Rebuilding the basics, *Refocus* on behaviours & *Recover* from misconceptions

Text: Nicki de Villiers, Registered Dietitian, hpc

Sport nutrition is a discipline directed to a range of individuals; from those who start living actively with regular, structured exercise programmes; to the athlete in the making; and the high performance athlete aspiring to optimal results. Dietary intake of all these individuals is influenced by the life cycle, gender, type of sport, training load, goals (performance and anthropometric) and competition schedule and should therefore be individualised.[1]

THE START OF SPORT NUTRITION

The relationship of food and performance was established long before the science confirmed what we know today. Reports of the dietary preferences of Greek and Roman athletes refer to diet similar to the general population, including whole grains, fruits, cheeses and diluted wine with sporadic intake of fish and meat. Goat meat was although advised for jumpers and bull meat for runners; a myth based on the specific animal properties converted to the athlete![1]

The use of certain foods and ergogenic aids were already described as strategy to enhance performance in the first Olympic Games of the modern era in Athens in 1896. Marathon runners competing in these games refrained from eating the night prior to the event. The following games saw the winning athlete consuming egg whites, brandy and strychnine during the run. The use of caffeine, alcoholic beverages and ether were common, obviously all in attempt to decrease pain![1]
There was obviously a definite need for science. The first studies linking nutrition and sport were published in 1842, mistakenly suggesting that muscle protein stores were the main energy fuel during exercise. Vitamins were identified in the beginning of the twentieth century and during the 1920s and 1930s studies discussed the use of carbohydrates and fats as fuel substrates during physical activity. Despite the identification of the association between low blood sugar levels and fatigue and confusion in runners in a study in 1924, it is only in the 1960s that the role of glycogen in performance was confirmed, leading to what we now know as carbo loading. The studies exploring carbohydrate intake and fatigue lead to development of carbohydrate based drinks during this decade. The relationship between protein intake and muscle mass gain was indicated in studies from 1940 leading to the appearance of the first protein supplements.[1]
The use of steroids to enhance performance started with the use of organs, especially testicles, in ancient Egypt to the Middle Ages which lead to the production of testicular extracts in 1889, culminating to the massive use of steroids in the Olympic Games held in Tokyo in 1964. The use of strychnine as a stimulant was later replaced by amphetamines in the 1930s. The use of various substances leads to the introduction of the first doping tests in the 1960s.[1]

Looking at the Olympic Games

The history of food intake and supply during the Olympic Games illustrates how food provision gradually became valued and describes the various practices of athletes throughout the years.[1]

Athens (1896)
- Athletes were responsible for their own food
- Catering was only available for dignitaries

Saint Louis (1904)
- Well water available to runners from the 19th kilometer

Paris (1924)
- Dining hall for athletes
- Three meals were served daily

Los Angeles (1932)
- Athlete's village was initiated
- 31 dining halls to serve athletes from different cultures

Berlin (1936)
- Three-story catering complex
- 40 kitchens and dining halls serving meals defined by chefs after discussion with coaches and physicians
- Water was provided for long distance runners every three kilometers
- Most popular supplements: lecithin, glucose and malt

London (1948)
- Difficult economic conditions
- Inadequate food availability
- Many countries provided food for their own athletes and donated food to other countries

Helsinki (1952)
- Central restaurant with various cuisines
- Honey, maltose and grape sugar were seen as performance enhancing

Los Angeles (1984)
- Catering company and complex logistics to provide food
- Suggested, after the games, that dietitians should be involved in menu planning for future games

Atlanta (1996)
- Participation of about 10 thousand athletes
- More than one million meals were served
- Snacks were introduced at training and competition venues

Sydney (2000)
- Team of ten dietitians developed a 10-day cycle menu: 1 500 food items and 345 recipes
- Emphasising carbohydrate sources and the use of a variety of preparation techniques
- Nutrition information about the ingredients made available
- Dietitians delivered a service to assist in food choices

London (2012)
- Challenged to meet the requirements of athletes involved in the 30 days of Ramadan fasting

WHAT WE KNOW NOW

Nutrition goals can be directed toward sports performance, recovery, brain function, anti-inflammation, supporting bone health, enhancing immunity and the provision of anti-oxidants.[2]

- Nutrition is one of the foundation elements during the preparation and training of athletes.[2]
- Nutrition goals and requirements are not static. Food intake should be periodized to support the goals of daily training sessions and overall nutritional goals.[2,3] Planning of food intake should be personalized to the individual athlete to take into account the specificity and uniqueness of the sporting event, performance goals, practical challenges, food preferences, and responses to various nutritional strategies.[3]
- Nutrition during training would aim to assist the body for metabolic efficiency and flexibility. Competition nutrition would aim to provide adequate fuel stores to optimize performance and cognition.[2,3]
- Adequate energy intake supports optimal body function and assists with achieving the ideal body composition. Energy intake should match energy expenditure which varies with training mode, volume and intensity. Athletes should aim to achieve optimal energy availability throughout training phases to support health and function.[2,3]
- The achievement of a suitable body composition advantageous for the specific sporting code is an important, but challenging goal.[3] In attempt to lose fat, energy intake is often manipulated. Ideal weight loss should be gradual (1 kg per week) and should aim to maintain fat-free mass. Rapid weight loss could result in hypohydration, loss of glycogen stores and catabolism with an overall reduction in lean body mass, resulting in impaired endurance cardiac function and body temperature regulation.[2] Body composition goals should consider sport specific needs and be realistic in considering individual characteristics.[2,3]
- The availability or absence of nutrients influences functional and metabolic adaptations. Optimal performance is achieved through the provision of proactive nutrition support but training adaptations may be enhanced in the absence of nutrition support.[3]
- It is important to, apart from general daily targets for nutrient intake; consider the timing of nutrient intake in relation with training sessions and over the rest of the day.[3]
- Nutrition intake during competition should aim to reduce or delay factors contributing to fatigue. These factors can be specific to the event, the environment and the individual athlete.[3]
- The presence of carbohydrate and potentially other nutritional components in the oral cavity can be sensed by the brain to enhance perceptions of well-being and increase self-chosen work rates. These strategies could enhance performance in shorter events by influencing the central nervous system.[3]
- Supplements should be evaluated through a cost-to-benefit analysis of the use of products. The use of supplements is of the greatest value when added to a well-chosen eating plan.[3]
- Protein is important for the building, maintenance and repair of tissues in the body.[4] Recommended protein intake for athletes aligns closely with the recommendations for healthy eating with suggestions for a modest increase of protein as part of a mixed diet for athletes, with a higher intake assigned to strength athletes compared to endurance athletes. Protein requirements are also influenced by training in that protein requirements are higher in athletes initiating training compared to the “trained” athlete who is ready for competition. The role of protein supplements for competitive athletes is minimal as the requirement can be fulfilled with a balanced diet.[2]
- Carbohydrate serves as the key fuel for aerobic training and the nervous system. Bodily stores of carbohydrate are limited and athletes should pay attention to optimal carbohydrate intake to enhance

performance. Strength training requires less carbohydrate when compared to endurance training. Poor carbohydrate availability contribute to an increased sense of fatigue, a decreased work rate, impaired cognitive skills and concentration and an increased perception of effort.[2] Carbohydrate is found in various foods, with the key indicators of quality of carbohydrate sources being the amount of added sugar and the fiber content.[4]

- The glycemic load and glycemic index of carbohydrate-rich meals seems not to affect the metabolic or performance outcomes of training once carbohydrate and energy intake is adequate.[3]
- Dietary fat provide fuel, aid in the absorption of fat soluble vitamins, give food a hedonistic quality through affecting its taste, smell, palatability and satiety.[4] In general, a quarter to a third of total calories consumed should be comprised of fat with emphasis on limited intake of saturated fat. The use of a high fat/low carbohydrate diet has become popular, and could be beneficial during training with prolonged sub-maximal exercise. Most studies up to date although show no performance benefit and do not seem to enhance training capacity. In fact, it could be detrimental to use a high fat/low carbohydrate diet at the time of actual competition with maximal intensity of exercise.[2]
- Meals before training or competitions should be high in complex carbohydrates, and low in fat, protein and fiber to limit gut discomfort.[2,5]
- Small carbohydrate feedings may be required during endurance events lasting longer than one hour in duration to delay the sense of fatigue. The requirement for carbohydrate depends on the overall fuel stores of the athlete and exercise intensity. Fluids should be ingested on a fixed schedule during the activity.[3]
- Nutrient intake after training or competition can aid recovery and glycogen repletion that will support maximal athletic gains. Protein intake after exercise enhances protein synthesis and the combination of protein and carbohydrate intake after exercise enhances muscle reserves, recover performance and replete glycogen.[2,3]
- Chocolate milk provides dairy protein, high in leucine and branched-chain amino acids to optimize muscle strength and improve body composition.[2]
- Physical activity may increase the need for some vitamins and minerals which can be met through a balanced high-carbohydrate, moderate-protein, low-fat diet.[2]
- Iron deficiency anemia may impair athletic performance through impaired muscle function and limited work capacities. A low energy intake, a vegetarian diet without meat, heavy menses, rapid growth, high altitude training, or continued blood donation can increased the risk for iron deficiency anemia.[2]
- Calcium is important to maintain the structure and integrity of the skeletal system, vascular contractility, vasodilation, neuromuscular function, cell membrane integrity, intracellular signaling and hormonal secretory activities. Dairy products are rich natural sources of calcium, with lactose, casein and peptides to promote calcium absorption. Additional sources include salmon and sardines canned with their soft bones, almonds, Brazil nuts, sunflower seeds, tahini, dried beans and molasses.[4] Female athletes can be at risk for osteoporosis based on reduced calcium intake, low estrogen levels, ingestion of alcohol or caffeine, family history, or the amount and type of physical activity. Assuring an adequate calcium intake may help prevent the development of osteoporosis.[2]
- Adequate levels of vitamin D may prevent injury, promote rehabilitation, reduce inflammation, decrease risk of stress fractures and acute respiratory illness and improve neuromuscular function.[2,4] Athletes at risk for vitamin D deficiency include those living north of the 35th latitude, those who compete primarily indoors, those with high body fat and those with dark complexion.[2]
- Sodium intake is tightly correlated with hydration. Athletes are advised to not restrict sodium in their post-exercise nutritional intake. Ingestion of sodium during exercise should be considered in an athlete has a high sweat rate, salty sweat or in exercise conditions with a duration

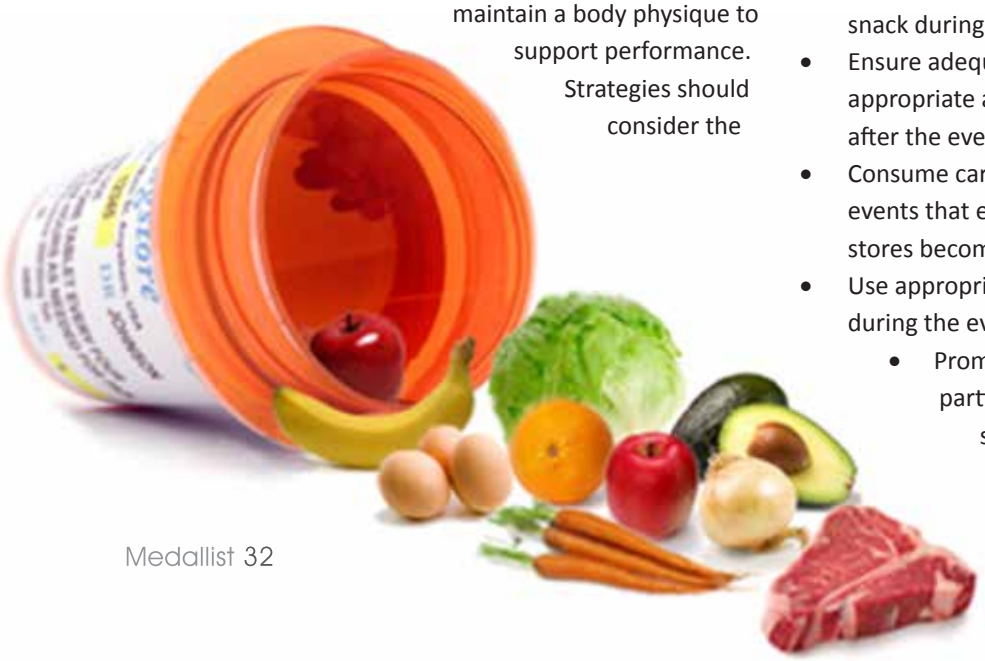
greater than 2 hours. Over-drinking fluids in excess of sweat and urinary sodium losses, can lead to hyponatremia and water intoxication.[2]

- Chronic training could contribute to a constant oxidative stress on cells, but the supplementation with antioxidants seems not to enhance performance, and may even negatively influence training adaptations.[3]
- Dehydration impairs athletic performance. Increased dehydration results in reduced muscle strength, endurance and coordination and increases the risk for cramps, heat exhaustion, heat stroke, cardiovascular strain, altered central nervous system function and likelihood for injury.[2,3]
- Athletes should ensure adequate intake prior to exercise to enter the session in a fully hydrated stated and should ensure adequate fluid intake after exercise to recover any dehydration. Athletes are encouraged to test different drinks throughout training, to avoid gut discomfort during competition.[2]
- Alcohol can contribute to unwanted energy intake, suppressed lipid oxidation, increased unplanned food consumption and may compromise the achievement of body composition goals. Taken prior to or during training it can impair exercise metabolism, thermoregulation and skills or concentration. Alcohol intake after exercise may interfere with recovery by impairing glycogen storage, delay rehydration and impair muscle protein synthesis necessary for adaptation and repair.[3]
- And so much more….

NUTRITIONAL GOALS

During Training[5]

- *Ensure* adequate energy and nutrient intake to ensure adequate fueling during training.
- Set realistic goals and plan strategies to achieve and/or maintain a body physique to support performance. Strategies should consider the manipulation of training and nutrition to achieve levels of body mass, body fat and muscle mass that is consistent with good health and good performance.
- Ensure adequate nutrient intake supportive of adaptation and recovery after training sessions.
- Refuel and rehydrate well during each training session to support quality sessions.
- Apply intended competition nutrition strategies during training sessions to identify and fine-tune beneficial strategies.
- Ensure adequate intake of all nutrients to maintain optimal health and function, emphasising the increased needs for some nutrients resulting from heavy training.
- Support optimal immune functions through heavy training periods by maintaining a healthy body composition, achieving an energy balance and including nutrients believed to assist immune function (e.g. consume carbohydrate during prolonged exercise sessions).
- Make well-considered decisions about the use of supplements and specialized sport foods based on a benefit-cost analysis.
- Eat for long-term health by following healthy eating guidelines
- Enjoy food and the pleasure of sharing meals



During Competition[5]

- Achieve the competition weight division with minimal harm to health and performance when competing in weight division sports.
- Fuel up adequately before an event through the intake of carbohydrate and the tapering exercise during the days leading up to the event depending on the importance and duration of the event. Carbohydrate loading strategies can be considered before events that exceeds 90 minutes.
- Top up carbohydrate stores with a pre-event meal or snack during the 1 to 4 hours before competition.
- Ensure adequate hydration through the intake of appropriate amounts of fluids prior to, during and after the event.
- Consume carbohydrate foods or beverages during events that exceeds 1 hour or if body carbohydrate stores becomes depleted.
- Use appropriate fluid and food options before and during the event to minimize gut discomfort.
- Promote recovery after the event, particularly during multi-day competitions such as tournaments and stage races.

- During a prolonged competition program and traveling, ensure good dietary behaviours to support overall energy and nutrient intake goals.
- Make well-considered decisions about the use for supplements and specialized sport foods that have been shown to enhance competition performance or meet competition needs.

FROM THE LAB TO THE KITCHEN

Athletes should concentrate on overall eating patterns that benefit health and performance and supply adequate nutrients within individual energy needs. Foods cannot be labelled as "good foods" or "bad foods". All foods are allowed with emphasis of moderation and proportionality. It is for example acceptable to use small quantities of added sugar and fat in order to enjoy nutritious foods, such as a sprinkle of sugar on a grapefruit, but a regular intake of large portion of energy-dense food, such as fried chicken or cold drinks can impair performance. Athletes can make food choices within a broad range and accommodate their own preferences, genetic background, health status and performance goals. Food intake therefore should reflect personal choice.[7]

Food choices should promote:

- Variety
  - **Include foods from all food groups**
- Proportionality
  - **Eating more nutrient-dense foods and beverages (fruits, vegetables, whole grains, fat-free or low-fat milk products) and less of others (high in saturated or trans fats and added sugars)**
- Moderation
  - **Control portion sizes**
- Gradual improvement
  - **Take small steps to achieve interim, realistic goals**
- Food patterns, rather than individual nutrients or individual foods.7

Skill Check[6]

- Can you read a nutritional label and make sense thereof?
- Can you locate CREDIBLE sources of nutrition information?
- Can you personalise nutrition information to suit your training and competition needs?
- Do you know where to buy healthy food?
- Can you make healthy food choices from a variety offered?
- Can you identify the warning signs of dehydration?
- Can you assemble a balanced meal?
- Do you shop with a grocery list?
- Can you use simple recipes to prepare food in bulk?
- Do you know how to safely store fresh and leftover food?
- Do you time food intake to include a pre-training meal?
- Do you apply an individualised hydration strategy?
- Can you identify a false supplement claim?
- Do you plan food intake ahead of traveling?
- Do you have a realistic body composition goal?
- Do you know how to adjust your food intake for different training phases?

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