# PREPARING FOR THE OLYMPICS FROM A SPORTS NUTRITION PERSPECTIVE

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## INTRODUCTION

The Olympic Games, held once every 4 years, stands as the most important competition for athletes across the World. During the "Olympic year" the main objective of every elite athlete is to qualify for the Olympics in his/her specialized event and to perform at their absolute best in competition day/s.

Several training and nutritional strategies can be implemented to achieve this target. Training Periodization is a strategy where specificity, intensity, and volume in training sessions vary throughout the year. The concept of progression of training activities dates to the ancient Olympic games, and this evolved to periodization which was restructured in the 1940s by Soviet sports scientists advocating a systematic approach to the planning and distribution of training activities to optimize performance. They discovered that varying the training stresses throughout the year improved athletic performance, rather than maintaining constant training from month to month[1]. While the scientific basis of this approach is disputed in modern scientific literature, the principle and the pedagogical approach is still in place in the coaching communities. In parallel, the concept of nutritional periodization was developed and implemented to optimize these training load changes during the year, and to ensure the different energy expenditures align with adequate energy and nutrient intake whenever the training load fluctuates[2]. **In fact, nutrition goals and requirements are not static, and a yearly nutrition plan should be tailored accordingly**.

There are three main training cycles, each with very specific goals[1]:

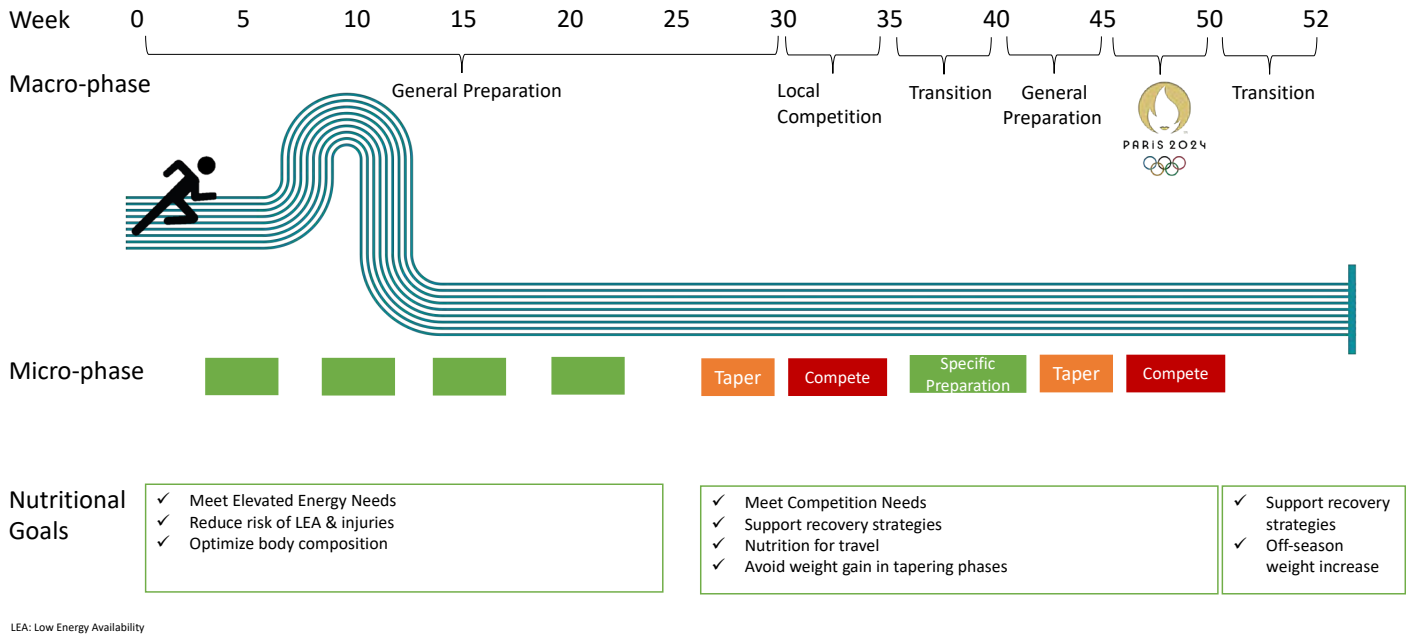
- Macrocycle: "the big picture" includes the entire year or a 4-year plan for Olympic athletes,
- Mesocycle: spans 2-3 months around competition schedules and
- Microcycle: details of each week.

Each athlete is unique in his/her own way, and each sport discipline and event require different training loads and specificities, hence the nutrition plan is as individualized as the training program. This paper addresses the critical aspects of sports nutrition for track and field athletes preparing for the Olympics, emphasizing the significance of periodization in both training and nutrition. Figure 1 outlines nutrition periodization goals for track and field athletes during training cycles throughout the year.

## PRESEASON NUTRITION: FOCUS ON INJURY PREVENTION

Each of the traditional periodization training plans for Track and Field start with high volume, low intensity training[4]. Training volume is related to energy expenditure (EE) and the higher the volume in the general preparation phase, the higher the post exercise EE and Resting Metabolic Rate[5,6].

When considering the objectives of preseason nutrition (Table 1), common nutritional challenges during the periodized training and across the Track and Field disciplines are (1) achieving the optimal body composition (high muscularity in sprints and hurdles; moderate muscularity in jumps and throws; lean physique in mid/long distance runners), and (2) avoiding Low




*Adapted from Stellingwerff et al*[3]

**Figure 1:** Overview of nutrition goals during yearly training phases for track and field athletes.

## Table 1

***Track and Field athletes should follow a tailored nutritional plan to:***

- *Ensure high fuel availability*[7,8]
- *Support training volume in preseason while minimizing weight gain*[9]
- *Avoid extreme dieting behaviors that affect health and performance*[8]

**Table 1:** Objectives of Preseason Nutrition in Track and Field.

Energy Availability (LEA) and its negative health and performance effects.

*a. Preseason Energy Needs; Concerns About Restriction*

A dietary survey among track and field athletes reported that there was a 30% lower caloric intake than the energy needed[10]. In addition, some studies reported that female athlete's energy intakes are lower than that of males, per kilogram of body weight (BW) per day; 40 Kcal/Kg BW/day for females and 55 Kcal/Kg BW/day for males[11]. Many factors may explain the intake difference between sexes, including a lower requirement due to lower training volume/intensity or even under reporting. However, the mismatch between dietary surveys and needs shows that sports dietitians supporting the Olympic athlete should monitor energy availability (EA) during the season, especially in the preparation and competition phase where load and intensity fluctuate, and when athletes may focus on weight loss and reduce voluntarily their intakes, negatively affecting their performance.

In the general preparation phase, athletes train 9-14 sessions amounting to more than 12 hours per week. This load translates into an increase in EE during preseason; it is important to ensure that adequate energy intake is optimal for EA and assess for Relative Energy Deficiency in Sport (REDs), if required[9].

For some track and field disciplines such as jumps and middle distance, development of power-to-weight ratio is needed and meal plans after the preseason can focus on gradual fat mass loss, without compromising performance and recovery. This strategy should be adopted many months in advance of competition and should not be sustained throughout the season.

*b. How to Assess Energy Availability?*

EA assessment calculates the amount of energy that the body uses for health, well-being, and performance functions. It is the amount of fuel left for ideal physiological function after accounting for the energy demands from exercise. It is common that when the preseason load increases, Exercise Energy Expenditure (EEE) increases, reducing the amount of fuel available for bodily functions and leading to a low and problematic EA (see Equation 1). This can also result in negative health and performance consequences known as REDs[7].

$$\textbf{EA in Kcal per Kg per day} = \frac{\textbf{EI (Kcal)} - \textbf{EEE (Kcal)}}{\textbf{Fat Free Mass (Kg)}}$$

**Equation 1:** Equation for Energy Availability Assessment[7].

EI; Energy Intake may be assessed through a 24-hour recall. EEE; Exercise Energy Expenditure may be calculated using smart watch devices [however be wary of the estimation errors] combining heart rate monitors and accelerometers/Metabolic equivalent equations/ indirect calorimetry. FFM; Fat Free Mass may be assessed through Bio Electrical Impedance Analyzer machines (BIA) / Dual Xray Absorptiometry (DEXA).

While still under examination, there is a general understanding that EA of 30 Kcal/Kg BW in females may be an indicator of Low Energy Availability (LEA). This number is still not well researched in males[7] but < 30 Kcal/Kg BW in males may be used as a guidance that an athlete requires careful examination of his/her energy intake during the preseason.

REDs must not be confused with LEA as it is a *"A syndrome of impaired physiological and/or psychological functioning experienced by female and male athletes that is caused by exposure to problematic (prolonged and/or severe) LEA"*[7(p1074)]*."*

When left untreated, prolonged LEA and REDs may lead to increased risks of injuries and missed training days, which may significantly impair Olympics' preparations.

*c. Fueling and Bulking Needs for Training and Recovery: Carbohydrate and Proteins*

As track and field disciplines are varied, there is not one single nutritional plan that can be applied in preseason to all the athletes. An individual assessment of body composition, training program and objectives are recommended to tailor a plan.

Protein needs should be considered based on the training activities, the event the athlete competes in and the body composition individual targets. For example, when the training focus is on resistance exercise and/or large volumes of plyometric activities (typical of jumps, sprint, throws) there may be the need to increase protein intake and adjust timings of intake to facilitate an increase in Muscle Protein Synthesis (MPS). For example, a bedtime dose of 40 g protein or more can be appropriate to support overnight recovery and enhance MPS[12,13]. In Combined Events (CE), it is important to ensure protein containing snacks are spread around the multiple training sessions. Protein intake in combination with carbohydrates before and/or after specific training sessions might improve the quality of the session, amplify the adaptations, and potentially aid in recovery[14].

Jumps

Training focuses on technique and explosive speed development. Athletes may have back-to-back sessions of strength training, sprint training, sports specific training and plyometrics, or sessions may be separated by a few recovery hours. The energy system mostly utilized is anaerobic and carbohydrate needs are low to moderate. These athletes are constantly trying to control body composition and avoid gaining body weight.

However preseason training focuses on technical and strength training and is higher in volume. The focus should be on the athlete's carbohydrate intake at frequent times during the day to fuel and recover from the multiple sessions[13].

Throws

Throwers' training focuses on upper body, trunk, and legs power to maximize throw velocity. Preseason sessions include throwing where athletes repeatedly throw and retrieve, and weight bearing training. Throwers have large body masses and there is limited information on their dietary requirements based on training activities. Although scarce, studies show that throwers are eating less than their estimated needs of 4,328 Kcal/day for males and 2,956 Kcal/day for females[15].

Energy and carbohydrate needs will increase if heavy lifting phase increases or when throws are repeated during the preseason. Throwers' carbohydrate needs remain on the low to moderate range in the preseason, but when calculated according to body weight, the number may seem elevated in comparison to other track and field sports as throwers' body mass tends to be higher than other track and field disciplines[8]. Increases in lean mass are often sought with throwers and the appropriate balance of protein and carbohydrate intake should be sought. It is likely that throwers might need larger protein amounts than the RDA of 0.8 g/Kg/BW. It is also important to state that excessive protein intake might not be advisable either. A recent systematic review and meta-analysis analyzing randomized controlled trials in healthy individuals performing resistance exercise reported that protein intakes at amounts greater than ~1.6 g/Kg/day do not further contribute to resistance training-induced gains in FFM[16].

Combined Events

CE athletes train for 3-6 hours 6 days per week; their sessions cover 3-5 events per day. In the preseason, there is a higher volume of fitness, strength, and training sessions devoted to improving cardiorespiratory function, while track and technique sessions increase in intensity and frequency during the competition preparation[8]. The main limitation is that of time and resource management; (1) finding suitable slots to eat and (2) enough time away from the next training to digest, and (3) space to prepare/hold and consume meals are challenging.

Carbohydrate intake before training and EA are primary for performance in these disciplines, especially if the training sessions are between 90-120 minutes. Track and field athletes may train their gut to fuel between 60-120 g of carbohydrate-containing foods (Table 2) per hour to maintain performance[17].

It is recommended that breakfast and pre training snacks account for more energy and carbohydrates than other meals and it is proposed that later meals, ie. Dinner, are lower in carbohydrates and energy[8]. It is also recommended that easily digestible and fast absorbed forms of carbohydrates and protein are consumed as snacks between training sessions, to support the fueling and recovery for the next training. It can be in the form of solid foods like peanut butter sandwiches, or Greek yoghurt with fruit, carbohydrate gels, whey protein mixes with milk, sports bars containing carbohydrate and protein, or even fruit purees or smoothies with yoghurt/protein powder when appetite is low. However, based on personal observation, athletes in the preparation phase miss lunch times and recovery snacks due to the congested schedule; this affects their recovery, performance on next sessions, and physiological adaptations to trainings. This is one of the reasons why they are at risk of LEA during the preseason. Therefore, for these athletes, food intake plans are crucial and reliance on frequent

**Table 2**

***Foods that provide 30 g carbohydrate for fueling:***

- *1 large/ 2 small bananas*
- *400-500ml sports drink*
- *1 thick slice of bread with jam/ honey*
- *4 tablespoons raisins*
- *1 cup orange juice*
- *2 small apples*
- *Sport bar*
- *1 packet sport gel*

**Table 2:** Examples of carbohydrate containing foods for fueling.

## Table 3

| *To enhance iron intake through nutrition:* |
|---|
| • *Reduce consumption of tannins found in tea/coffee by 2 hours around mealtimes and around iron supplement intake.* |
| • *Avoid intakes of dairies in high amounts around mealtimes.* |
| • *Choose heme iron sources at each meal: meat, chicken, fish, seafood, tuna, canned sardines, eggs.* |
| • *Combine iron sources with Vitamin C like chicken + green salad + lemon oil dressing.* |
| • *Avoid skipping meals.* |

**Table 3:** Dietary modifications to enhance iron intake.

## Table 4

| *Aim for 3-4 servings of calcium sources per day:* |
|---|
| • *Solid cheeses* |
| • *Yoghurt* |
| • *Milk* |
| • *Tahini* |
| • *Canned sardine* |
| • *Beans* |
| • *Almonds* |
| • *Leafy greens* |
| • *Edamame* |
| • *Dried figs* |

**Table 4:** Dietary sources of calcium.

## Table 5

| *One day example of carbohydrate loading providing 650 g of carbohydrate (for a 65 Kg male consuming 10 g CHO/Kg/day)* | |
|---|---|
| *Breakfast:* | *2 cups cereal with milk + 250 ml fruit juice + 1 large banana + 2 thick slices of toast + thick spread of jam* |
| *Snack:* | *1 medium chocolate muffin* |
| *Lunch:* | *1 large bread roll with honey + 1 large cookie + fruit smoothie + 200 g flavored yogurt* |
| *Snack:* | *2 cereal bars or granola bars* |
| *Dinner:* | *3 cups of cooked pasta + 2 cups of fruit salad + 500 ml sports drink* |
| *Snack:* | *80 g chocolate bar* |

**Table 5:** One day example of carbohydrate loading. CHO=carbohydrate.

snacking during the day might overcome the challenges and provide adequate nutritional intake to support health and enhance performance. Choice of snacking should be individualized to preference, intolerances, training activities content and adequate ratio of macronutrients.

*d. Immunonutrition And Deficiencies; Vitamins, Minerals And Antioxidants*

Since preseason is where the most strenuous exercise happens, it is important to protect athletes from vitamin/mineral deficiencies and support the immune system that is affected from the increased training volume.

Track and field female athletes are at higher risk of iron deficiency compared to other sports, specially in the early preparation phases where adaptation is still low[18]. Iron is also a contributor in supporting immune function; a reduction in iron levels affects the ability to defend from an infection[19]. Plasma serum ferritin ranging from 12-35 μg/L indicates iron deficiency and requires remediation through iron supplementation and nutritional changes. Dietary modifications prioritize enhancing iron absorption and including iron rich foods at each meal (Table 3) to meet the recommendations[18].

Female athletes are also more at risk for stress fractures than male athletes, due to a higher exposure to REDs; this can reduce the calcium absorption and fixation and ultimately reduce the bone density[20]. It is important to ensure that athletes have an adequate intake of energy first and Vitamin D, protein, and calcium sources, in combination with appropriate sun exposure. An easy way to ensure this is by consuming daily a variety of fruits and vegetables at each meal and in between meals, and the daily inclusion of 3-4 calcium food sources (Table 4).

It has been documented that periods of prolonged and intense training increase the incidence of illness in elite athletes. Immune cells activity is reduced during recovery after intense bouts of exercise, which results in immunodepression[21]. However, studies do not indicate that antioxidant supplementation is certainly helpful in supporting immunity during these periods of time. On the contrary, antioxidant supplementation might reduce exercise adaptations that are necessary for performance[19]. Dietary sources of antioxidants and polyphenols are recommended with a focus on fruits, vegetables, nuts, and seeds. This will help in reducing exercising-induced inflammation and in enhancing viral defense.

COMPETITION PHASE NUTRITION: FOCUS ON PERFORMANCE STRATEGIES

As the season progresses nearly to the competition phase, whether regional or international, there is a reduction in training volume for track and field athletes. For jump athletes the emphasis shifts to optimizing jump-specific skills. For throws, the priority turns to refining throwing techniques and power. In combined events, the training becomes more specific, and event focused.

*a. Carbohydrate Loading:*

Although carbohydrate needs may decrease during this phase due to reduced intensity loads, it remains important to strategically consume carbohydrate sources a few days pre-competition to support performance.

Carbohydrate loading is a nutrition strategy that involves eating more carbohydrates to boost athletes' energy before a competition.

Carbohydrates serve as the body's primary energy source, stored as glycogen for use during high-intensity activities lasting over 90 minutes[22]. Carbohydrate loading can maximize glycogen stores before competition, benefiting events reliant on glycogen, such as intense resistance training or repeated explosive movements in jumps/throws/sprints. This strategy aims to delay fatigue, maintain performance, and prevent the decline in pace or output that happens towards the end of competition. Carbohydrate loading involves consuming 10-12 g/kg BW of carbohydrates 2-3 days before competition (example plan in Table 5), coupled with reduced training intensity[2]. This stored glycogen acts as fuel for optimal performance during the event.

*b. Pre-Event Meal:*

Foods and drinks consumed in the four hours before an event play multiple roles in competition preparation. Certain roles include enhancing muscle glycogen stores if they have not been fully restored since the last exercise session, as well as avoiding any gastrointestinal discomfort and upset often experienced during exercise. Athletes are recommended to consume a meal containing 1-4 g/Kg BW of carbohydrate during the 4-hour period leading to the competition[22]. The pre-event meal should include carbohydrate rich foods and drinks, moderate amounts of lean protein, and small amounts of foods with fat and fiber. Since every athlete is unique, the timing and type of pre-event meal may vary. Athletes should find a preferred familiar pre-competition meal that had already been tested for its gastrointestinal comfort during the preseason and should not try any new nutritional strategy on competition day.

*c: Competition Hydration:*

Athletes should prioritize proper hydration before competition, avoiding restrictions on water intake leading up to warm-up. It is essential to develop effective approaches for maintaining proper hydration and re-hydration strategies to prevent dehydration[23]:

1. Monitor urine color using a chart to assess hydration status, aiming for a lighter yellow color (Figure 2)
2. Pre-competition, consume water-rich and electrolyte-rich foods like bananas, nuts, milk, and crackers.
3. In the 60-90 minutes before the event, aim for 400-700 ml of fluid intake.
4. During competition, drink 300-600 milliliters every 15-20 minutes, incorporating electrolyte drinks/gels for longer events or in hot conditions.
5. Weighing oneself before and after exercise helps determine fluid loss, with a goal of drinking 1.2-1.5 liters for each kilogram of body weight lost.

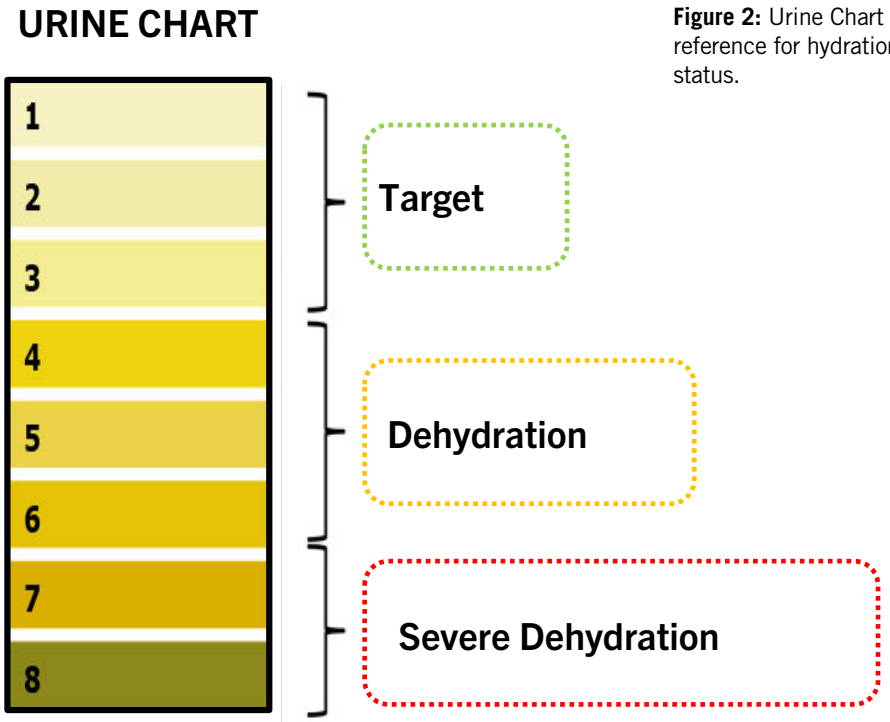



**Figure 2:** Urine Chart reference for hydration status.


**Figure 3:** QR code reference for sports supplements safety.

*d. Sports Supplements and Safety:*

The sports supplement industry's lack of regulation raises concerns about false advertising and unverified claims, putting athletes at risk of anti-doping violations due to potential contamination with banned substances. Manufacturers' claims don't guarantee compliance with anti-doping standards, and contaminated supplements may contain undisclosed banned substances. To mitigate these risks, athletes are advised to choose third-party tested supplements, providing independent verification of purity. Ethical use of sports supplements is a personal decision, and athletes should stay informed about prohibited substances through regulatory bodies, World Anti-Doping Agency (WADA), and the level of scientific evidence for supplements through organizations like the Australian Institute of Sport (AIS) (see Figure 3). Scientifically proven supplements are limited, and qualified Sports Dietitians are crucial for assessing athletes' nutrition and providing evidence-based guidance on

## Table 6

| *Sports Nutrition Key Recommendations* |
|---|
| 1. *Nutrition Periodization Cycles Approach:* |
| • *Use training and nutritional periodization to align with changing intensity, volume, and specificity throughout the year.* |
| • *Macrocycle: Plan nutrition for the entire Olympic cycle.* |
| • *Mesocycle: Adjust plans every 2-3 months based on competition schedules.* |
| • *Microcycle: Tailor weekly plans to individual needs and event specifics.* |
| 2. *Preseason Nutrition Focus:* |
| • *Emphasize injury prevention.* |
| • *Monitor energy intake to prevent LEA and associated health issues.* |
| 3. *Fueling for Training and Recovery:* |
| • *Customize protein intake for muscle repair.* |
| • *Prioritize easily digestible carbohydrate and protein sources between sessions.* |
| 4. *Immunonutrition and Deficiency Prevention:* |
| • *Address vitamin/mineral deficiencies, especially iron for females.* |
| • *Support immune function with dietary antioxidants and polyphenols.* |
| 5. *Competition Phase Nutrition:* |
| • *Consider carbohydrate loading 10-12g/Kg BW 2-3 days pre-competition to maximize glycogen stores.* |
| • *Consume a pre-event meal with 1-4 g/Kg BW of carbohydrate 4 hours before the event.* |
| • *Prioritize proper hydration with individualized strategies.* |
| 6. *Sports Supplements Considerations:* |
| • *Exercise caution with sports supplements due to regulation gaps and anti-doping risks.* |
| • *Choose third-party tested supplements for purity verification.* |
| • *Consult qualified Sports Dietitians for evidence-based supplement guidance.* |

**Table 6:** Key recommendations for athletes preparing for the Olympics from a sports nutrition perspective.

the effectiveness, safety, and proper dosage of supplements[2]. It is important to remind athletes of the strict liability principle when considering taking supplements. Products can become contaminated with prohibited substances during the manufacturing process. An important principle of the WADA Code is strict liability, which states that athletes are solely responsible for any prohibited substances in their system, regardless of how it got there and if there was an intention to cheat. Before taking supplements, athletes must therefore assess the need, risk, and consequences to their careers. Coaches should seek advice from qualified sports dietitians when recommending supplements to athletes and avoid providing athletes with unnecessary and/or potentially harmful supplements.

SUMMARY STRATEGIES

Sports nutrition key recommendations vary by sports discipline and individually, for the athlete preparing for the Olympics. It is important that Sports Dietitians engage with coaches and athletes to understand the Training Periodization, the daily demands, and the competition and travel schedule. Key recommendations are listed in Table 6, while Table 7 (next page) summarizes the nutritional strategies according to the training period, with a matching range of macronutrients. It is also important to sit down with the athlete and reevaluate and change strategies frequently, to guarantee an individualized approach based on not only performance, but also on how the athlete 'feels' and is applying the strategies.

*References*
*Available at www.aspetar.com/journal*

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**Table 7**

| *Season time* | *Physiological Goals* | *Sports Nutrition Areas of Focus* | *Macronutrients (g/Kg BW/ day)* |
|---|---|---|---|
| *Pre-season (preparatory/base cycle)* | • *Improve strength, endurance, flexibility, sports-specific technical and tactical skills.*<br>• *Improve metabolic efficiency (oxidize more fat to preserve glycogen stores).* | • *Fat loss for optimized performance (in general the weight gained during off season).*<br>• *Nutritional needs are based on the training load; reduce risk for Low Energy Availability.*<br>• *Perfect time to experiment foods to determine whether they are "GI friendly" before, during and after workouts.* | *CHO:*<br>*Jumps: 5-7*<br>*Throws: 3-6*<br>*CE: 5-8*<br><br>*PRO:*<br>*1.5- 2.2*<br><br>*Fat*<br>*0.8 – 1.5* |
| *Competition phase/ In Season* | • *More sports-specific goals: focus on specificity (improving strength, speed, power, agility, economy…)*<br>• *Intensity is higher (thus energy expenditure is greater)*<br>• *Regardless of the pattern, each training day is different, and the athlete should eat for that day's energy expenditure goals.* | • *Strategies that reduce or delay factors that would cause fatigue.*<br>• *Practice competition simulation eating during training where the specific nutrition plan (before, during, and after) can be tried.*<br>• *Fine-tuning the nutrition plan (including hydration, electrolytes, supplements) based on length of training and climate conditions.*<br>• *When traveling, routine is disrupted; reduce the risk of illness, travel fatigue and exposure to openly available food by taking the time to plan and prepare the nutrition plan before traveling.* | *For competition*<br><br>*CHO:*<br>*Jumps: 3-5*<br>*Throws: 3-5*<br>*CE: 5-12*<br><br>*PRO:*<br>*1.4 – 2.0*<br><br>*Fat*<br>*1 – 1.5* |
| *Off-season* | *Physical and mental break from training and competition or engaging in regular exercise without structure.* | • *Manage calorie intake (training is lower, necessary nutritional shift to support a lower energy expenditure).*<br>• *Prevent a large body weight and fat gain.* | *CHO: 3-4*<br><br>*PRO: 1.5 – 2.3*<br><br>*Fat: 1.0 – 1.2* |

**Table 7:** Sports Nutrition Strategies for Track and Field Athletes following a periodized training.
CHO=Carbohydrates; PRO=Protein; CE=Combined Events.
Adapted from Sygo et al[8] and Seebohar[1].