



6

Nutrition and the brain and prolonged exercise

Phil Watson, Loughborough University, Loughborough, UK



Evidence has accumulated to suggest that events arising entirely within the brain can influence an individual's sensation of fatigue and thus potentially affect performance. Interestingly, this opens an opportunity to manipulate the central nervous system through changes in diet or supplementation with specific nutrients, including amino acids (branched-chain amino acids, tyrosine), carbohydrates and caffeine. Some nutritional supplements that may influence performance during prolonged exercise are outlined in the table below.

Supplement	Dose(s) studied	Proposed effect on the brain	Does it influence performance?
Branched-chain amino acids (BCAA)	5–20 g	Reduces brain serotonin production	<ul style="list-style-type: none"> Evidence is generally weak. A few studies suggest an effect, but many more find no benefit May reduce perception of effort and enhance mental performance during exercise
Caffeine	3–10 mg/kg BM	Reduces effect of adenosine in the brain	<ul style="list-style-type: none"> Performance in events lasting more than a couple of minutes can be enhanced by caffeine Alters mood, increases alertness and reaction times Large individual variation in sensitivity to caffeine
Carbohydrate (CHO)	30–90 g/h	Increased energy for the brain. Influences neurotransmission and cerebral metabolism	<ul style="list-style-type: none"> Evidence suggests a benefit to performance in most cases Possible that part of this ergogenic effect is due to influence on the CNS
Tyrosine	5–10 g	Increases production of brain dopamine and noradrenaline	<ul style="list-style-type: none"> Few studies investigating effect of tyrosine on performance, but show no effect on physical performance Some evidence of a benefit to mood, memory and cognitive function

Some points for consideration when using supplements to influence the development of central fatigue

- This is a relatively new area of research in exercise physiology, and there are still many gaps in our knowledge of the effects of these supplements.
- At the moment, consistent benefits to performance during prolonged exercise are only reported with caffeine or carbohydrate.
- This is not to say that amino acid may not be useful, and there is some emerging evidence that various aspects of mental fatigue and cognitive function can be positively influenced. In sports requiring the controlled execution of skills and/or rapid decision making, amino acid supplements may yet prove beneficial.



- Everyone is different, and individuals may experience varying responses to some of these supplements. This is particularly apparent when considering caffeine supplementation: some experience marked effects with small doses, while others display little noticeable effects, even with relatively large amounts. For this reason it is advised that these supplements are used first in training, ahead of competition.
- Some supplement manufacturers have jumped on results of early studies, and introduced products with ingredients that claim to delay 'mental fatigue' (e.g. BCAAs). Often the inclusion of these ingredients is done with little sound evidence, and the amount of ingredient included is very small (a few hundred milligrams).
- The use of some dietary supplements acting on the central nervous system may be potentially harmful to health. A case in note is ephedra, which is found in some herbal supplements and is reported to be used widely in some sports. Ephedra is a stimulant that increases the amount of dopamine within the brain. A number of deaths from heat illness occurring during exercise have been either directly or indirectly linked to this supplement, and its use will result in a positive doping test under current WADA rules.

7

Building muscle:

Mark Tarnopolsky, McMaster University, Hamilton, Canada

By far and away the most important factor for increasing muscle mass and strength is resistance exercise training. Even in a fasted state, resistance exercise training promotes the retention of protein and after a period of training there is an increase in muscle mass and strength.

General Nutrition Strategies.

Nutrition can influence the response to resistance exercise training in multiple ways:

- The total energy content of the diet must be sufficient to meet the needs of daily turnover, growth (pediatrics and adolescence) and the energy cost of physical activity.
- An adequate carbohydrate intake also enhances protein retention with the added benefit of maintaining glycogen stores for the endurance component of cycled training (> 7 gCHO/kg/d for women; > 8 gCHO/kg/d for men).
- There is an increase in dietary protein requirements at the onset of resistance exercise training; however, the body adapts to this stress and with time the increase in protein requirements is attenuated. The maximum dietary protein requirement for an elite athlete performing weight training and/or endurance training would be ~ 1.7 g/kg/d.
- Finally, the timing of nutrient delivery around each of the training bouts is particularly important. The early provision of carbohydrates with and without protein in the very early period following endurance exercise has been shown to increase the rate of glycogen resynthesis. Numerous studies have shown that the early provision of carbohydrate and amino acids (protein) in the early period following resistance exercise can enhance protein retention.

