What's new in sports nutrition?

LOUISE BURKE AOM, PhD, BSc, Grad Dip Diet, FSMA, FACSM

New research findings are providing guidance on nutritional strategies that will benefit athletes before, during and after exercise.

MedicineToday 2012; 13(12): 43-46

Professor Burke is Head of Sports Nutrition at the Australian Institute of Sport, Canberra, ACT.

SERIES EDITOR: Dr Ken Crichton, MB BS(Hons), FRCSP, Director of Sports Medicine, North Sydney Orthopaedic and Sports Medicine Centre, and Consultant Sports Physician at the Children's Hospital Institute of Sports Medicine, Sydney, NSW.

Over the past three decades, sports nutrition has become a recognised science promoted by specially trained professionals. New ideas and strategies are continually evolving in the race to be faster, higher and stronger. Sometimes this evolution occurs because of the emergence of new data that are so compelling a strong evidence base quickly develops to guide new practices. In other cases, a new issue has become a high priority and practitioners have to react to this need by generating best practice based on the available but less certain evidence.

This article reviews some of the current hot topics in sports nutrition, noting the level of certainty that underpins their application. Further information on the topics covered in this review can be found in the articles accompanying the 'IOC consensus on sports nutrition 2010', published in the *Journal of Sports Science*.[1]

LEVEL 1. AREAS WITH EVIDENCE LEADING TO NEW GUIDELINES

The following three examples are areas in which our knowledge has been updated, resulting in a good evidence base and leading to new practice guidelines.

Protein intake after exercise

Underpinning science

Intake of 20 to 25 g of high quality protein, particularly from

TABLE 1. READY RECKONER OF HIGH QUALITY PROTEIN-RICH FOODS[2]

Protein source	Amount needed to provide 10 g protein
Animal foods	2 small eggs 300 mL reduced or low fat milk 30 g (1.5 slices) of reduced fat cheese 200 g carton low-fat fruit yoghurt 250 mL low-fat custard 35 g lean beef, lamb or pork (cooked weight) 40 g lean chicken (cooked weight) 50 g grilled fish 50 g canned tuna or salmon
Vegetable foods	120 g tofu or soy meat 400 mL soy milk
Supplements and sports foods	10,000 mg free-form amino acids 15–20 g high protein powder or protein hydrolysate 120–150 mL liquid meal supplement (e.g. Sustagen Sport or PowerBar Protein Plus) 20–30 g high protein sports bar
Less expensive alternatives to supplements and sports foods	25 g skim milk powder 250 mL homemade fruit smoothie Ingredients for 600 mL: 250 mL low fat milk, 200 g fruit yoghurt, 1 banana or cup of berries 150 mL fortified milk shake Ingredients for 600 mL: 500 mL low fat flavoured milk, 4 tablespoons ice-cream, one-quarter cup of skim milk powder

Adapted from Burke L, Cox G. The complete guide to food for sports performance. 3rd ed. Sydney: Allen and Unwin; 2010.[2]

rapidly digesting protein sources, soon after exercise optimises muscle protein synthesis (and thus muscle hypertrophy, adaptation and repair) after exercise.

Practical implementation

Athletes should plan their meals and snacks to allow an even spread of moderate amounts of high quality protein over the day, including after key workouts and or events. Table 1 provides examples of commonly available food sources providing 10 g of protein.[2] Note that dairy and liquid sources of protein are rapidly digested.

Carbohydrate intake during brief high-intensity exercise

Underpinning science

During brief high-intensity exercise lasting about one hour, regular intake of small amounts of carbohydrate, including simply mouth rinsing, enhances pacing and performance. This probably occurs through direct stimulation of the central nervous system by carbohydrate-sensing receptors in the oral cavity.

Practical implementation

According to the logistics of their event, athletes should experiment with regularly swilling, sucking, and or consuming carbohydrate sources such as sports drinks, gels or confectionery with a focus on maximising the amount of time that the carbohydrate is in contact with the mouth.

Carbohydrate intake during prolonged high-intensity exercise

Underpinning science

During prolonged events (lasting more than 2.5 to 3 hours), there appears to be a dose response to carbohydrate intake, with optimal performance being achieved with intakes of 80 to 90 g/hour. Maximal rates of oxidation of carbohydrates ingested during exercise are achieved by using mixtures of sugars that have different intestinal transport mechanisms (e.g. glucose plus fructose). It appears the gut can be trained to increase such capacity by chronic practice of consuming carbohydrate during exercise.

Practical implementation

During prolonged events such as an ironman triathlon or a distance cycling race, a well-practiced race plan should attempt to deliver high rates of carbohydrate at rates – up to 80 to 90 g/hour – from a range of sources of 'multiple transportable carbohydrates', including specialised sports products. Table 2 provides an example of carbohydrate sources often consumed during exercise, providing about 50 g serve of carbohydrate.[2]

LEVEL 2. NEW FAST-TRACKED AREAS OF RESEARCH

Research in several new areas of interest, including the three examples below, is being fast tracked.

Beetroot juice supplementation

Underpinning science

Consuming beetroot juice, a rich source of nitrate, in the two hours (and perhaps days) before exercise enhances exercise economy and performance, although results are less apparent in higher calibre athletes.

Practical implementation

The athlete might benefit trialling beetroot juice or other sources providing about 300 mg nitrate in the hours before an event, perhaps supported with daily intake beforehand.

Future research is warranted to determine the range of events in which this might be useful, and optimal protocols of use.

Vitamin D deficiency

Underpinning science

Athletes represent a subgroup at risk of suboptimal vitamin D levels. Vitamin D is important for optimal function of many body systems, including bone health, muscle function and the immune system.

Practical implementation

Athletes at risk of low UVB exposure, such as those who train indoors, live at latitudes greater than 35 degrees north or south of the equator or otherwise spend little time outdoors, should be regularly screened and receive appropriate vitamin D supplementation if they are found to have suboptimal levels of vitamin D.

Low energy availability

Underpinning science

When energy intake minus the energy committed to exercise is below a critical value (i.e. low energy availability) there is impairment of bone health, menstrual function, energy metabolism and other body systems. Low energy availability, which forms part of the female athlete triad, does not necessarily require an eating disorder to be present, and is probably also found in many male athletes.

Practical implementation

All athletes suspected of restricted eating or of failing to replace the energy cost of high volume training should be assessed and counselled appropriately.

TABLE 2. COMMON FOOD AND FLUID CHOICES USED TO REFUEL DURING SPORT[2]

Food or fluid	Amount to provide 50 g carbohydrate
6% carbohydrate sports drink (e.g. Gatorade, Powerbar Isoactive*)	800 mL
8% carbohydrate sports drink (e.g. Powerade)	600 mL
Sports gel* (40 g sachet)	Two sachets
Powerbar*	1.25 bars
Sports confectionery*	60–70 g packet (e.g. nine PowerBar Gel Blasts lollies)
Cereal bars or muesli bars	Two bars
Bananas	Two medium
Other fruit (e.g. oranges)	Three medium pieces
Jelly beans or jelly lollies	60 g
Chocolate bar	80 g
Dried fruit	80 g
Cola drinks (11% carbohydrate)	450 mL
Bread/sandwiches	Medium roll or two thick slices of bread with honey/jam
Fruit bread or cake	100 g

* Note that some brands are manufactured with blends of glucose and fructose to maximise gut absorption (e.g. Powerbar C2MAX blend).

Adapted from Burke L, Cox G. The complete guide to food for sports performance. 3rd ed. Sydney: Allen and Unwin; 2010.[2]

LEVEL 3. AREAS WITH A GROWING EVIDENCE BASE

Level 3 comprises areas in which there is a continued gathering of evidence but that require further work.

Low-dose caffeine use

Underpinning science

Supplementation with 3 mg/kg caffeine before or during exercise, including just before the onset of fatigue, enhances performance of many types of sports via caffeine's effects on the central nervous system.

Practical implementation

Some athletes might benefit from experimenting with low doses of caffeine (3 mg/kg total), including intake during and late in the event. Future research is warranted to determine the range of events in which this might be useful. Individual experimentation is warranted to find optimal protocols of use.

Training when carbohydrate levels are low

Underpinning science

Training when the body has a low glycogen level (for example, when an athlete does a second workout soon after a glycogen-depleting session) or is in a fasted state amplifies many signalling pathways responsible for training adaptations, especially those involved in fat oxidation.

Practical implementation
Athletes consciously or unconsciously undertake some sessions when they have low carbohydrate stores. Since the potential downside of such training is a reduction in exercise intensity, it needs to be part of a periodised plan rather than a universal training model. Note that this strategy does not relate to athletes eating a low carbohydrate diet; it relates to training sessions that are scheduled for times in the day when carbohydrate status is low.

Beta-alanine supplementation

Underpinning science
Chronic supplementation with beta-alanine increases muscle carnosine content, increasing muscle buffering capacity and perhaps other muscle functions that may lead to enhanced performance.

Practical implementation
Some athletes might benefit from taking beta-alanine supplements (3 to 6 g/day over four to 10 weeks, up to a total intake of 200 to 400 g). Future research is warranted to determine the range of events in which this might be useful, and optimal protocols of use.

LEVEL 4. SMALL EVIDENCE BASE BUT HIGH PRIORITY AREAS

The following examples are topics of high priority requiring a response despite the current small evidence base.

Reducing the risk of illness

Underpinning science
Inadequate energy and carbohydrate availability reduce immune system function. Some immune-enhancing nutrients may reduce the risk of contracting illness (e.g. probiotics, polyphenols) or reduce the impact of an illness once it is contracted (e.g. zinc).

Practical implementation
The athlete should be proactive with strategies that provide adequate energy and carbohydrate availability. During periods of high volume and or intensity training or in high-risk environments, some athletes might benefit from experimenting with immune-enhancing nutrients. Future research is warranted to determine the range of substances that might be useful, and optimal protocols of use.

Rehabilitation from injury

Underpinning science
Adequate energy availability and a good intake of a range of high quality protein sources support injury repair and minimise disuse atrophy. Other substances (e.g. fish oils, creatine) may also assist in achieving such goals.

Practical implementation
Athletes should work with their sports dietitian to implement an energy- and protein-adequate diet to support injury repair during acute and longer-term rehabilitation. Further research is warranted to determine other nutrients and substances that can reduce the atrophy associated with disuse and enhance injury repair.

LEVEL 5. CONTROVERSIAL AREAS

Level 5 represents areas of controversy.

Hydration during sporting events

Underpinning science
There has been recent publicity of the view that hydration/dehydration is not important in performance outcomes and that athletes need only drink during sporting events if they are thirsty. This is at odds with information that few events in elite sport offer athletes the opportunity for *ad libitum* fluid intake to address thirst.

Practical implementation
All athletes should develop their own event nutrition plan that balances the specific opportunities provided by their event to consume foods or drinks; the potential benefits of intake of fluid, carbo - hydrate and other ingredients; and their individual tolerance and experiences.

SUMMARY

Nutritional needs differ between sports, between individuals in the same sport, and across an individual's periodised training and competition calendar or sporting career. The benefits of sound eating practices are highly apparent and well-rewarded in the case of elite athletes, but recreational and subelite athletes also value outcomes such as achieving personal bests or other sporting goals. MT

REFERENCES

1. IOC Conference on Nutrition in Sport, 25-27 October 2010, International Olympic Committee, Lausanne, Switzerland. J Sports Sci 2011; 29(S1): S1-S136.
2. Burke L, Cox G. The complete guide to food for sports performance. 3rd ed. Sydney: Allen and Unwin; 2010.

FURTHER READING

A list of further reading is included in the pdf version of this article available at www.medicinetoday.com.au.

COMPETING INTERESTS. Professor Burke is an employee of the Australian Institute of Sport, which has sponsorship agreements with several sports food companies (Gatorade Australia, Powerbar Australia) and food companies/groups (Nestle Australia and Dairy Australia).

Medicine Today 2012; 13(12): 43-46

What's new in sports nutrition?

LOUISE BURKE AOM, PhD, BSc, Grad Dip Diet, FSMA, FACSM

FURTHER READING

1. Burke LM, Broad L, Cox G, et al. Dietary supplements and nutritional ergogenic aids. In: Burke LM, Deakin V, editors. Clinical sports nutrition. 4th ed. Sydney: McGraw-Hill; 2010. p. 419-500.
2. Burke LM, Maughan RJ. Nutrition and therapy. In: Zachazewski J, Magee D, editors. IOC handbook: sports therapy. In press 2012.
3. Churchward-Venne TA, Burd NA, Phillips SM, Research Group EM. Nutritional regulation of muscle protein synthesis with resistance exercise: strategies to enhance anabolism. Nutr Metab (Lond). 2012; 9(1): 40. Epub ahead of print.
4. Jeukendrup AE, Chambers ES. Oral carbohydrate sensing and exercise performance. Curr Opin Clin Nutr Metab Care 2010; 13: 447-451.
5. Burke LM, Hawley JA, Wong SH, Jeukendrup AE. Carbohydrates for training and competition. J Sports Sci. 2011; 29(S1): S17-27.
6. Jeukendrup AE. Carbohydrate and exercise performance: the role of multiple transportable carbohydrates. Curr Opin Clin Nutr Metab Care 2010; 13: 452-457.
7. Cox GR, Clark SA, Cox AJ, et al. Daily training with high carbohydrate availability increases exogenous carbohydrate oxidation during endurance cycling. J Appl Physiol 2010; 109: 126-134.
8. Lansley KE, Winyard PG, Fulford J, et al. Dietary nitrate supplementation reduces the O2 cost of walking and running: a placebo-controlled study. J Appl Physiol 2011; 110: 591-600.
9. Bescós R, Sureda A, Tur JA, Pons A. The effect of nitric-oxide-related supplements on human performance. Sports Med 2012; 42: 99-117.
10. Larson-Meyer DE, Willis KS. Vitamin D and athletes. Curr Sports Med Rep. 2010; 9: 220-226.
11. Burke LM. Fueling strategies to optimize performance: training high or training low? Scand J Med Sci Sports 2010; 20(Suppl 2): 48-58.
12. Walsh NP, Gleeson M, Shephard RJ, et al. Position statement. Part one: Immune function and exercise. Exerc Immunol Rev 2011; 17: 6-63.
13. Walsh NP, Gleeson M, Pyne DB, et al. Position statement. Part two: Maintaining immune health. Exerc Immunol Rev 2011; 17: 64-103.
14. Stellingwerff T, Decombaz J, Harris RC, Boesch C. Optimizing human in vivo dosing and delivery of ß-alanine supplements for muscle carnosine synthesis. Amino Acids. 2012; 43: 57-65.
15. Derave W, Everaert I, Beeckman S, Baguet A. Muscle carnosine metabolism and beta-alanine supplementation in relation to exercise and training. Sports Med 2010; 40: 247-263.
16. Burke LM. Caffeine and sports performance. Appl Physiol Nutr Metab 2008; 33: 1319-1334.
17. Burke LM. Fluid fads and facts. Aspetar Sports Med J 2012; 2: 87-93.