One step at a time:

From Nutrients to Food, back to Nutrients…

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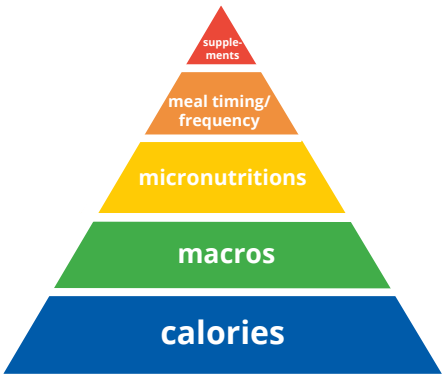
When talking sports nutrition, order counts. Following a step by step approach will assist the athlete to attend to the most beneficial dietary practices first, followed by fine-tuning of dietary strategies. As athletes continue onwards and upwards, fine-tuning of specific dietary strategies can give the edge, specific to individual athletes in certain training conditions. To benefit from the fine-tuning strategies, athletes should start at the bottom in their quest to elevate to greatness.



The Pyramid of Nutrition Priorities

1 Enough calories:

The most important component and obvious start of optimal training and performance nutrition is to ensure adequate energy intake to support energy expenditure and maintain strength, endurance, muscle mass and overall health.[1] All athletes are fuelled by calories. Appropriate energy intake supports optimal body function, determines the capacity for intake of macronutrient and micronutrients and assists in manipulating body composition.[2] When energy consumption is inadequate to balance energy output, the effort of training can be lost, since muscle and fat will be used for energy. A restricted energy intake can also compromise the intake of other essential nutrients necessary for optimal sport performance and good health.[3]

Athletes must consume enough energy to cover the energy costs of daily living, the additional energy cost of their sport and the energy costs associated with building and repairing muscle tissue. Female athletes of reproductive age must also cover the costs of menstruation, whereas younger athletes must cover the additional costs of growth.[3] Maintaining an overall energy balance is although influenced by various internal (e.g. genetic, metabolic, hormonal, neural) and external (e.g. environmental, social, behavioural) factors specific to each individual, that complicates accurate assessment of the energy needs of athletes in everyday living conditions. Athletes can although use prediction equations to estimate daily energy expenditure and therefore, daily energy need.[3,4]

Optimal energy intake will ensure higher energy levels, faster recovery and better concentration. The optimal diet to meet energy needs and enhance athletic performance would need to be personalized to meet the demands of the training schedule and competition.[4] An adjustment in total food intake will have the greatest impact on health or performance should this be an area that is of concern.

Macronutrient goals:

Individuals engaging in a general fitness programme typically can meet their macronutrient needs by consuming a normal diet of 45% to 55% of calories from carbohydrates (3 to 5 g/kg/day), 10% to 15% from protein (0.8 to 1 g/kg/day), and 25% to 35% from fat (0.5 to 1.5 g/kg/day).[1] Macronutrient goals differ for various intensities and types of exercise. The longer an athlete is engaged in activity, the more carbohydrate (and less fat) is proportionally needed in the diet, whilst the protein will remain fairly constant.

Carbohydrate plays an important role in performance and adaptation to exercise. The size of carbohydrate stores in the body is limited and can be manipulated through dietary intake and exercise sessions. It serves as a key fuel for the brain and central nervous system and a versatile fuel source for muscular contraction during aerobic and anaerobic conditions.[1,2,4] It offers advantages over fat through greater exercise efficiency. A lack of carbohydrate availability is associated with fatigue resulting in reduced work rates, impaired skill and concentration and an increased perception of effort.[2,4] Carbohydrate recommendations should consider the athlete's training or competition program and the priority of performance during high intensity training sessions or enhancing the training stimulus or adaptation.[1,2] Carbohydrate intake of 5 to 7 g/kg/day will likely suffice for endurance athletes, although elite athletes training 5 to 6 hours a day may need as much as 12 g/kg/day or a range of 420 to 720 g of carbohydrates a day for the 60 kg athlete.[1,4] Carbohydrate is provided through a variety of foods, including starches (e.g. rice, breakfast cereal, bread, pasta, etc.), fruits and fruit juices, vegetables (e.g. potatoes, sweet potatoes, mealies, etc.), milk, yoghurt, legumes (e.g. dried beans, lentils, chick peas) and sweets. Athletes should:

- Make starchy foods part of most meals
- Eat plenty of vegetables and fruit every day
- Eat dry beans, split peas, lentils and soya regularly
- Have milk, maas or yoghurt every day
- Use sugar and foods and drinks high in sugar sparingly[5]

Dietary **protein** provides a trigger and a substrate for contractile and metabolic protein synthesis and enhances structural changes in support tissues such as tendons and bones. Athletes are therefore advised to increase their protein intakes above the Recommended Dietary Allowance to maximize metabolic adaptation to training.[2] Nitrogen balance studies in endurance athletes suggest a range of 1.2 g/kg to 1.4 g/kg/day, and for strength athletes 1.2 to 1.7 g/kg/day for protein intake, with the higher end of the range recommended early in the competitive season.[1,4] Daily protein intake recommendations can be achieved through the regular intake of moderate amounts of high-quality protein source across the day and following strenuous training sessions.[2,4] Protein is supplied through various food sources including meat, fish, poultry, eggs, milk, yoghurt, cheese, eggs, nuts and legumes (e.g. beans, chickpeas, lentils, etc.)

- Fish, chicken, lean meat or eggs can be eaten daily
- Eat dry beans, split peas, lentils and soya regularly
- Have milk, maas or yoghurt every day5

Fat is a vital component of a healthy diet, serving as a fuel substrate, forming an essential element of cell membrane and facilitating the absorption of fat soluble vitamins.[2] Essential fatty acids are necessary for cell membranes, skin health, hormones, and transport of fat-soluble vitamins.[1] In general, 20 – 30 % of total calories consumed should be comprised of fat. However, in certain sports with higher energy demands, a higher percent of fat (with its inherent caloric density) may be required. Athletes should avoid fat intake of less than 20% of total energy consumed, because of the risk of reduced ingestion of fat soluble vitamins and limited intake of essential fatty acids.[4] Although fat is a valuable metabolic fuel for muscle activity during longer aerobic exercise and performs many important functions in the body, more than the usual recommended amount of fat is not indicated.[1] Recommendations for athletes should be individualised considering training levels and body composition goals.[2]

- Use fats sparingly and choose vegetable oils, rather than hard fats[5]

3 Micro-nutrition

Micronutrients enable the use of macronutrients for all physiologic processes and are key regulators in health and work performance. Athletes who fail to consume a diet with adequate vitamins and minerals can become deficient, which can lead to impairments in training performance. Training and work schedules, low-nutrient snacks, infrequent nutrient-dense meals, and overall low caloric intakes may cause inadequate intakes of vitamins and minerals. Athletes who adopt popular diets that eliminate whole food groups such as meat, dairy, grains or fruits run the risk of poor micronutrient intake. Micronutrients such as calcium, zinc, iron, vitamin B12 and others will be of concern.[1]

Practical ideas to ensure optimal intake of micronutrient intake:

- Be open to trying new foods and new recipes
- Make the most of foods in season
- Explore all the varieties of different foods
- Mix and match food at meals
- Think carefully before banishing a food or group of foods from you eating plan
- Include fruits and/or vegetables at every meal and snack
- Aim to include at least 3 servings of dairy foods per day
- Consume moderate servings of red meats in 3 – 5 meals per week
- Choose whole wheat starch options

4 Nutrient timing:

Nutrient timing describes the athlete's daily eating pattern. It answers how often the athlete eats, how much food is taken per meal and how meals interact with other daily activities. Timing of substrate availability should aim to counter fatigue and the deterioration of performance outputs, therefore maintaining power, strength, agility, skill and concentration during exercise. Strategies aim to increase or replace key fuel sources and provide substrates to return the body to homeostasis to support training and recovery.[2]

Athletes should aim to eat at least 20 g of protein every 3 – 4 hours to maximally trigger muscle protein synthesis. Nutrient timing is also important to consider for carbohydrate intake. Athletes should concentrate some carbohydrate intake during and around exercise. The remainder should be spread out evenly amongst frequent meals and/or snacks. The basic planning of meals should therefore consider:

- Eat 5 – 6 meals per day, spacing them ~3 hours apart.
- Eat a high-protein item in every meal and snack.
- Eat more carbohydrate rich foods during and around exercise.

Nutrient timing can be discussed in three occasions relative to exercise, referred to as before, during and/or after training, although the line between after and before training can be blurry where an athlete trains multiple times per day.[3]

Before exercise

The meal prior to training or an event should keep athletes from feeling hungry before and/or during the exercise and it aims to maintain optimal levels of blood glucose for the exercising muscles. The pre-training meals should consider personal preferences and psychologic factors and should be high in carbohydrate, low in fat and protein, and easy digestible.[1,4]

During exercise

Carbohydrates consumed during endurance exercise exceeding 1 hour ensure sufficient energy availability in the late stages of exercise, leading to an improved performance. The type of carbohydrate used during training does not seem to matter physiologically and athletes can use carbohydrate containing foods, gels or beverages according to personal preferences. Athletes should aim to ingest at least 30 g carbohydrate per hour of exercise, but can increase the intake depending on exercise intensity and duration.[1,4]

After exercise

Dietary strategies in the period after exercise can enhance recovery and promote physiologic adaptation, both leading to performance benefits and sport career longevity. The intake of 1 to 1.85 g carbohydrate/kg/h immediately after exercise contributes to high muscle glycogen synthesis rates.[1] Muscle protein synthesis is optimized in response to exercise through the consumption of a high biological value protein source supplying ~10 grams of essential amino acids in the early recovery phase (within 2 hours after exercise). This translates to a recommended protein intake of 0.25 to 0.3 g/kg body weight or 15 to 25 grams of protein.[2,4] A common nutritional strategy post-exercise is to provide chocolate milk to athletes as they come off the field. Dairy protein has high leucine and branched-chain amino acid content and is good to optimize muscle strength and improve body composition.[4]

Dietary periodization

Nutrition periodization is a term to describe dietary modification to match specific training phases, e.g. during in and off seasons as well as pre- and post-competition periods, which are marked by different nutritional needs. Pre-season dietary strategies will consider an athlete's weight goals and greater protein needs for lean muscle mass development. During the competitive season, energy recommendations would be fine-tuned to energy expenditure, with higher carbohydrate recommendations to support high intensity competition. Protein and fat needs would be adjusted to weight maintenance, recovery and overall health. During post-season phases, energy recommendation is adjusted to suit the active rest-transition cycle of conditioning and recovery. Guidelines are towards more lax behaviour to support a mental and emotional competitive break.[1]

Supplementation

The cherry on the cake will be the use of a supplement should it be necessary. Performance enhancing supplements should only be considered once the remainder of the nutrition strategies is in place as they will provide only marginal gains in the majority of individuals. Meal replacement or macronutrient type supplements may assist in achieving dietary goals at a lower level of the pyramid due to their practicality and ease of use but they should not be relied upon indefinitely. When choosing a supplement athletes should pay attention to efficacy and safety thereof. All athletes considering the use of supplements are encouraged to consult with an experienced sports nutrition professional to determine their unique, nutrition requirements and whether supplements would be appropriate for the training regimen.[4]

References

- Mahan LK & Raymond JL. Krause's food and the nutrition care process. 14th ed. Missouri: Elsevier, 2017.
- Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. J Ac Nutr Diet. 2016;116(3):501-28.
- Burke L, Deakin V. Clinical sports nutrition. 4th ed. Sydney: McGraw-Hill Medical; 2010.
- Grout A, McClave SA, Jampolis MB, Krueger K, Hurt RT et al. Basic Principles of Sports Nutrition. Curr Nutr Rep. 2016;5:213-22.
- Vorster HH, Badham JB, Venter CS. An introduction to the revised food-based dietary guidelines for South Africa. S Afr J Clin Nutr. 2013;26(3):S5-S12.