

Drinking after Exercise, Are You Engaged in Prudent Practice? 運動後飲水：你是否謹慎行事？

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Abstract

Restoration of fluid balance after strenuous exercise where substantial body water may be lost is an important part of the recovery process and is even more important in hot and humid conditions. Re-hydration after exercise requires that both fluid and electrolyte losses, particularly sodium, to be replaced for fluid balance. Drinks for re-hydration must have higher electrolyte content than drinks that are formulated for consumption during exercise. Most soft drinks contain virtually no sodium at all and are ineffective for the restoration of fluid balance after exercise. Drinks with high sodium content may not be very palatable to many people and may result in under-consumption. Drinks with low sodium content are ineffective at re-hydration, will also reduce the stimulus to drink. The addition of a small amount of carbohydrate may improve the rate of intestinal uptake of sodium and water and will also improve palatability. Drink palatability is very important especially when large volumes of fluid need to be voluntarily consumed. Alcohol is contraindicated as a hydration fluid following exercise.

摘要

人體在劇烈運動中往往伴隨著體液的丟失，特別是在炎熱與潮濕的環境下進行運動，因此運動後如何恢復機體的水平衡是十分重要的。運動後體液的恢復需要補充液體與電解質，尤其是鈉離子。其電解質補充量應高於運動中的丟失量。遺憾的是大多數的軟飲料並不含有鈉離子，飲用這些飲料無助於運動後機體水平衡的恢復。高鈉飲料其口味不盡人意，令不少人難以接受；而低鈉飲料則會影響體液的恢復。如果在飲料中加入少量的碳水化合物，則可促進胃腸道對鈉離子和水的吸收，並可使其味如甘泉。可口的飲料對於運動後液體的補充是非常重要的，尤其是當機體需要大量水分時。值得提醒的是運動後不可飲用含有酒精的飲料。

Introduction

There is an Irish saying among men in pubs that goes "I only drink on two occasions; when I am thirsty and when I am not." If this saying applies to water and is practised by physically active people on a daily basis, before, during and after exercise, then more people would be engaged in prudent practice that is beneficial to general health and to sports and exercise performance.

Water is essential and our bodies depend on it for all sorts of biological processes. Indeed, water is the body's transport

medium for nutrients, gases and waste products. All chemical reactions in the body occur in an aqueous environment. All major organs have a high water component. For instance, 75% of the brain and muscle are composed of water. Water in the form of sweat as it evaporates helps the body maintain a stable core temperature. Water aids in joint lubrication and also gives the body form and structure. Drinking enough will also help keep the skin supple and healthy. Males have about 10-15% more water than females because they tend to have a greater muscle mass while females tend to have a greater fat mass. Despite this difference, there is no sex difference in terms of the need for adequate hydration.

In hot and humid climates like that in the tropics, the adult body can lose up to 3.5 litres of water daily even when it is sedentary (Chia, Leong, & Quek, 2002). Of course, more water is lost when exercising in the heat. A recent survey among young people in Singapore revealed that on the average, they consumed the equivalent of 1.4 litres of fluids, when their daily needs are projected at two litres, without taking into account the additional needs when they are physically active (Asian Food Information Centre, 1999). The same survey revealed that women aged between 55 and 65 years old were also not meeting their hydration needs. Complete restoration of fluid balance after exercise is an essential part of the recovery process and this becomes even more important in hot and humid conditions. If a subsequent exercise bout has to be performed after a relatively short interval, the speed of re-hydration is crucial (Chia, Leong, & Quek, 2002).

Thirst Mechanism Explained

The desire to drink is initiated by the sensation of thirst and this is important in the control of fluid intake and balance. Thirst, however, is a poor indicator of hydration status and research informs us that both young people and adults do not drink enough (Ramsay, & Booth, 1991). The young and the elderly are particularly prone to dehydration, so special attention needs to be paid to their hydration needs. Some researchers are of the view that by the time the sensation of thirst is noticed, the person would have been dehydrated over the last hour (Chia, Leong, & Quek, 2002). Others recommend that we should drink about one litre of fluids more than what our thirst dictates (Shirreffs, & Maughan, 1998). After developing a water deficit, the drinking response in humans usually consists of a period of rapid ingestion of more than 50% of the total intake, followed by intermittent ingestion of smaller volumes of drink over several hours (Shirreffs, & Maughan, 1998). The amount of fluid ingested is regulated by receptors in the mouth, esophagus and stomach, and the distension of the stomach is thought to reduce the perception of thirst.

Fluid Loss

The maintenance of the body's temperature, known as 'thermal homeostasis', especially during exercise, is made possible by thermal conductance and latent heat of vaporisation (i.e. cooling is produced by evaporation of sweat off the skin surface). During exercise in warm and not too humid environments (about 30-70% relative humidity), cooling by evaporation is the major means for the body to dissipate the heat produced by the exercising muscles. This accounts for about 55% of heat loss. Water losses are exacerbated with vigorous exercise. Research informs us that trained and acclimatised people can lose sweat at a rate of two

litres per hour even in a cool environment, when the work rate is high. Indeed, body mass losses in marathon runners can range from between one and six percent (0.7 to 4.2 kg body mass for a 70 kg man) at low (10° C) ambient temperatures to more than 8% (5.6 kg) in warmer conditions (Shirreffs, & Maughan, 1998). The most practical means of gauging the extent of de-hydration after physical activity, and re-hydration status, after some hours of consuming food and drinks, is the colour of the urine. When the body is dehydrated, the colour of the urine tends to be darker. A lighter shade of yellow indicates adequate re-hydration. Fluid loss during the exercise and the restoration of that loss can also be estimated by weighing the person before and after the exercise. The loss in body weight following intense exercise is almost entirely due to fluid loss (Chia, Leong, & Quek, 2002).

Water Deficit and Exercise Performance

Research informs us that the inadequate replenishment of fluid loss, before and during exercise affects performance. According to Ramsay and Booth (1991), a water deficit of as little as one percent of body weight can impair exercise performance and a 3.5% drop in high intensity exercise performance has been reported after a fluid loss of 2.5% of body mass induced by sauna exposure. In races of over 1,500m, 5,000m and 10,000m, performance times increased by 0.16, 1.3-and 2.62 minutes, respectively, in athletes who were dehydrated by two percent of body weight, relative to their finishing times when they were eu-hydrated (i.e. adequately hydrated). Work capacity is negatively affected with dehydration. Many studies have indicated that adequate hydration is necessary for peak performance, especially when the activity is prolonged. For instance, a loss of just 4% of body water causes a 22% decline in performance and when the loss rises to seven percent of body water, weakness sets in and the person may even have difficulty speaking (Ramsay, & Booth, 1991). Blood flow to the muscle must be maintained at a high level during exercise to supply oxygen and energy substrates. At the same time, increased blood flow to the skin is necessary to dissipate the metabolic heat produced by the muscles. Hypo-hydration (i.e. inadequate hydration) before and during exercise is associated with a higher cardiovascular strain and impaired thermoregulation. This also nullifies any protective benefits that are conferred by acclimation.

Drinking after Exercise

The primary factors that determine hydration after exercise are the volume and composition of the fluid that is consumed. How much of the fluid is consumed, will in turn be influenced

by many factors including the palatability of the drink and its effect on the thirst mechanism (Chia, Leong, & Quek, 2002). The ingestion of solid food is also an important factor but most people will tend to avoid eating solid food between exercise sessions or immediately after exercise.

Beverage Composition

The composition of the beverage ingested is important for the restoration of fluid balance following exercise. Studies have shown that plain water is not the ideal post-exercise re-hydration beverage when rapid and complete restoration of fluid balance is desired and where the intake is in the liquid form (Chia, Leong, & Quek, 2002). Research informs us that when water was the liquid for re-hydration following a 4% body mass loss in fluid induced by exercise, even after four hours, positive fluid balance had not been achieved due to increased urinary loss due to drinking water. In contrast, when an electrolyte-containing solution (106g/L carbohydrate, 22 mmol/L sodium, 2.6 mmol/L potassium, 17.2 mmol/L chloride) was ingested, urine output was less and the water balance was closer to pre-exercise level after four hours (Ramsay, & Booth, 1991).

It appears that the consumption of electrolyte-free drinks such as plain water resulted in greater urine production and therefore did not allow subjects to be in positive fluid balance for a long time. Contrarily, plasma volume was better maintained when electrolytes, particularly sodium was present in the drink that was ingested. It has been proposed that the amount of sodium added to the hydration fluid should also mirror the amount of sodium loss in the sweat. However, the concentration of sodium in the sweat shows considerable variation among different people, making it difficult to have a single prescription to suit all people (Ramsay, & Booth, 1991).

Drinks that Rehydrate

Sports drinks

Sports drinks are popular among people who exercise as well as people who do not exercise. When sports drinks were first made available, many sports nutritionists consider them as gimmicky as they were either too sweet or had too much sodium in them. The high sugar and sodium content in the drinks stimulated drinking but did not actually quench the thirst. Since then, sports drinks have evolved. Nowadays, most sports drinks contain less sodium and the carbohydrate in the form of sugar in the drink help in the absorption of the water from the gut to the blood stream where it is needed. Hence sports drinks deliver not only water, but also energy to the body (Chia, Leong, & Quek, 2002).

Sports drinks consumed before an exercise session contains just the right amount of calories to boost energy and hydrate at the same time and are a convenient energy source. Following intense exercise, the carbohydrate in sports drinks also help to replenish the muscle carbohydrate used during the exercise. To replenish the lost carbohydrate in the muscle after exercise, it is important to consume enough carbohydrate within the first two hours after the exercise activity as this is the time when the body is most active in replacing the muscle carbohydrate used. Drinking carbohydrate sources following very intense exercise is a good strategy as the appetite to eat solid food is usually decreased. Sports drinks are an easier and more convenient source of carbohydrate during the first two hours after vigorous exercise. The general consensus from research is that moderate amounts of carbohydrate and sodium, as well as other electrolytes, that are present in most sports drinks stimulates consumption, and improves absorption compared with simply drinking water (Chia, Leong, & Quek, 2002).

Fruit Juices

Fruit juices contain a fructose, a form of sugar that interferes with the absorption of water in the juice. Fruit juices come in many flavours and in many colours. They taste great and they are a rich source of vitamin A and vitamin C. Fruit juices are also a good source of potassium, an important mineral for the healthy function of the nervous system. Although fruit juices are not a good source of hydration just before, and during the exercise activity from the absorption standpoint, they are nevertheless great sources of carbohydrate and water after exercise (Chia, Leong, & Quek, 2002).

Carbonated Soft Drinks

Some people drink carbonated soft drinks before exercise for their caffeine and sugar content. Both substances boost energy levels. Caffeine is a stimulant and it increases heart rate and stimulates the nervous system making you more alert. The sugar in carbonated drinks is a reservoir of available energy and may benefit the person who needs the calories. Many people drink carbonated soft drinks just before, immediately after exercise. However, the sugar in carbonated drinks is in the form of sucrose and some research has shown that sucrose, like fructose also interferes with the absorption of water during exercise. The caffeine is present in most cola drinks may also induce diuresis, increasing urine output, thus exacerbating dehydration (Chia, Leong, & Quek, 2002).

Alcoholic Drinks

It is common to find games players of popular sports relax in environments where there is a copious consumption of alcohol and it appears that this post-training and match culture is gaining popularity. It is well established that alcohol has diuretic properties and is therefore not recommended when fluid replacement is a priority. Research informs us that when subjects were hypo-hydrated following exercise, the consumption of 4% alcoholic drink resulted in the greatest urine excretion but all the alcoholic drinks resulted in a predicted dehydration of nearly 8% across all trials (Shirrefs, Taylor, Leiper, & Maughan, 1997). Hence alcohol consumption does not aid re-hydration following exercise, instead it may exacerbate it.

Ingested Volume of Fluid

Even in the dehydrated state, there is obligatory urine excretion due to the need to get rid of metabolic waste. Therefore it is prudent to ingest more fluids after exercise than what has been lost during the exercise. The advice to drink at least one litre of fluid more than what thirst dictates (Shirrefs, & Maughan, 1998) and also drinking beyond the amount of fluid lost through the activity has merit. Research informs us that following a 2% body mass loss in body water, drink volumes of 50, 100, 150 and 200% of the sweat loss were consumed after exercise. The best hydration results obtained some six hours after the exercise, were those where the subjects consumed 150 and 200% volume of their sweat loss and where the drink composition had the same amount or higher concentration of sodium as their sweat (Ramsay & Booth, 1991).

Palatability of the Drink and Voluntary Ingestion

Unlike in controlled research trials where fixed volumes of various compositions are consumed, in everyday situations, the amount of fluid consumed is determined by a combination of psychological and physiological factors. Ramsay and Booth (1991) reported that when beverages consisting of carbonated water, a commercial sports drink, an orange juice/lemonade mixture and an oral re-hydration solution (a mixture used in the treatment of diarrhea), were made available, subjects drank a greater volume of sports drink and orange juice/lemonade mixture than either of the other drinks over a period of two hours. The results demonstrate the importance of drink palatability in getting people to drink enough following exercise where great amounts of fluid could have been lost.

Implications for the Physically Active

- ❖ *Encourage physically active people to drink beyond the sensation of thirst following exercise.*
- ❖ *Weight loss immediately following exercise is indicative of sweat loss. To restore fluid balance after exercise, drink up to twice the amount in fluids that was lost in the form of sweat.*
- ❖ *Restoration of fluid balance takes time so it is important to continue to drink in small amounts (e.g. 150 ml) every 15-20 minutes up to four to five hours after the exercise.*
- ❖ *Plain water is not the best re-hydration fluid if the fluid loss during exercise is to be replaced quickly. Copious consumption of water in large amounts after exercise will instead increase urine output, resulting in less fluid being retained by the body.*
- ❖ *The ideal re-hydration drink after exercise is one that contains sodium and some carbohydrate in low concentrations as this will stimulate drinking and aid in absorption of fluid from the gut. Most people prefer their drinks to be cold rather than warm and the availability of cold drinks after exercise will cater to this preference.*
- ❖ *Cola, carbonated drinks, and alcoholic drinks do not help in the restoration of fluid balance after exercise; instead they may exacerbate de-hydration.*

Conclusion

Restoration of fluid balance after strenuous exercise where substantial body water is lost is an important part of the recovery process and is even more important in hot and humid conditions. If a second exercise bout is required after the first, the speed of re-hydration is crucial in maintaining good performance. Re-hydration after exercise requires that fluid and electrolyte losses, particularly sodium, to be replaced for fluid balance. The electrolyte composition of sweat is highly variable among individuals; but the ideal re-hydration drink is one where the sodium content of the drink matches the sodium amount that is lost through sweating. Ingesting excess sodium from a post-exercise drink is rarely a problem if the volume of the intake is sufficient

and if kidney function is unimpaired; any excess sodium will be excreted in the urine as the kidneys restore equilibrium.

Drinks intended specifically for re-hydration must have higher electrolyte content than drinks that are formulated for consumption during exercise. Most soft drinks contain virtually no sodium at all. These drinks are therefore ineffective for the restoration of fluid balance after exercise. Drinks with high sodium content may not be very palatable to many people and may result in under-consumption. On the other hand, drinks with low sodium content are ineffective at re-hydration, and they will also reduce the stimulus to drink. The addition of a small amount of carbohydrate may improve the rate of intestinal uptake of sodium and water and will also improve palatability. Drink palatability is very important especially when large volumes of fluid need to be voluntarily consumed. Alcohol is contraindicated as a hydration fluid following exercise.

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