



2. Breathing and relaxation techniques

3. Sensory withdrawal – dark, quiet environment

4. Warming the skin and/or cooling core body temperature

- Hot water immersion
- Hot/cold showers
- Other forms of hydrotherapy

5. Utilizing good recovery strategies to minimize pain and inflammation

- Appropriate recovery nutrition
- Hydrotherapy
- Stretching



Suggested additional resources

1. Cole RC. Nonpharmacologic Techniques for Promoting Sleep. *Clinics in Sports Medicine*: 24 343-353, 2005.
2. Stepanski EJ, and Wyatt JK. Use of sleep hygiene in the treatment of insomnia. *Sleep Medicine Reviews* 7: 215-225, 2003.
3. Reilly T, and Edwards B. Altered sleep-wake cycles and physical performance in athletes. *Physiology & Behaviour* 90:274-284, 2007.
4. Afaghi A, O'Connor, H and Chow CM. High-glycemic-index carbohydrate meals shorten sleep onset. *American Journal of Clinical Nutrition* 85: 426-430, 2007.

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Dietary supplements

— *RJ Maughan, Loughborough University, Loughborough, UK*

Many athletes use a wide range of dietary supplements in ever-increasing dosages, but this may do more harm than good. Any athlete contemplating the use of any supplement should conduct a cost-benefit analysis. There is good evidence of potential benefits for a few supplements but for many, there is little or no proof of benefit or of safety. The limited regulation of the dietary supplements market has resulted in several possible risks. Some supplements do not contain ingredients listed on the label, or contain only small amounts (this applies especially to expensive ingredients). Some supplements are contaminated with microbial agents and other constituents (lead, broken glass etc) that may be harmful. Many of the supplements on sale may also be contaminated with substances that may lead to a positive doping test. Strict liability means that the player who tests positive as a result of ingestion of these supplements is still liable to suspension from the game.

Information available to coaches and athletes often comes from the suppliers of supplements, who have a strong interest in selling as much product as possible. Routine supplementation is not generally helpful, but the athlete with restricted energy intake or limited food choices may benefit from a low-dose broad

spectrum multi vitamin multi-mineral complex obtained from a reputable supplier. A few supplements that can offer benefits, but only if they are used at the appropriate time and in the right amounts.

Creatine use in sport remains controversial. Creatine is found in a normal meat-containing diet in amounts of about 1g/day, but supplementation usually involves about 10–20 g/d for a few days followed by about 2–3 g/d. Supplementation in these amounts can increase muscle creatine and creatine phosphate levels, and, although not all published studies show positive results, performance of strength tasks and short term high intensity exercise can be improved by supplementation. In particular, there are many reports of improvement when a few repeated short sprints with limited recovery are performed. The increase in lean body mass that often accompanies supplementation may be of benefit to some athletes.

Creatine supplementation can also promote glycogen storage, which can be important when rapid and effective recovery is needed after glycogen-depleting exercise. Caffeine can improve performance, in part by stimulation of fatty acid mobilisation and sparing of the body's limited carbohydrate stores, but also via effects on muscle and the brain. There may be improvements in performance of vigilance tasks and limited evidence of efficacy in tasks involving performance of skilled tasks. The effective dosage of caffeine is smaller than previously thought and benefits have been reported with doses as small as 1–2 mg/kg.

Bicarbonate acts as a buffer, and high doses of bicarbonate taken before events where large amounts of lactic acid are produced can help improve performance: in practice, this generally means events lasting from about 1–10 minutes.



More recently, there are promising results for supplementation with carnosine and β -alanine, which can increase the muscle content of carnosine, an important intracellular buffer: early results suggest this can be effective in improving performance in events where acidosis may be limiting. None of these products contravenes the current WADA regulations on doping in sports.

Supplementation is particularly prevalent among strength and power athletes, where an increase in muscle mass can benefit performance. Protein supplements have not been shown to be effective except in those rare cases where the dietary protein intake is inadequate, but intake of small amounts of proteins in the period just before or just after training may result in increased protein synthesis, which may help promote adaptations to training. These effects are achieved by essential amino acids alone, with the non-essential amino acids apparently having little effect. Other individual amino acids, especially lysine, ornithine, arginine and glutamine are also commonly used, but their use is not supported by well-documented evidence. Chromium and hydroxymethylbutyrate (HMB) are also used by strength athletes, but again there are no well-controlled studies to provide evidence of a beneficial effect.

Athletes use a wide variety of supplements aimed at improving or maintaining general health, and vitamin and mineral supplementation is widespread. Immune function may be compromised during periods of very heavy training and at times of stress. Many herbal and other products are used by athletes, as indeed they are used by the general population, to try to stimulate immune function, but most of these have not been well-researched, and athletes would be better advised to consume a sound diet that meets energy needs and contains a variety of foods.

In summary, the first step in nutrition support for athletes should be to identify individual nutrition goals and to ensure that a dietary strategy that will meet these needs is in place. Athletes and coaches must be cautious about supplement use. If it sounds too good to be true, it probably is.