DO YOU HAVE A DRINKING PROBLEM?

I remember the first time I experienced substantial dehydration in a 100km trail race. It snuck up on me, like a clipboard-carry Scientologist at a busy street corner. Both will get into your head first, with dehydration creating a throbbing headache that made simple concentration and decision-making as hard as World Championship-level Sudoku. Any pain I had felt worse and my pace slowed, not helped by the fact that my stomach shut itself off with a wave of nausea thrown against any food offered to it, apart from some glucose tablets. But these were just mild and very common reactions – if you don't get your hydration right, the consequences can be much worse.

Drinking a bit too much or too little can add up over the many hours of an ultramarathon and cause big problems

Running dry – all about dehydration

Dehydration most commonly occurs in exercise when the fluid lost due to sweating is not properly replaced. Now that may seem the equivalent of pointing out that the Pope is probably busy on Easter Sunday, but in ultramarathons you also have the chance of diarrhoea, vomiting and excessive urination, all of which are very dehydrating and extremely unpleasant, especially if you're actually running when they occur.

Dehydration by sweat loss, by contrast, isn't as obvious as a stain on your shorts or a loud yell for Huey, but the effects on athletic performance can be just as ugly. It's commonly claimed performance drops off once 2% or more of total body weight in water is lost. Here's a summary of the reasons dehydration sucks down your performance level:

- increased heart rate
- reduction in blood volume
- decreased skin blood flow
- decreased sweat rate
- decreased heat dissipation
- increased core temperature
- increased rate of muscle glycogen use

A study by Shiffeffs and Sawka (2011) found that the effects of dehydration are more than physical. They concluded that dehydration influences cognitive function, mood and mental readiness, all of which are vital to the ultra runner trying to read maps and make important judgements about their pace, eating and drinking, and their will to live. Dehydration has also been shown to increase the level of perceived exertion, which means that when you are dehydrated, everything will *feel* more difficult.

There are some clear physical symptoms of dehydration you should be aware of:

- dry or sticky mouth
- irritability and general discomfort
- headache
- weakness
- dizziness
- low or no urine output, very dark coloured, concentrated urine
- cramps
- chills
- sunken eyes, skin may 'tent' when pinched (doesn't bounce back quickly when released)

- heartburn, vomiting, nausea
- your stomach rejects food
- head or neck heat sensations

Thirst is a notoriously poor indicator of dehydration because it is a delayed response. An athlete can lose over 1.5 litres of body water before becoming thirsty. Conditions can also make it difficult to know how much to drink. In hot, dry conditions, your sweat can dry off your skin and clothes almost immediately, even though your sweat rate is very high, whereas in humid conditions, the sweat doesn't dry off, which can give the impression that you are sweating more.

A simple method to check on your hydration status is to compare your urine colour with a urine colour chart. A light "straw" colour (1 or 2) means you're probably well hydrated, while a dark colour (5 or 6) indicates dehydration. If you want to play field pathologist (see page 137 of the third *50 Shades of Grey* sequel… I think), you could measure your own urine specific gravity with a refractometer (because asking another runner to do it for you would be just awkward). A urine specific gravity less than or equal to 1.02 or urine colour less than or equal to 4 should be the upper range of acceptable.

A specific gravity test has the advantage that it is less subjective than comparing urine colour. Trust me, examining urine colour and specific gravity won't be the oddest thing you'll see on an ultramarathon course, but either test could be too hard to do on the trails, especially for women. At least try to pee immediately after a long training run so you can use this as a guide to how well you are hydrating yourself.

50 Shades of Yellow

Use this or a similar colour chart to match your urine colour so you can assess how well hydrated you are.

What You've Heard:

"Top marathon runners often finish their races with a fluid loss of 5% or more of their body weight – and they're faster for it because that's a few less kilos they have to run with."

It may well be true that an elite marathon runner can get away with this, but not the ultra runner. The elite marathon runner goes at a faster pace for around 2.5 hours, so the total time spent in a dehydrated state of more than 2% is potentially a lot less than an ultra runner. While the marathon runner may dehydrate rapidly, the total volume and/or effect of the dehydration can be less than it would be for the ultra runner. Even if elite marathon runners do reach as much as 7% dehydration, they may finish the marathon and fix their hydration status before any disastrous effects occur.

Some sadists for sports science (Sawka, Young, Francescone, et al. 1985) looked at eight subjects walking on a treadmill at a mere 25% of their VO2max, with the aim to make it to 140 minutes. Conditions were very hot and dry (49°C, 20% relative humidity). The test was repeated with the same subjects when they were euhydrated (i.e. they had a normal state of body water content) at the start, then again when they were dehydrated by 3%, 5%, or 7% loss of body mass. All eight subjects were able to complete 140 minutes walking when euhydrated and 3% dehydrated. Seven subjects completed the walk when 5% dehydrated, but when dehydrated by 7%, six subjects stopped walking after an average of only 64 minutes. So even for relatively low-intensity exercise, dehydration clearly increases the incidence of exhaustion from heat strain.

Sawka et al. later (1992) repeated the test conditions, but had subjects walk to exhaustion at 47% VO2max when euhydrated and again when dehydrated to a loss of 8% of total-body water. Dehydration reduced exercise endurance time from 121 minutes to 55. Dehydration also appeared to reduce the core temperature a person could tolerate, as core temperature at exhaustion was about 0.4°C lower in the dehydrated state.

Your hydration plan

This is the part where you want me to give you an exact recommendation, or at worst a magic formula you can apply to work out just how much your fluid intake should be. Unfortunately, there's no 'one size fits all' guideline that can apply to all people in all conditions, even for the exact same distance. Like the running itself, you need to practice and take notes of your hydration and sweat loss to find what works best.

Some people are very efficient sweaters and excrete less than a litre of sweat per hour, even under adverse environmental conditions. In others, sweat loss during physical activity can reach very high levels, at times exceeding two or even three or more litres per hour (Murray, 2000). On the other hand, you will sometimes see recommendations that athletes restrict fluid intake to no more than 400–800 ml per hour during exercise to reduce the risk of hyponatremia (Noakes, 2002) – the fancy name for 'over hydration' or water toxicity, a topic we'll talk about a little later on.

Here are some factors and considerations that will help you get the hydration right for your body and the conditions of your training or event.

Create opportunity for and encourage fluid intake if:

- your event finishing time is fast
- there are limited opportunities to drink before or during the event
- conditions are hot
- you're male
- your body weight is on the heavier side
- you're over 45 – our thirst mechanism may decline with age, plus certain medicines increase the risk for becoming dehydrated.

Control your fluid intake and avoid over drinking if:

- your event finishing time is slow
- conditions are cool
- you're female
- your body weight is on the light side
- you're a slower or more inexperienced runner

Don't think that you don't need a plan – runners typically start off drinking well, but reduce their rate of drinking over the next several hours, even when drinks are available and the runners are dehydrated

Especially in trail ultramarathons, you may want to have a minimum fluid intake target based on time rather than distance. This is because the terrain and elevation gain and lost may have a big impact on your pace, while your effort level is probably more consistent. If you are doing an ultra where the terrain and elevation is much more consistent, then you might like to set your fluid targets based on distance, which will allow for you to back off the pace from time to time.

[INSERT CARTOON – woman checking pee on course]

The fluid balancing act

There's an easy way to make a rough assessment of how much you need to drink:

- weigh in before training, preferably after going to the toilet. For preference, weigh yourself in your undies or naked
- if you pee during your training session or event, have a guess at the volume of urine (since peeing into a measuring jug would just be weird – but how weird are you anyway?)

- after your event or training session, towel-dry your hair and weigh yourself again
- your ***total sweat loss*** for the session (in grams) = bodyweight difference (grams) + fluid consumed (ml) – urine loss

This method is not flawless. It's often pointed out that the metabolism of energy (i.e. "burning" calories) contributes to water loss a little, then you can get some error creeping in with sweat that stays in your hair or clothing and then shows up as bodyweight when the fluid is no longer in your system (solution: weight yourself naked, depending on the location!). However, in the battle between practicality and accuracy, it's not a bad solution and it is one commonly recommended by sports science authorities.

After your event or long training run, simply drinking to make up for lost grams of body weight after you finish exercise won't fully restore fluid balance, because you tend to keep sweating afterwards and you keep producing urine. Typically, you need to drink a volume equal to 125-150% of the fluid loss in the first 4-6 hours of recovery.

Fluid retention – why you're worth your salt

We've all seen footage of runners dragging themselves to the finish line of a marathon on hands and knees, or staggering right and left on legs that seem to have drunk a bottle of vodka each. People think that these runners have pushed themselves over the edge of exhaustion. The more accurate explanation is that they've really just screwed up their electrolytes. If you ever find yourself lying beside a track with your legs in spasm, you can bet you're lacking in sodium.

Athletes who sweat a lot are one of the few groups of people who may need to deliberately consume salt, particularly if they are 'salty sweaters' (their sweat contains a high concentration of sodium). Athletes also benefit from the power of electrolytes which, according to drink manufacturers, can make you run through walls, beat previously invincible foes, and deflect the prospect of incredible pain with the slosh of a plastic bottle. So what do these electrolytes actually do?

Electrolytes are ions (atoms or molecules with a net electrical charge) that are comprised of four minerals – sodium, potassium, magnesium and calcium. Electrolytes are vital for cellular

Pill-popping and dehydration

It's common for ultra-endurance athletes to gobble down ibuprofen drugs and other NSAIDs (non-steroidal anti-inflammatory drugs) like they're M&Ms. You'll see them doing this during an event, and many take them immediately prior to a race because they think will help ward off the inevitable inflammation that will come later on*. Both tactics are a little bit stupid.

NSAIDs should only be taken when your body is well hydrated – that is, save them for well after the race or training session once you have properly rehydrated.

Even at the best of times, NSAIDs mess with your hormonal control over the blood flow into the kidneys, which in turn cause a sharp decrease in urine and in oxygen delivery to the kidneys. A well-hydrated body offers some (and only some – that's why there are dosage limits!) protection against this effect, but if you're already dehydrated, then all bets are off. Dehydration concentrates the medication in the blood, and then you combine this with the stress that's already on the kidneys as they try to deal with dehydration. It can all add up to a dangerous increase in potassium and a drop in your sodium, which can lead to dehydration, hyponatremia (low sodium concentration in the blood) and at the extreme, kidney failure.

A study of 58,055 people by eHealthMe reported that women were more susceptible to suffer dehydration and the resulting complications after taking NSAIDs, but the biggest risk group by far are any adults over age 60.

* *David Neiman, director of the human performance lab at Appalachian State University, North Carolina, conducted a study during the running of the 100-mile Western States trail running race to see what effect ibuprofen had on the runners. There was a control group, a group taking 600 mg of ibuprofen one day before and on race day and a group taking 1200 mg of ibuprofen one day before and on race day. Neiman found that there were no differences across the groups for self-reported DOMS (delayed onset of muscle soreness) or perceived exertion. However,* <u>both</u> *ibuprofen groups had higher blood markers for muscle damage than the control group.*

function, which in turn affects many operations in the body, such as:

- temperature control
- fluid level and fluid transport into and out of cells
- breathing rate
- kidney function and bladder control
- digestion
- glucose metabolism
- energy production
- thought, memory and how all the senses gather information and then transport that message to the brain and muscles

Real runners say

"When you're running long distances, you have to keep checking on yourself to see if you feel a bit off. If you do, then it's usually because you need one of four things: sugar, salt, water or caffeine. Fortunately, these are all easy things to guzzle down."

– ***Adam Connor***

[INSERT CARTOON – electrolytes supero/demi-god]

Even if just one of the four basic electrolyte minerals is out of whack, it can have major effects on the body. Electrolytes need to be in balance.

Sodium is the most important electrolyte found outside the body's cells, while potassium is its 'counterweight' inside the cells. The sodium helps regulate blood pressure and blood volume (amount of blood circulating), and assists in the distribution of fluid and nutrients between the inside and outside of cells. When the sodium concentration falls outside its normal range, the delicate balance is thrown out of whack and many body functions get screwed up.

Electrolytes, especially sodium, are lost in all bodily fluids, but particularly sweat. Massive sweat losses can potentially deplete the body's electrolyte stores. Training and acclimatisation can offset this by helping the body to adapt to a hot environment by diluting sweat, which will conserve electrolytes. The catch is that the heavy sweating is not what has the greatest impact on electrolyte concentration, it's actually the way we rehydrate ourselves.

Replacing lost fluids just with water can make things worse as the concentration of the electrolytes in the blood (blood plasma osmolarity) becomes even more diluted (weaker). Drinking too much plain water (or other salt-free drink) too quickly can dilute the concentration of the electrolytes in the blood (blood plasma osmolarity) and cause you to run to the toilet / bushy shrub, and consequently you lose even more water and minerals.

Studies have shown that the best way to improve fluid retention is to consume some sodium (salt) at the same time as you drink, which is why drinks associated with endurance sports have a fair hit of sodium in them. Drinking water or some other non-salty drink while eating salty foods is also effective. Salty drinks will also help you maintain both your thirst and appetite during a long run.

There is a happy medium to this – the benefits taper off if you just keep adding salt.

In a study of athletes who sweated 2% of their body weight, the most effective level of fluid replacement in rehydration and minimising fluid lost in urination *after activity* was around 52 mmol/L*, which is why you will often see it argued that many of the more common 'sports' drinks are often not ideal for long endurance, as they can have only 12–13 mmol/L of sodium in them.

** actually, **100 mmol/L** worked slightly better, but at this level the salty taste was so unappealing that it discouraged people from drinking – so with less total volume of fluid drunk, there is no point pushing to this level. Also note that this was done **after** activity was completed, when subjects were drinking more (including other fluids, such as water) and sweating less, so there was less risk of overdoing the sodium. This level is not recommended for general use during an ultra, although it may be used to rectify an electrolyte imbalance at a stop during the race, or as part of post-race hydration.*

CONTINUES NEXT PAGE

Composition of common Sports Drinks and Sports Waters

in table below include a 'zero sugar' or low carb option

Product	Carbohydrate g/l	Carbohydrate (%)	Sodium (mmol/L)	Potassium (mg/L)	Other ingredients
Sports drinks					
Gatorade	60	6	23	225	n/a
Gatorade Endurance	62	6.2	38	392	Chloride Calcium Magnesium
Staminade	72	7.2	12	160	Magnesium
Powerade Isotonic	76	7.6	12	141	
Sports water					
Pumped	22 0	2.2	4.8	47	n/a
MiZone Water	37	2.7	10	0	B vitamins Vitamin C

Sports Dietitians Australia

NB – ***Hydralyte Sports*** has a sodium osmolarity of 50 mmol/L

The way we drink is important, too.

- Drink with regular sips before, during and after exercise. This will maximize the absorption fluids and electrolytes.
- Drinking too fast or too much at one time can give you that 'sloshy' tummy feeling and trigger your bladder.

Practise your drinking plan on your long runs – how you drink, when you drink, what you drink and how much you drink. This will help you work out how your body will respond on race day.

Too much of a good thing?

Most of us have been trained to be terrified of dehydration (and possibly I haven't helped!). In fact, beverage companies would have us believe that any time spent in a state of thirst is a near-death experience. Now the hysteria has flipped us too far in the opposite direction and many people are putting themselves in danger of **hyponatremia**, which is when your cell concentration of sodium is too low.

For many people – I was one of them – it may come as a surprise that you can drink too much water. After all, we've all heard so many new age health nuts

Understanding kidneys

There's a lot of talk in this chapter about kidney function, but what do the kidneys actually do?

Most people think of kidneys as a kind of filtration system for the body, but they also regulate blood volume and blood pressure. By keeping the blood volume (the amount of blood circulating) in equilibrium, the kidneys can control blood pressure.

The kidneys use a feedback system to regulate blood volume and pressure. When blood volume decreases (due to dehydration, for example) the kidneys absorb less water so that blood pressure can be restored. The flipside is that when you have too high a concentration of sodium inside you, you will lose potassium (important for controlling muscle contraction and nerve function) and the resulting water retention can lead to higher blood pressure.

talking about drinking four litres, five, even seven litres of water a day – and all they do is a little yoga.

"We have to be careful about telling athletes to drink all the time, because we see some athletes drinking crazy amounts of fluids. They get up to three, four even five percent over [their body weight in fluids]," Dr Shane Brun told me. Dr Brun is a former President of Sports Doctors Australia and Associate Professor of Sports Medicine at James Cook University, and what he's seen at running events has shocked him.

"At fun runs nowadays, we're probably seeing more people collapse because of over hydration than those who are under hydrating.

"Up to a 2% fluid change more or less, people can still function fine, but once you go more than 2% in either direction, people's performance is adversely affected. Ideally, we keep people within 1-2% of their pre-activity weight."

HOT TIP

"During training, you need to work out what your drinking strategy will be for the race."

"People who run slower or are less experienced runners, they're more at risk of over-drinking. In an ultramarathon, you should not gain weight – you should lose weight. At the GNW 100 (a 175km race through mountains and bush terrain) we weigh people at various checkpoints and if people are heavier than when they started the race, we wait until they reduce weight before we let them continue."

– ***Dr Jonathan King**, ultra runner, sports doctor and and race doctor*

Drinking too much – even the purest water from the most pristine Swiss springs – can be deadly. Kelly Barrett at the Chicago marathon in 1998, Cynthia Lucero at the 2002 Boston marathon, Hilary Bellamy at the 2002 Marine Corps marathon in Washington, DC, David Rogers at the 2007 London marathon – they all died from hyponatremia. Even at a moderate level, over hydration leads to reduced performance because your blood has to soak up some of the excess water in an attempt to equalize your body's salinity. Cells begin to swell, causing all sorts of drama, from gastro to dizziness (yes, just like dehydration!), soreness and several of other symptoms that do nothing to make you faster.

A field study at the 2002 Boston Marathon found that 13% of 488 runners tested were hyponatremic.

"What runners drink is important," Dr Brun says. "If you're exercising heavily for an hour or more, you need to replace electrolytes."

Hyponatremia is usually caused by a combination of sweat sodium loss and excessive water intake, rather than just drinking too much water alone. Studies (Hiller 1989) have suggested that it is possible for dehydrated athletes to become hyponatremic during prolonged events if they lose a lot of sodium in sweat and drink water (and/or other salt-poor beverages) to replace most – but not all – of their sweat. For example, if a runner loses 10 litres of salty sweat in a long, hot race and then drinks eight litres of water, the runner will become both dehydrated and hyponatremic. This fits with what physicians have seen at the Hawaii Ironman triathlon, where some finishers arrive at the medical tent with signs and symptoms of dehydration (e.g., sunken eyes, 'tented' skin, ongoing low blood pressure when standing, etc.), yet they are also hyponatremic.

As with dehydration, some people are more prone to hyponatremia than others.

- Masters and veteran athletes are at risk again, because as we age the kidneys end to have slower response to water and sodium loads.
- Women in general tend to have lower sweat rates than men, which can put them at higher risk of hyponatremia.
- The group most at risk are those athletes with paranoia about dehydration. Under most conditions, abnormally large volumes of fluid have to be sucked down to create hyponatremia – but that's exactly what happens with many casual or recreational exercisers who constantly suck on drink bottles like a leech on a fat ankle, blissfully unaware that excessive drinking can be dangerous.

The real danger comes when runners are overhydrated but they *think* they're dehydrated because they haven't urinated during training/competition (another symptom common to both dehydration and over hydration) and so they drink even more.
As with dehydration, hyponatremia can creep up on the ultra runner. Slower people in longer events seem to be most at risk, because they might be sweating less and they have more time to over-drink without taking in enough sodium. A little too much water may not come back to haunt you over a couple hours, but over 12 hours it can all accumulate to one hot mess of hyponatremia.

The long duration of an ultra may place less pressure on a runner to run at a precise pace, but it leaves much less room for error when it comes to hydration and nutrition

Here are some physical symptoms of hyponatremia to look out for:

- bloating, a feeling of fullness or a 'sloshing' in your stomach
- nausea, poor absorption of food (you need the right sodium concentration for digestion) and vomiting
- hands and wrists get tight and puffy
- little or no urination
- urination may eventually come in high volume and crystal clear
- you might shiver when it's not that cold

Note how similar some of the symptoms above are to the symptoms of dehydration!

Neurological signs are bad news and indicate it's time to see a medic. These include:

- dizziness
- incoherence and/or disorientation
- irritability
- headache

As you can see, diagnosing hyponatremia is not always simple, nor is fixing it. Taking salt tabs during a race as a preventative measure to offset sodium depletion or over drinking is *not* recommended, because if you have adequate levels of sodium but you're carrying too much water, adding a lot more sodium does not help.

A deficiency of water or sodium can be corrected within minutes, but correcting excesses of either can take hours – and an IV drip!

It is better to be conservative with the sodium (another reason we don't recommend to go with 100 mmol/L sodium in your drinks!) so that if you have too much water on board then a one-time dose of electrolytes, along with sitting or walking, may prompt urination that will dump excess water. If you're craving salt, eat a salty snack. Your body will often tell you what it needs – you don't always need to anticipate it!

HOT TIP
drinking before an ultra

It is possible to 'super-hydrate' a little before an ultramarathon or a very long training run. Aim to sip on 600ml of an isotonic sports drink (i.e. a drink that contains electrolytes and carbohydrates) and 250-500ml of coconut water in the 24 hours beforehand while drinking 150% of your normal water/fluid intake. This will help you retain some fluid that can be utilised during your big run.

Drinks all round – what ultra runners need

As an ultra runner, you will want a combination of drinks. You will see people (especially former half marathon and marathon runners!) who want to find the one, single perfect solution of fluid or food that will see them through an entire event. While this may work for an event that lasts three hours, for most people this will not be the most

effective solution for an ultramarathon. There are several reasons for this:

- some nutrients or combinations of nutrients will work more effectively for your body at different times of the race and in set concentrations.
- 'flavour fatigue' can set in and discourage you from drinking as much as you should
- using a combination of different drink types (e.g. carbs, water, electrolytes) makes it easier to correct any imbalance that may occur in your body.

[INSERT CARTOON – one drink to rule for everything]

In addition to water, your drinks checklist for an ultramarathon should include a range of different drinks that contain:

- electrolytes
- carbohydrates
- protein (optional)
- caffeine (optional)
- a range of different flavours

Electrolyte drinks

Electrolyte drinks should play a part in any running session of 90 minutes or more, or even anything over an hour in high-sweat conditions. As we've seen earlier, the concentration of sodium in a drink affects fluid retention and urine loss. This means that an electrolyte drink could be drunk the day or evening before a long endurance event. During the event, alternate a drink containing sodium with other drinks rather than drinking a whole litre at a time or drinking just the sodium-containing drink.

After a long endurance event or very long training run, an electrolyte drink should make up part of your rehydration so that you recover your normal fluid levels faster.

Electrolyte needs will vary with the individual. Every ultra runner will need sodium, but 'salty' and heavy sweaters may need more than others. Some runners may respond well to drinks that have more magnesium in them, especially if they are prone to cramps. Others may crave potassium and find that things like cold potatoes (high in potassium – a potato has 900mg), bananas (about 500mg in a 20-25cm banana) and coconut water (up to 800mg of potassium in a small bottle) may go down well during a long run or a race.

A great solution for unsupported races or long runs where you will pass a water supply is to buy some electrolyte tablets or powders – just chuck them into plain water, mix, and hey presto, you have an electrolyte drink that you didn't even have to carry with you for 30km.

Coconut water

Many athletes will put natural coconut water up on a pedestal, only to have many sports dietitians shoot it down like a Coke can on a fence post.

During World War II, coconut water (the liquid found inside young coconuts) was administered to soldiers intravenously to provide sterile hydration, with an IV tube going straight from coconut to a soldier's vein. It worked because coconut water contains electrolytes, natural sugars and essential amino acids, all of which are components of our intracellular and extracellular fluids. The issue some people have with coconut water is that it does not contain enough of any one of these things to meet the endurance athlete's needs – but this is the wrong approach. As mentioned earlier, looking for a single drink or food source to meet the ultra runner's needs is a little foolish anyway. As a drink that is part of a wider nutrition strategy, coconut water is actually a great all-rounder. It also makes for a refreshing change from the sweet and salty taste of sports drinks, plus it's appropriate for diabetics (if unsweetened). The downside is that coconut water can cause nausea in some people, but this can subside once you get used to it and/or you have it at a cooler temperature.

Coconut water contains more than 15 times the amount of potassium found in a standard sports drink, so people who do not get enough potassium in their diet through fruits and vegetables may benefit from coconut water (although you should really fix up your diet!). However, coconut water typically has as little as 40% of the sodium in a standard sports drink (e.g. Gatorade, Powerade). There's an easy solution to this: add a little salt to your coconut water.

A lot will come down to taste – some will prefer sports or electrolyte drinks, others like the taste of coconut water. One point in favour of coconut water is that it was found to cause less nausea, fullness and stomach upset when compared with plain water and sports drinks, according to a study published in the *Journal of Physiological Anthropology and Applied Human Science* (2001).

Sources of potassium (*table similar to this*)

Food	Serving Size	Potassium (mg)
Swiss chard, cooked	1 cup	961
Potato, baked	1 medium	926
Winter squash, baked	1 cup	896
Prunes	1/2 cup	637
Roasted soy nuts	1/4 cup	632
Portobello mushroom	1 cup	630
Plain yogurt	1 cup	625
Coconut water	1 cup	600
Apricots, dried	1/4 cup	550
Sweet potato, baked	1 medium	541
Wild salmon, grilled	3 ounces	534
Lima beans, cooked	1/2 cup	485
Banana	1 medium	422
Tomato juice	6 ounces	417
Milk	1 cup	366
Artichoke	1 medium	343
Quinoa, cooked	1 cup	318
Soymilk	1 cup	287
Pumpkin seeds	1/4 cup	280
Peanuts, dry-roasted	1/4 cup	240

Carbohydrate drinks

Any run over 90-120 minutes requires you to take in carbohydrates during the run. An intake of 30-60g of carbohydrate per hour is commonly recommended to keep your glycogen stores up. A 'sports drink' is designed to replace fuel (carbs) and salts at the same time, and they tend to have a 4-8g of carbohydrate per 100ml (10-35 mmol/L).

In ultramarathons, runners usually manage solid food which will help keep up their carb intake – they are better able to handle solid food than, say, a half-marathon or marathon runner because their pace is slower (with a lower heart rate, the body is better able to digest food). However, digestion of solid food may become difficult as your stomach "tightens up" in the later stages of a race. At this point, even sugar-rich soft drinks (make sure they are flat – bubbles can cause troubles) may be beneficial.

Be wary of any sports-oriented drink that is 'zero sugar' but still claims to give you 'energy' from things such as caffeine, guarana (another source of caffeine), taurine, etc. At best, these ingredients are stimulants and do not supply energy. The only thing that 'supplies energy' is actual energy – which means calories.

Protein drinks

If carbs and electrolytes are the singer and lead guitarist rock stars of the endurance athlete's nutrition world, then protein is the bass player – often overlooked and generally underestimated. We will get to this poor guy more in the nutrition chapter.

You should have 10–20g of an easily-digestible form of protein within 20 minutes of finishing a moderate to long/hard training session or any event. Many of the best forms of protein for this will come in drink powders (e.g. whey protein isolate [WPI] or for vegans or people with milk intolerances there are combination brown rice and pea protein powders). During a long event, however, muscle breakdown will occur in the body *while you are still running*, so after every 5–10 hours (or the nearest checkpoint to this) you can benefit from having a protein shake in water or some other easily digestible protein snack, e.g. boiled agg, protein bar. This will help alleviate fatigue and muscle soreness/stiffness during the race. Be sure to test your tolerance for this during a long training run or hike.

Caffeine

You've probably had someone tell you to avoid anything with caffeine – coffee, tea, cola, energy drinks – because they will dehydrate you. It's a storm in a teacup (or coffee cup) – a review of a large number of studies in everyday situations concluded that low to moderate amounts of caffeine have minimal effect on urine production and hydration in people who have caffeine regularly. The study suggested that the tiny difference in fluid losses from caffeine drinks were offset by the fact that people were more likely to enjoy drinking them for taste or social reasons. When used wisely, caffeine can help give the ultra runner a kick along. It can:

- provide a jolt of energy – caffeine increases the release of catecholamines (such as adrenaline), which can send more blood to your muscles and tell your liver to release sugar into the bloodstream for energy
- give the perception of reduced exertion – hey, running is easier now!
- increase alertness by boosting the effects of the neurotransmitters serotonin, acetylcholine and dopamine (which affect concentration). In trail ultras you see runners whose legs keep going, but the mind wanders… and then so does the body, off course!
- help keep you going through the night at that time when brain and body expect to shut down and sleep. Caffeine blocks the adenosine receptors in the basal forebrain, which typically signal the brain when it's time to go to bed.

The trick is to use as little caffeine as you need to get an effect – use too much caffeine

HOT TIP

drink bladders vs water bottles

Drink bladders that you can store in your backpack and suck down fluids through a connecting tube can be a great way to drink on the run, which makes you much more likely to drink more frequently. These are great for events that might last a couple hours on a hot day, especially for activities such as cycling and kayaking where it often might be awkward to reach for a drink bottle. Just don't rely on drink bladders alone for ultramarathons. As discussed earlier, ultras require you to have a mixture of drinks, and a drink bladder can hold just has one type of drink – usually. You can buy twin bladders that have two drinking hoses, which enables you to carry two different types of drinks. Another option is to carry your main drink in your bladder and use a backpack that has pockets for drink bottles on the straps (so you can reach them without removing your pack) or carry small bottles filled with other drinks on a running belt.

and you may get some nasty effects, such as an increased heart rate, headaches, irritability, and more. Caffeine tolerance varies wildly between individuals, but a recommended level for a healthy adult is 400mg per day.

Caffeine strips can be a way to get a near instant effect from a low dose of caffeine, because the caffeine is absorbed under the tongue for a faster route into the bloodstream. These typically have 40-60mg of caffeine, which is the equivalent to a can of cola, but less than a cup of instant coffee (always drink water or other fluids with each strip). These are often criticised by health authorities, who are concerned that these provide an easy way for children and idiots to abuse caffeine. In the hands of a responsible, grown-up runner, they should actually provide an easy way to keep your caffeine dosage *lower*.

Not everything is about the milligrams and the science, though. For many people, no study can put a precise value on the comfort and mood-lifting effects of a hot cup of coffee and tea with a block of chocolate with your support crew in the middle of night after 16 hours of racing!

Flavour, temperature and the thirst mechanism

Most people like drinks to be cool (5-15°C) rather than icy cold or warm. People like sweet drinks, especially when they are dehydrated, however salty drinks don't turn off the thirst drive as quickly.

Be prepared for **'flavour fatigue'** – a nice term for being bored witless from sucking down the same stuff over and over again, to the point where you are not really motivate to drink as you should. Find a range of drink flavours or tastes (savoury and sweet) that you enjoy. Don't kid yourself that once you've found the 'perfect' drink formula, you will just force it down, even though it tastes like rancid yak pee. Sure you're tough, but one less unpleasant or uncomfortable thing to get through will help you put your efforts into other areas – like running.

SUMMARY

- Dehydration can have a negative effect on both your physical and mental performance
- There is no 'one size fits all' guide to how much you should drink – this will vary with individuals and weather conditions
- Ideally, you want to keep your bodyweight within 2% of what you started your run with. You should never put on weight during an ultramarathon
- You will need a combination of drinks to get you through an ultramarathon. Water and drinks containing electrolytes and carbohydrates are a must, while many people will benefit from having caffeine drinks and protein drinks in long races.
- Aim to hydrate slowly by taking regular sips before, during and after exercise so that maximizes your absorption of fluids and electrolytes
- A deficiency of water or sodium can be corrected within minutes, but correcting excesses of either can take hours
- Keep track of how much you are drinking and urinating during a long training run, and check your weight before and afterwards. This will help you develop a hydration strategy for a race.
- Avoid taking ibuprofen drugs and other NSAIDs before and during a race or long run
- Drinking too much can be even more dangerous than drinking too little, and harder to correct
- Have a variety of flavours to your drinks and keep your drinks cool – this will encourage you to keep drinking.