AIS SPORTS SUPPLEMENT FRAMEWORK
SPORTS DRINKS (CARBOHYDRATE-ELECTROLYTE DRINKS)

What is it?

> Sports drinks are designed to deliver a balanced amount of carbohydrate and fluid to allow an athlete to simultaneously rehydrate and refuel during and after exercise.

> According to various expert position stands, the composition which provides rapid delivery of fluid and fuel and maximises gastric tolerance and palatability is within the range of 4–8% (4–8 g/100 ml) carbohydrate and 23–69 mg/100 mL (10–30 mmol/L) sodium.[1]

> Carbohydrates consumed during exercise can support or enhance performance via two different mechanisms: provision of fuel for the muscle and a mouth sensing benefit to the brain and central nervous system. Guidelines for carbohydrate intake during different sporting activities vary according to the importance of these effects.

- Performance benefits have been clearly demonstrated in a range of sporting events when carbohydrate is consumed during exercise to provide an additional fuel to the muscle.[2,3]
- Mouth sensing: the exposure of receptors in the mouth/oral cavity to carbohydrate creates a favourable response in the brain and central nervous system (CNS), decreasing the perception of effort and enhancing pacing strategies.[4,5]

> There may be other roles for carbohydrate support during prolonged strenuous exercise that are of benefit to athlete health, particularly for high performance athletes. These roles are based on studies that investigate the acute response to exercise; further work is needed to determine if these actions translate into a reduced risk of illness and injury.

- Consuming carbohydrate before, during and/or after prolonged intensive exercise may help to protect immune function by being associated with a reduction in the detrimental changes in cytokines and immune system cells normally induced by exercise stress.[6]
- Such intake may also be beneficial to bone health by reducing the effect of exercise with low carbohydrate availability on markers of bone resorption.[7]

> The electrolyte content of sports drinks, particularly sodium, helps to preserve the thirst drive. Sodium concentrations of ~ 10–25 mmol/L enhance the palatability and voluntary consumption of fluids consumed during exercise, although higher sodium/electrolyte concentrations may increase fluid retention.

> The taste and temperature of sports drinks are also important factors in meeting hydration goals:

- Studies show that athletes more closely match fluid intake to sweat losses when offered flavoured sports drinks compared to water.[8,9]
- Cool fluids are generally more palatable for athletes who are exercising in hot conditions or have become hot through the heat gain associated with high-intensity exercise; with studies showing that voluntary intake of cool drinks is increased.[10]
- Sports drinks are suitable to serve in “slushie” (ice slurry) form for use pre- and during- exercise as part of a “cooling” strategy to assist comfort and thermoregulation during activities undertaken in hot environments.[11]

What does it look like?

> Commercially available sports drinks come in both ready-to-drink and powdered forms in a wide range of flavours which vary according to their carbohydrate and electrolyte content as well as the addition of other ingredients.

> The type and quantity of carbohydrates provided in sports drinks varies according to the manufacturer, with factors such as taste, osmolarity (concentration of individual particles), intestinal absorption and gut tolerance being considered.

> Typical carbohydrate concentrations range from 6-8% (6-8g /100 ml), however some drinks vary from 2-14% carbohydrate and several low energy/”sugar free” varieties also exist:

- Certain new varieties may contain ~14% carbohydrate and are designed to meet high fuel targets during endurance exercise. Some of these may be made with special techniques; for example, the use of pectin and alginate gel to create a “hydrogel” that is claimed to aid stomach emptying of the drink. Further research is needed to support these claims and athletes should ensure that they practice the use of more concentrated formulas to confirm tolerance and perceived benefit.
- Low energy/‘sugar free’ varieties may be useful when fluid intake is desired without carbohydrate intake (e.g. protocols to “train low” or when attempting to decrease energy intake).

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> Typical sodium concentrations range from ~20-40 mmol/L (~46-92 mg/100 ml), however some drinks are lower (<10 mmol) in sodium:
  - Lower sodium concentrations increase palatability and therefor usually promote greater fluid intake.
  - Higher sodium concentrations target the replacement of sweat electrolyte losses, with greater effects on fluid absorption/retention and thus may be more effective in recovery after exercise.
  - Note that dedicated electrolyte supplements with higher sodium concentrations are discussed in the Electrolyte Replacement Supplements fact sheet).
> Other electrolytes (e.g. magnesium, potassium and calcium) may be included in sports drinks. Current evidence indicates that magnesium losses during exercise can be met by dietary means and it is unlikely that additional magnesium intake via sports drinks will enhance hydration goals or reduce cramping.
> Protein or amino acids (2% or 2 g/100 ml) can be found in a small number of sports drinks.
  - The case for consuming protein during exercise to enhance performance is contentious. A meta- analysis of the literature (11 studies) suggested a methodological bias in the current studies; benefits are seen with time to exhaustion protocols and when protein is added to sub-optimal intakes of carbohydrate. It was concluded that any ergogenic benefits may result from a generic effect of additional energy intake rather than a unique benefit of protein.[12]
  - It is possible that protein consumed during prolonged lower- or intermittent intensity exercise may assist with protein synthesis goals and recovery during intensified training or competition; however other everyday foods or sports food sources may be consumed to achieve this.
  - Further research is warranted, but the effects of amino acids/ protein on the flavour profile of a drink and gastrointestinal comfort should also be considered.

How and when do I use it?

> Sports drinks provide a convenient option for simultaneously addressing fuel, fluid and electrolyte needs before, during and after exercise.
> **Use pre-exercise:** may be part of the pre-exercise meal or consumed immediately before exercise to enhance fluid and fuel status.
  - Pre-exercise "slushies" may be part of pre-cooling strategies for exercise in hot environments.
> **Use during exercise:** promotes hydration, fuelling and reduced perception of effort during exercise.
> **Use post-exercise:** Can contribute to refuelling goals but other foods/sports products should be considered to provide a more nutrient-dense approach to total recovery needs.
  - Hydration: promotes voluntary drinking and fluid retention to assist the athlete to achieve a fluid intake plan that keeps the fluid deficit incurred during exercise to an acceptable level. Opportunities to drink fluids during sporting activities vary according to the rules and practical features of the sport.[13]
  - Fuelling: carbohydrates consumed provide an additional fuel source for the muscle according to the requirements of each sporting activity. See Table 1 for recommendations.
  - Mouth sensing: 5-10 second exposure of mouth/oral cavity to carbohydrate every 10-20 minutes stimulates reward centres in the brain to make the athlete feel better. Effect is repeatable throughout exercise and can directly enhance performance of shorter events (45-75 min) as well as provide additional benefit in longer events.
> Delivery of carbohydrate consumed during exercise to the muscle is largely influenced by the rate at which it can be absorbed in the small intestine. Typically, ingesting glucose-based carbohydrates (e.g. sucrose, glucose polymers, maltodextrin) at rates in excess of ~ 60 g/h during exercise does not lead to additional performance benefits. In fact, because intestinal glucose transporters (called SGLT1) are saturated at this level, excessive carbohydrate intake can cause gut discomfort/problems that impair performance.
  - The gut can be 'trained' by consuming carbohydrates during exercise to maximise the number and activity of the SCGT1 transporters, thus enhancing glucose uptake and reducing gut symptoms.[14,15]
  - In addition, some newer sports drinks and sports foods contain 'multiple transportable carbohydrates' - a blend of carbohydrates such as glucose and fructose which are absorbed via different transporter molecules in the intestine to overcome the usual bottleneck on a single transport system.
  - Studies have shown that when carbohydrates are consumed at high rates (> 60 g/h) during exercise to meet new guidelines for prolonged strenuous events, drinks containing multiple transportable carbohydrates are more effective than glucose-based products in maintaining gut comfort, promoting muscle carbohydrate oxidation and enhancing performance.[16]
> The composition of sports drinks provides a generic balance between fluid and carbohydrate needs across a range of sports. The relationship between fluid and fuel needs may vary according to the environment, the athlete's nutritional preparation and the demands of the exercise.
  - If fluid needs are greater than carbohydrate needs: sports drinks with lower carbohydrate content or diluted sports drinks may be used.
  - If carbohydrate needs are greater than fluid needs: sports drinks with higher carbohydrate content may be used or supplemented with sports gel/ sport bar/ sport confectionery.

Table 1: Guidelines for carbohydrate intake during sporting activities[17]

Type of sport/ Exercise	Duration	Carbohydrate Target	Comments
Brief exercise	<45 min	Not needed	
Sustained high intensity exercise	45-75 min	Small amounts including mouth rinse (swilling in mouth)	> A range of drinks, gels and sports products can provide easily consumed carbohydrate. > The main benefit from carbohydrate use in these events comes from interaction with the brain and CNS. To achieve optimal benefit, the athlete may need to organise their event nutrition strategy to allow frequent (e.g. every 10-20 mi) "mouth sensing" with a significant duration of mouth contact (e.g. 10 s).
Endurance exercise including "stop and start" sports	1-2.5 h	30 – 60 g/h	> Opportunities to consume foods and drinks vary according to the rules and nature of each sport. > A range of everyday dietary choices and specialised sports products ranging from liquid to solid may be useful. > The athlete should practice finding a fuelling plan that suits individual goals including hydration needs and gut comfort. > The benefits of carbohydrate intake strategies in these events are likely to be achieved both in the muscle (fuel) and CNS (perception of effort).
Ultra-endurance events	>2.5-3 h	Up to 90 g/h	> As above > Higher intakes of carbohydrate are associated with better performance. > Products providing multiple transportable carbohydrates (glucose: fructose mixtures) will achieve high rates of carbohydrate absorption and oxidation during exercise. > The benefits of carbohydrate intake in these events are likely to be achieved both in the muscle (fuel) and CNS (perception of effort).

Are there any concerns or considerations?

Unnecessary expense

Sports drinks are not needed at every training session and may be an unnecessary expense.

Unnecessary energy intake

Athletes need to consider their physique goals and total nutritional goals when deciding whether to consume sports drinks. In the case of athletes who have short- or long-term restrictions on dietary energy intake, overuse of energy-dense fluids such as sports drinks may create problems with energy balance and overall nutrient density of the diet.

Dental erosion

Sports drinks, like other carbohydrate-containing fluids such as soft drinks and fruit juices, have been shown to contribute to dental erosion. To help reduce the potential impact of sports drinks on dental health, athletes should consider the follow options when they are practical or able to be balanced with the sports nutrition plan.

> Minimise the contact time the sports drink has with the teeth and avoid holding or swishing the drink around the mouth. A straw or squeezy bottle can also minimise contact time with the teeth by directing fluids towards the back of the mouth.

> Use a water chaser immediately after consuming a sports drink to rinse the mouth out

> Where practical, consume dairy products after the session or chew sugar free gum immediately after consumption of the sports drink.

> Avoid brushing teeth for at least 30 minutes after consuming sports drink to allow tooth enamel to re-harden.[18]

Gut discomfort

> Some athletes report that sports drinks cause gut discomfort or make them feel unwell. While some athletes may not tolerate sports drinks well, the following strategies can help to minimise problems.

- Dehydration increases the risk of gastrointestinal problems during exercise and is often the cause of such complaints. Practicing fluid intake strategies during training can assist in preventing dehydration as well as helping to overcome problems such as dislike of the taste, mouthfeel of the drink and gastrointestinal discomfort.
- 'Gut training' – deliberately consuming a gradually increasing volume and concentration of sports drink during workouts - can allow the gut to develop better capacity to absorb carbohydrate and feel comfortable.
- The use of sports drinks with multiple transportable carbohydrates may assist in maximising gastrointestinal comfort, particularly when carbohydrate is consumed at high rates of intake (> 60 g/h).

> Individuals with fructose malabsorption or FODMAP intolerance should be aware of the fructose content of sports drinks containing multiple transportable carbohydrates.

Interference with opportunities for training adaptation

Some athletes may periodise their carbohydrate intake to help support training adaptations. This may include the prescription of workouts in which there is "low carbohydrate availability" (i.e. the session is undertaken with low muscle glycogen stores and/or after an overnight fast). This strategy may increase some of the important adaptive responses to exercise. Therefore, on some occasions, an athlete may deliberately choose not to consume a sports drink during the session or during the first part of a session.[19,20]

Where can I find more information?

Sports Dietitians Australia Sports Drinks Factsheet

www.sportsdietitians.com.au/factsheets/fuelling-recovery/sports-drinks

Supplement safety information

www.sportintegrity.gov.au/what-we-do/anti-doping/supplements-sport

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Athletes should be aware that the use of supplements may have doping implications. Athletes are reminded that they are responsible for all substances that enter their body under the 'strict liability' rules of the World Anti-Doping Code. Some supplements are riskier than others. The Sport Integrity Australia (SIA) app is a useful resource to help mitigate the risk of inadvertent doping by helping to identify supplements that have been batch-tested. The SIA App provides a list of more than 11,000 batch-tested products. We recommend that all athletes consult the educational resources of SIA regarding the risks associated with supplements and sports foods.. While batch-tested products have the lowest risk of a product containing prohibited substances, they cannot offer you a guarantee that they are not contaminated (**www.sportintegrity.gov.au/what-we-do/supplements-sport**).

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