbalances, such as low oestrogen in females, reduced bone density (e.g., seen via DEXA scans), and nutritional deficiencies identified through blood tests.

Accurately measuring energy availability in free-living athletes is difficult, as tracking energy intake, exercise expenditure, and fat-free mass pose significant challenges. As a result, clinicians typically assess RED-S risk using indirect markers such as menstrual irregularities, hormonal imbalances, and signs of compromised bone health. The diagnosis of RED-S is ultimately a medical process requiring a thorough evaluation by trained healthcare professionals. Once RED-S is identified, management should be guided by a multidisciplinary sports medicine team, including physicians, dietitians, and mental health professionals, to ensure comprehensive care and support.

For full details on diagnosis and the return-to-play criteria see the **RED-S Clinical Assessment Tool (RED-S CAT)** [11]

KEY MICRONUTRIENTS CONSIDERATIONS

Female athletes are at higher risk of deficiencies in certain micronutrients, particularly iron, calcium, and vitamin D, due to menstrual losses, inadequate intake, and the demands of training.

IRON

Female athletes are at increased risk of iron deficiency due to menstrual blood loss and the demands of exercise, which can cause fatigue, reduced performance, and delayed recovery. Iron deficiency is particularly common in female endurance athletes, with prevalence rates of 15–35%[12]. Regular screening, especially in

high-risk population groups (RED-S, heavy menstruating female, vegan athletes etc.) is essential, as symptoms may not always be obvious[13]. While the UK RNI for women aged 19–50 is 14.8 mg/day, female athletes may need more to meet higher demands, especially if they have heavy menstrual cycles, train intensely, or follow restrictive diets[14,15]. Dietary strategies should emphasise iron-rich foods and pairing plant-based sources with vitamin C for better absorption[16]. Supplementation, if needed, must be guided by healthcare professionals to avoid side effects such as iron overload.

CALCIUM

Adequate calcium intake, ranging from 1,000 to 1,300 mg per day, is essential for maintaining bone health[17]. Athletes at higher risk of low calcium intake (i.e. menstrual disturbances or those at risk of RED-S) should aim for 1,500 mg per day to optimise bone health[5]

VITAMIN D

To protect bone health, female athletes should also aim to maintain 25-OH-vitamin D levels above 50 nM. This can be achieved through daily supplementation of 1,000–2,000 IU of vitamin D3, depending on factors such as time of year and regular sun exposure[5].

TAKE HOME POINTS

- High-quality evidence is limited: Research on female athletes, especially the impact of menstrual cycle phases, is still developing.
- Because hormonal fluctuations can impact carbohydrate and fat metabolism, hydration needs, and recovery, female athletes may require specific nutritional strategies to account for physiological and hormonal differences.
- Female athletes are at a higher risk of RED-S, and maintaining adequate energy availability is critical for both performance and long-term health.
- Micronutrients such as iron, calcium, and vitamin D are particularly important for female athletes to support bone health and overall performance.

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