

3.2 Other Issues to Consider

Recently, themes regarding sports hydration have received considerable attention. Among them are a range of different studies on the types of drinks that can be used, how to improve the adaptability of liquids to exercise, and supplements that can be used to hydrate athletes.

These points are just some of what we'll be covering throughout this module.

3.2.1 Using Other Drinks in Exercise

With the advancement of the industry and the appearance of different drinks on the market, making the choice has become more complex for athletes. We previously mentioned some points to consider regarding the virtues of sports drinks for athletes, but we didn't address the advantages and disadvantages of other liquids that can be drunk during physical exercise.

Water

Water is a universal liquid and the most available drink in nature. It holds a crucial role in a large number of physiological functions:

- It acts as a medium to allow multiple metabolic reactions.
- As the principle component of blood, it helps transport nutrients, hormones, waste products, and more.
- It is the solvent that helps eliminate soluble metabolic waste by means of the kidneys via the production of urine.
- It is responsible for body temperature regulation and is the principle component in sweat. Its evaporation on the surface of the skin helps dissipate excess body heat.

Nevertheless, as we have seen, in the context of sustained physical activity, it can cause dilution of sodium levels in the blood, thereby causing hyponatremia. Although it is vital for many bodily functions, we must always remember that it neither provides the electrolytes nor the calories at times required by physical effort.

Sugar-Free Sports Drinks

This group of drinks has appeared recently thanks to producers who have decided to expand the market with a "reduced" sugar option. These drinks are based on the fact that they deliver the most important

electrolytes during physical effort (sodium and potassium) without adding calories. Herein lies one of the main problems, as they cannot consistently provide the carbohydrates needed to compensate for the fall in glycogen during activity. Nevertheless, they can be a valid option for individuals who do not “tolerate” sweetened sports drinks, as they imply less effort for adaptation and tolerance in the gastrointestinal tract.

At some points during physical exertion, the redistribution of blood flow is not the same in the stomach as at the beginning of the activity. Here is when athletes often report an intolerance to certain foods, and the same thing happens with sweetened sports drinks. Although, as we will see later, it is a “trainable” process, it is here where the reduced sugar content in these drinks can make tolerance more efficient for athletes.

Perhaps understanding that an athlete’s choice of drink is the sports drink (as it replaces CHO and electrolytes), this group of sugar-free drinks has appeared as an alternative to consider when its consumption is interspersed with that of regular sports drinks, as its greater adaptability in the gastrointestinal tract improves the subject's tolerance.

Energy Drinks

Energy drinks are non-alcoholic, generally carbonated, and basically made with caffeine and CHO with different rates of absorption, as well as other ingredients (amino acids, vitamins, minerals, vegetable extracts, etc.).

The industry markets them as a functional food, as they were designed to deliver a beneficial effect related to a quick sensation of well-being and greater physical or mental strength in the consumer when faced with exerting extra effort.

The concept of an energy drink comes from the calories as well as the vitality delivered to the body by the guarana and the caffeine, which accelerate mental activity and create an energetic sensation.

Generally, carbonation, high CHO content and caffeine are factors that inhibit hydration. Such a composition usually slows stomach emptying and interferes with the absorption of other nutrients in the intestine (Bonci, 2002).

In turn, its consumption tends to generate a higher number of post-effort side effects, such as insomnia, nervousness and irritability, which often interfere with sleep patterns, considered to be a fundamental pillar of athletes’ performance (Salinero, Lara, Abian-Vicente, González-Millán, Areces, Gallo-Salazar, Ruiz-Vicente & Del Coso, 2014).

Oral Serums

The use of oral serums is promoted in many different sports activities, due to their main ingredients: water, electrolytes, carbohydrates. The World Health Organization (WHO) suggests their use for replacing losses due to diarrhea, which is why their concentrations are completely different than those of a sports drink, as the quantity of liquids and electrolytes lost in that way is much higher than those lost through sweat. A serum containing oral rehydration salt ingredients (ORS) from the WHO is shown in the following table:

Table 4: Composition of Standard and Reduced-Osmolarity ORS per the WHO

Composition	Standard ORS via WHO (1975)	ORS reduced osmolarity via WHO (2002)
Glucose (mmol/L)	111	75
Sodium (mEq/L)	90	75
Potassium (mEq/L)	20	20
Chloride (mEq/L)	80	65
Citrate (mmol/L)	10	10
Osmolarity (mOsm/L)	311	245

Source: JAMA, 2004(291):2632-5

In addition to the differences in the concentration of electrolytes, another big problem with their use by athletes stems from their low CHO content (60 g/L vs. 13 g/L) and their rather disagreeable flavor, which can become a significant factor when drinking large quantities is necessary.

3.2.2 Supplements and their Impact on Hydration

The most studied supplements linked to hydration patterns are glycerol, creatine and caffeine. In a brief review, we'll study the supposed advantages and disadvantages of using said supplements during physical exercise.

Caffeine

Caffeine has historically been recognized as a potential diuretic, which is why it is best to avoid it before and during exercise. However, the latest research posits that the problem only occurs when more than 300 mg are consumed before the exertion. Other studies suggest that consumption of around 250 mg does not cause dehydration during rest or while exercising (EFSA, 2015).

Stemming from the latest recommendations and in virtue of the ergogenic effect of caffeine in athletes (especially on endurance), there is no reason to avoid its consumption if keeping to under 300 mg before

activity.

Creatine

In various studies, results indicate that supplements with creatine elevate total body mass. Early changes observed in body weight after ingesting creatine can probably be explained by the increase in body water, especially in intracellular muscular compartments. It is speculated that the reason for increased body fluid is the greater osmotic load associated with the increased concentration of creatine in the cell.

Another study reported on the possible dehydration that it could cause; a factor which promotes muscle cramps.

Some past information suggested that creatine extracted water from vascular spaces (to store itself in intracellular spaces), which could be the cause of heat stress.

In fact, studies that apply more serious research methods report no consistent risk whatsoever of adverse side effects influencing hydration patterns in subjects, other than increased weight due to the increase of intracellular compartments within muscles (Buford, Kreider, Stout, Greenwood, Campbell, Spano, Ziegenfuss, López & Landis, 2009).

Glycerol

Glycerol is a hyper-hydrating agent that is usually used before competition. Its main function is to increase organic water storage, and under certain conditions, it can protect from heat stress. In any case, not all of the research demonstrates that glycerol generates significant effects in thermoregulation, compared to an adequate hydration pattern with plain water before exercising.

The dose generally used is 1 g of glycerol per kg of body mass, added to 1 or 2 liters of water before exercise (its hyperhydration effect lasts up to 6 hours). One of the problems is that its use is quite impractical, and in turn, often causes a series of collateral effects, such as headaches, nausea, dizziness and instability (Goulet, Aubertin-Leheudre, Plante & Dionne, 2007).

Though a relevant topic for the scientific community, the benefits of exogenous glycerol still need further research in order to reinforce these concepts.

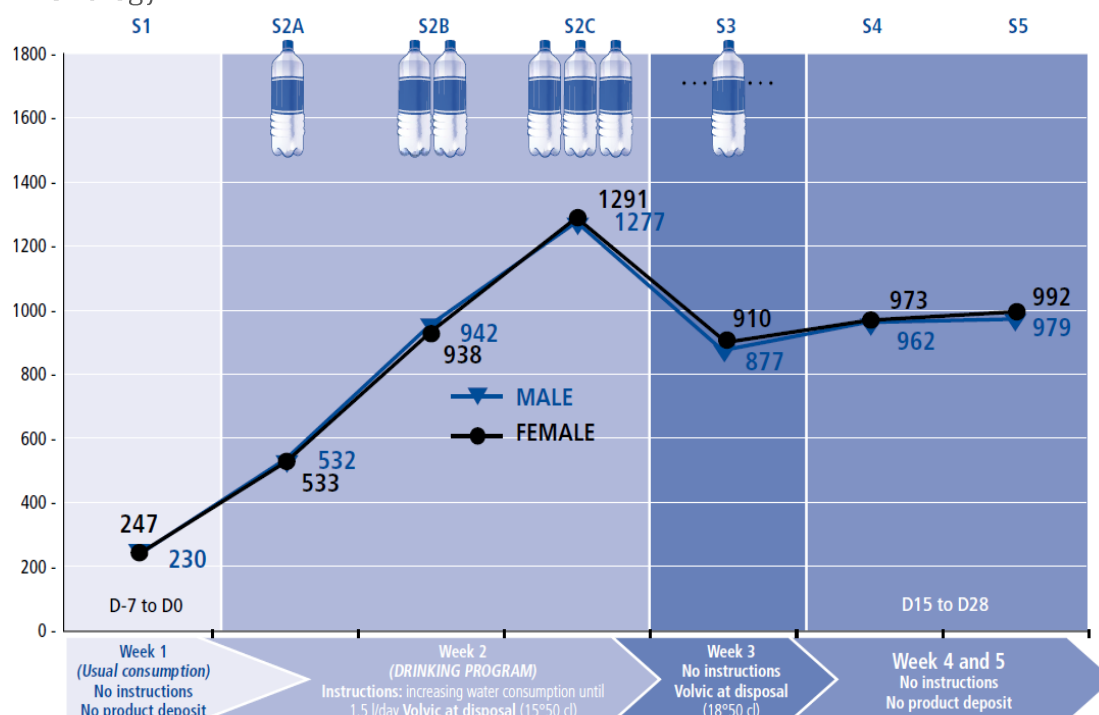
3.2.3 Adaptability to Sports Drink Consumption

As clearly explained before, it is best to begin a physical task in a state of proper hydration. The same activity can cause post-effort dehydration if liquids are not ingested. In turn, another concept that we must understand is that if we begin our physical activity in a state of dehydration, it would be very difficult to pass to a state of euhydration or over-hydration during the activity.

That is why the adaptability to liquid consumption before and during exertion is fundamental to avoiding situations that trigger dehydration in athletes. Here we must review the concept of adaptability to liquid consumption in individuals.

It's known that training and adaptability to liquid consumption can be improved in 3 to 4 weeks with an adequate nutritional strategy. In 2010, though a study conducted in 4 French cities, Laurent Le Bellego et al. (2010) demonstrated that test subjects moved from an approximate consumption of 240 ml/day of water to almost 1000 ml/day, using differences strategies (recording liquid intake, increasing the availability of liquids, having pertinent instructions for consumption, etc.).

Figure 3: Adaptability to Liquid Consumption in the Context of a Nutritional Strategy



Source: Laurent Le Bellego et al.

The nutritional choices made by the subjects (whether athletes or not) are influenced by multiple factors, including biological, social and cultural factors. Likewise, they are influenced by information delivered via mass

media, advertising, interaction with peers, and obviously, product availability and their access to those products. Here is a key point; as a member of a healthcare team, improvement happens when we communicate with the athlete.

One of the tools that is not usually made available to athletes is nutritional education for improving their performance. Convincing athletes of how important hydration is to performance is the job of their collaborators. There are ample situations where athletes do not hydrate as required during a sports event because this point was not emphasized in the preceding weeks of preparation. Communicating the importance of systematic hydration is complicated (so that it comes naturally later) when the coach or the work group do not allow it to happen during preparation for an event. Only addressing the subject's physical or technical-tactical preparation and ignoring dehydration – and the lack of motor coordination it can cause – is a damaging factor; it is like not knowing all the “rules of the game”. As part of a multidisciplinary team, we must address these points.

Institutions and regulations play their part, in that they do not contemplate hydration as a process vital to athletic performance. Sports with mid-game breaks allow for a better hydration model than those without them. For example, it's much easier to hydrate in sports like basketball or volleyball, the dynamics of which facilitate mid-game pauses, as compared to soccer, where those moments don't exist and hydration is at the discretion of the referee.

Creating modifications in order to better structure these issues would be of vital importance as a strategy to promote changes in habit so that greater consumption of liquids could be allowed during sports events.

3.2.4 Designing Hydration Plans

To create an athlete's hydration plan we must consider two central points:

- 1) The maximum level of dehydration proposed by ACSM, as previously seen, must not exceed 2% of the body weight lost from the beginning to the end of the session;
- 2) We must stipulate, as we have previously seen, the subject's sweat rate in a climate similar to that for which the plan will be designed (i.e., ascertain the sweat rate in temperatures and at humidity levels similar to those for the plan).

With these issues in mind, the design of the diet plan is nothing more than a rule of three, which allows us to reach the total volume of consumption for the event. Next we'll look at an example of how to determine this.

Data:

- Sweat rate (SR): 2.3 L/hour (in conditions similar to the event).
- Athlete's weight: 80 kg.
- Duration of future event: 120 minutes (2 hours).
- Tolerable weight loss according to ACSM: $80 \text{ kg} \times 2\% = 1.6 \text{ kg} = 1.6 \text{ L}$.

Let's review:

- 1) The athlete's maximum loss threshold must not exceed 1.6 liters.
- 2) Supposing that the event lasts 2 hours with a SR of 2.3 L/hour (in a similar climate), around 4.6 liters total will be lost during exercise.
- 3) The maximum acceptable loss (2%) is 1.6 liters, which is why 3 liters of total liquid must be covered in that time ($4.6 - 1.6 = 3 \text{ L}$).
- 4) The ideal plan is established based on SR, so a minimum of 3 liters must be prescribed, at 1.5 liters of liquid/hour if possible, because it is not always feasible for the athlete to drink the ideal amount of liquids.

Once the total amount of liquid to prescribe has been determined, the different types of liquids to use can be listed, following Jeukendrup's (2014) proposal, which we have seen recently.

- *Up to 60 minutes: no CHO delivery.*
- *Between 60 to 120 minutes: 30 g CHO/hr.*
- *Between 120 to 180 minutes: 60 g CHO/hr.*
- *Over 180 minutes: 90 g CHO/hr.*

To conclude our example, we can recommend the following consumption:

- Drink 1.5 liters of water in the first 60 minutes of exercise.
- Drink 1 liter of water + 500 cm³ of a sports drink (delivering 30 g of CHs) in the following hour. As a preventative measure, if the athlete is used to drinking sports drinks, he or she should also drink more of the sports drink (in this case the remaining 1.5 liters) after the second hour.

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