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Review Article

The Role of Sport Drinks in Athletic Performance: A Review

Mohammad Ali Izadi[1], Sajjad Mirzaei[2], Farhad Daryanoosh[1], Mohsen Davoodi[3]*

1. Department of Sport Science, Faculty of Education and Psychology, Shiraz University, Shiraz, Iran
2. Faculty of Physical Education and Sport Sciences, Islamic Azad University, Marvdasht Branch, Marvdasht, Iran
3. School of Paramedical Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

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**Corresponding author:*
Mohsen Davoodi, PhD;
School of Paramedical Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.
Tel: +98-9174080573
Email: mdavoodi827@gmail.com
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ABSTRACT

Exercise performance is influenced by numerous physiological factors, including hydration status, electrolyte balance, energy availability, and recovery processes. From the perspective of sport nutrition, the role of sports supplements in improving the performance of athletes cannot be denied. Sport drinks are also very popular among athletes; Therefore, these types of supplements can provide fluids, electrolytes, and carbohydrates, which are a source of energy, for the athlete. The application of these drinks is before, during and after training. In general, there are 3 types of sport drinks, including hypotonic, isotonic and hypertonic. The effectiveness of sport drinks on performance and prevention of fatigue has been proven, especially in sports of more than 1.5 hours. As a result, sport performance improves and the athlete gets tired later. In addition, sport drinks play a role in increasing endurance, improving cognitive performance and maintaining blood glucose. This review examined the components of sport drinks and their effects on athletic performance, also evaluated current research findings that demonstrated their importance in sport nutrition.

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Introduction

In sport nutrition, the role of sport drinks is to hydrate athletes and restore electrolytes, carbohydrates and other nutrients that are depleted during exercise (1). The essential role of functional drinks in sport is to delay fatigue, increase strength and endurance, and improve recovery and cognitive performance (2). Sport drinks are commonly consumed during exercise to provide hydration and energy and enhance athletic performance by delaying fatigue. Sport drinks are also consumed before or after exercise to help relieve stressful conditions and provide nutrients needed by the athlete. Body fluids are mainly consisted of extracellular and intracellular fluid (3), and consuming sport drinks can maintain water balance in athletes (4). Sport drinks are mainly composed of water and other nutrients such as carbohydrates. The standard carbohydrate concentration in a sport drink is 6 to 8 percent (5). Other ingredients of sport drinks are usually electrolytes such as sodium, potassium, magnesium, amino acids and some vitamins such as vitamin B and C (6). If the exercise time is more than 90 minutes, it is recommended to use a standard sport drink (7). These drinks are considered a source of energy especially during exercise and

are easily emptied from the stomach and absorbed through the small intestine. Sport drinks are used by most athletes around the world to give them a performance edge over their competitors (8). So, there are three main types of sport drinks including isotonic, hypertonic, and hypotonic ones, which contain varying amounts of fluids, electrolytes, and carbohydrates (9).

Hypotonic Drinks

Hypotonic drinks have a lower concentration of salt and sugar than the human body (10). The osmolality of this type of sport drinks is less than 275 mOsm/kg water. They can replace the water loss due to exercise. Hypotonic drink is suitable for moderate intensity and duration sports that do not sweat much (11). Also, these drinks are suitable for light sports such as gymnastics that require high hydration and low carbohydrates (10). However, if the goal is to maintain fluid balance during prolonged exercise, the use of hypotonic drinks is inappropriate due to differences in urine volume excreted (12).

Isotonic Drinks

Isotonic drinks have the same concentration as the human body in terms of salt and sugar. The osmolality of isotonic sport drinks is between 275 and 295 mOsm/kg water and has the same osmotic pressure as body fluids (11). These drinks can be a good substitute for fluids lost during exercise (13). The content of isotonic sport drinks includes a combination of carbohydrates (glucose and maltodextrin) and electrolytes such as sodium (14). American College of Sports Medicine (ACSM) also recommended that for physical activities lasting less than 3 hours, an isotonic drink (0.5 to 0.7 grams of sodium per liter) to be used, and for physical activities lasting more than 3 hours, a more concentrated drink (0.7 to 1 gram of sodium per liter) to be applied (15). Since they are also a carbohydrate source, they can provide the athlete with carbohydrate fuel. These drinks are suitable for most athletes, even long and medium distance runners. Furthermore, athletes are advised to choose isotonic drinks that contain fructose in addition to glucose, as they are digested and absorbed more quickly and have a positive effect on athletic performance (16).

Hypertonic Drinks

Hypertonic drinks have a higher concentration of salt and sugar than the human body. The osmolality of hypertonic sport drinks is more than 295 mOsm/kg of water and has a higher osmotic pressure than body fluids (11). It is usually recommended after training to supplement daily carbohydrate intake to restore muscle glycogen reserves. This type of sport drinks is usually prescribed to ultra-endurance athletes who need a lot of water, carbohydrates, and energy (8). The ingredients of sport drinks mainly include carbohydrates, proteins (amino acids), water, minerals and vitamins (17).

Carbohydrates

Since carbohydrates provide between 60 and 65 percent of an athlete's daily energy, the main ingredient in sport drinks is carbohydrates (18). Carbohydrates can also be stored as glycogen in the liver (approximately 80-120 g) and muscles (approximately 350-700 g) and used as energy when needed (19). It was shown that fatigue associated with prolonged exercise performance is caused by depletion of endogenous carbohydrate stores or concomitant hypoglycemia. Also, when carbohydrates are consumed before, during, and after exercise, exercise performance, especially endurance, is improved (20-23). Carbohydrate supplements in various forms such as chocolate, gel, drink, and powder have become popular as sources of carbohydrates that improve athletic performance. Regular carbohydrate intake in athletes affects the effectiveness of physiological responses and adaptations (5). Compared to protein and fat, carbohydrates have higher energy efficiency per mole of oxygen and improve sport performance by providing muscle glycogen reserves (24-27). Low carbohydrate levels can lead to premature fatigue during exercise. As the intensity and duration of training increases, the athlete's need for carbohydrates also increases (28). During exercise, carbohydrates in the form of glucose are absorbed from the blood by skeletal muscles to provide the energy needed for athletic performance (2, 29). ACSM has recommended 30-60 grams of carbohydrate per hour during exercise (15). The recommended carbohydrate concentration in a sport drink is between 6 and 8%, in this concentration, muscle glycogen is restored and there is no disturbance in the speed of gastric emptying and liquid absorption from the intestine. Because carbohydrate concentrations greater than 8% can compromise the rate of gastric emptying and fluid absorption from the gut (leading to some gastrointestinal (GI) problems (30).

In addition, carbohydrates increase water transport from the intestine and improve hydration (17). Simple carbohydrates are used for explosive exercises and complex carbohydrates are used to provide stable energy (15). It is now well confirmed that carbohydrate consumption in various forms preserves blood glucose stores, muscle glycogen, and can improve the endurance performance. Current research is focused on determining the optimal

carbohydrate composition (glucose, maltodextrin, fructose, sucrose, and galactose). Evidence suggests that one of the most optimal carbohydrate compositions is maltodextrin and fructose in a ratio of approximately 1:1. Maltodextrin is cleared from the stomach more quickly than glucose due to its lower osmolality for energy density, and may therefore be a better choice. Therefore, consuming a carbohydrate sport drink can be a suitable option for athletes (31).

Proteins and Amino Acids

Proteins make up a major part of biological cells and play three essential roles in exercise. First, they are part of the main structure of muscle. In addition, they have an enzymatic role and are involved in many metabolic processes. They are also used as a source of energy (32-34). Protein plays an essential role in the repair and regeneration of muscle after training as well as during exercise as a source of energy. The effect of protein consumption on muscle protein synthesis after endurance and resistance sports has been confirmed (35, 36). High-intensity resistance exercises and interval exercises increase inflammatory markers such as pro- and anti-inflammatory adipokines or high-sensitivity C-reactive protein (37). Therefore, consuming protein in the form of a drink, supplement, or food after exercise can help reduce these symptoms and improve recovery. Also, in long-term exercise, branched-chain amino acids (BCAAs), which include the amino acids leucine, isoleucine, and valine, can have anabolic effects on the athlete's skeletal muscle (38, 39).

BCAAs are used as a source of fuel for muscles, in addition to pyruvate, especially during multiple-intensity exercise. As active muscles are diverted from glycolytic substrates during multiple-intensity exercise, exogenous BCAAs can potentially serve as an alternative energy source. However, their contribution to ATP production may be more limited compared to other substrates. Therefore, consuming milk-based beverages containing whey proteins, casein, and beverages containing branched-chain amino acids is a good option (40, 41). Another important compound found in some sport drinks is taurine, which, although produced by the liver and kidneys, is known as a regulator of calcium release and can contribute to calcium homeostasis, fat metabolism, and athletic performance during exercise, especially long-term exercise. The presence of taurine in industrial sport drinks reduces the side effects associated with caffeine-induced insomnia. Additionally, dietary supplements containing taurine can inhibit tumor growth, promote bone and skin health, and prevent neurological disorders (42). Creatine, an amino acid found in a variety of red meats and fish, is also an energy-boosting nutrient widely used by strength and power athletes. A typical diet contains only 1 to 2 grams of creatine per day, which is not enough for high-intensity anaerobic exercise; therefore, creatine supplementation may be necessary for some athletes (43).

During exercise, creatine provides the possibility of rapid ATP regeneration and maintains muscle strength and contraction. Phosphorylated creatine (PCr) also acts as a source of cellular phosphate that can be used to phosphorylate ATP from adenosine di phosphate (ADP). Also, creatine plays a role in the spatial transfer of energy between places that produce energy (such as mitochondria) and places that need energy. Simultaneously, the availability of PCr at energy-requiring sites reduces the ADP concentration at these sites and reduces ADP-mediated Ca^{2+} leakage from the sarcoplasmic reticulum, thus maintaining force-generating capacity. Therefore, by maintaining and increasing muscle power production during exercise, creatine is used in some sport drinks to enhance its effectiveness (44, 45). Also, Highton *et al.* reported that sport drinks containing carbohydrates and proteins can increase the average speed in runners by 2-3%. The consumption dose of carbohydrates and protein in the sport drink was (8.3±52.7 grams per hour of carbohydrates plus 17.6±2.8 grams per hour of protein (46).

Electrolytes or Minerals

Minerals play a role in the structure of tissues, enzymes, hormones, regulation of metabolism, and nerve function. The results showed that mineral supplements improve performance especially in athletes with mineral deficiencies (32, 47, 48). Along with carbohydrates, electrolytes are drained from the body during exercise. Electrolytes can be used as muscle fuel during exercise fatigue (4). Electrolytes include sodium, potassium, chloride and magnesium (43, 49). Electrolytes, especially sodium, play an important role in fluid homeostasis, as large amounts of sodium and chloride are lost through sweat during exercise (50, 51). Sodium helps maintain extracellular volume and osmolality and plays an important role in membrane potentials and the transport of numerous molecules across cell membranes (52, 53). Electrolytes are very useful for the biological functions of the body. Potassium is also an essential electrolyte that is present in all body tissues, and its main roles are controlling blood pressure, maintaining intracellular fluid volume, and membrane potential (6, 54).

Sodium and potassium help regulate body water,

muscle excitability, cell permeability, as well as protein and carbohydrate synthesis. Chloride, as an essential component of gastric juice, maintains osmotic balance (55, 56). Magnesium is the second most common cation in human cells, after potassium, and the fourth most abundant element in the human body (57, 58). Magnesium is also a mineral found in many sport drinks. Magnesium is involved as a cofactor in enzymatic processes that ultimately lead to the regulation of physiological processes in the muscles, nerves, protein synthesis and energy production. Since magnesium plays a role in the process of muscle contraction, it can also be effective in preventing muscle cramps (59, 60). Magnesium also plays a role in moderating the effects of sodium on regulating blood pressure, and also increases anaerobic capacity, which is why it is used in sport drinks. Therefore, fluids and electrolytes are very important for the optimal performance of athletes (61).

Vitamins

Athletes often take micronutrient supplements to boost their immune system, improve athletic performance, and increase recovery. However, it was shown that micronutrient supplements have ergogenic effects in athletes with nutrient deficiencies and have no significant effect on athletes who did not have micronutrient deficiencies. Therefore, any supplement should be prescribed with the diagnosis of a sport nutritionist (62). Vitamins are also organic compounds and micronutrients that regulate metabolic and neurological processes, play a role in energy production, and also prevent cell damage. Vitamins are essential for body function and help maintain health and prevent disease (32, 63).

As vitamin C has antioxidant properties, the main vitamin content of sport drinks is vitamin C. Typically, the concentration of vitamin C in sport drinks is from 26 to 35 mg per 100 mL (11). It was shown that consuming 200-1000 mg of vitamin C per day can reduce exercise-induced oxidative stress in athletes, but doses higher than 1000 mg per day reduce exercise-induced adaptations due to the antioxidant effect (64). Vitamin E can also reduce markers of oxidative stress in athletes and, especially for athletes training at high altitudes, helps maintain red blood cell structure and is effective in muscle recovery. However, excessive consumption can also be harmful to athletes and reduce exercise-induced adaptations (62). In general, consuming sport drinks containing antioxidant vitamins such as vitamins C and E can reduce oxidative damage to muscles (65). In addition, B vitamins play a key role in the body's metabolism, with vitamin B1 involved in carbohydrate metabolism and vitamin B6 in protein metabolism. Hence, they are used in sport drinks too (6). It is noteworthy that vitamin B1 and C supplements can accelerate oxidation, reduce oxygen debt, delay fatigue, shorten the recovery period, and generally improve athletic performance. Therefore, sport drinks that contain various vitamins can improve sport performance (32).

Water

Water is an essential part of the diet. Around 70% of the adult body and 80% of the child's body is made up of water (7, 66). Water also plays an important role in regulating body temperature, transporting nutrients to tissues, regulating the digestive system, eliminating waste, and lubricating joints, which is very important for athletes (67). Water acts as a solvent for minerals, amino acids, glucose, vitamins, and electrolytes and is essential for regulating body homeostasis (68). Exercise and physical activity can alter the body's electrolyte and water levels, and consequently the athlete has a greater need for water and electrolytes due to increased energy expenditure and sweating. Dehydration during exercise reduces blood flow to the muscles and skin, ultimately leading to an increase in body temperature. Dehydration can also reduce the plasma volume, blood pressure, and cardiac output, which is very important for athletes and affects their performance (69). Therefore, evidences suggested that the use of ionic and electrolyte sport drinks can be a good option to prevent dehydration and maintain water and electrolyte homeostasis during exercise (70).

Sport drinks are also mostly made up of water with other nutrients added to create an energy boost. Any athlete, whether amateur or professional, may suffer from dehydration (71). Water consumption affects athletes' endurance and strength (72). The athlete should be fully hydrated before the sport training so that the sport performance of the athlete is not disturbed. It is also very important to drink water during exercise. It was shown that water consumption during exercise was related to the duration of physical activity. For example, fluid consumption during cycling that lasts more than 2 hours can increase sport performance by 3% (73). Drinking 1.5 times the weight of fluids lost during exercise is recommended for post-exercise recovery (74). Also, since dehydration threatens the performance and health of the athlete, it is very important to control the quality and the level of hydration not only during exercise, but also before and after physical activity (75). Therefore, for better results, some suggested consuming hypotonic drinks before exercise, isotonic drinks during exercise, and hypertonic drinks after exercise. The goal of this

strategy, in addition to hydration, was to maintain blood sugar and prevent glycemic shock during exercise (9).

Additional Compounds

Some additives in sports and functional drinks commonly include caffeine and artificial sweeteners. Caffeine is one of the most common stimulants consumed by professional athletes because it can improve mental performance and focus. Caffeine is also very popular among athletes as a fat-burning stimulant (76, 77). For active individuals, caffeine-containing products are available in a variety of forms: drinks, gum, gels, and chocolates. Among athletes, the effects of caffeinated beverages on athletic performance include increased endurance and strength, improved cognitive function, and fat burning (50).

Artificial sweeteners are common additives to food and beverages that provide a pleasant sweet taste without the calories of sugar. Common, safe artificial sweeteners that have been recognized by the US Food and Drug Administration (FDA) for use in foods and beverages include aspartame, acesulfame potassium, sucralose, and steviol glycosides (stevia). In fact, using artificial sweeteners and eliminating sugars in the formulation of exercise-related products can help reduce the spikes or dips in blood sugar responses caused by consuming high-glycemic index, sugar-sweetened beverages and reduce unwanted calorie intake. However, some people may report digestive side effects from consuming artificial sweeteners, especially sugar alcohols like erythritol, which have been linked to digestive problems such as diarrhea. But, in general, these additives appear to be safe for human consumption and have not been linked to side effects or an increased risk of cancer, cardiovascular disease, or neurological symptoms to date (6).

The Impact of Sport Drinks on Athletic Performance

As a result of exercise-induced dehydration; blood volume, body temperature, and cognitive function are reduced. Sport drinks can reciprocally improve performance by increasing blood glucose level, improving carbohydrate oxidation, and reducing feelings of fatigue. The efficacy of sport drinks in improving athletic performance has been studied before. It was demonstrated that proper hydration and nutritional support can enhance endurance, strength, and recovery. Here are some of the key findings supported by scientific evidence (50).

Endurance Enhancement

Due to the popularity of endurance and ultra-endurance competitions, special nutritional recommendations are used for them (78). Since endurance competitions are held early in the morning and during fasting, to reduce vital body reserves such as glycogen reserves, it is recommended to consume 1 to 4 grams of carbohydrates per kilogram of body weight 1 to 4 hours before the sports event. Therefore, the importance of consuming sport drinks because they are liquid and contain carbohydrates before the endurance race is revealed. It seems that a 3-4% decrease in body mass and a general decrease in body water during exercise leads to a 10% decrease in athletes' endurance (79). The role of carbohydrates during endurance training is very important to maintain sport performance. The use of carbohydrate mouthwash is also recommended during endurance training to stimulate taste receptor cells and the central nervous system in order to improve endurance and performance (80). Therefore, evidences suggest that water alone is not a good option for maintaining athletic endurance. Therefore, sport drinks containing electrolytes and carbohydrates are a better option for maintaining endurance (18).

Reduced Fatigue and Enhanced Recovery

Fatigue can be defined as a debilitating symptom in which a person's physical and cognitive functions are affected. Especially in athletes, fatigue is associated with the body's inability to maintain energy production from metabolic pathways, which leads to decreased athletic performance (81). Factors such as reduction of body water, electrolytes and fuel reserves of the body such as carbohydrates can ultimately lead to reduced performance and fatigue in athletes, especially endurance athletes. Body weight loss of 2% due to dehydration leads to more than 5% loss of body performance and fatigue during exercise (15). Therefore, maintaining the balance of fluids, electrolytes and energy stores during exercise is very important to maintain performance and prevent fatigue (50).

Also, consuming sport drinks containing lactate, fructose, and electrolytes is better than drinks containing only glucose and electrolytes, thereby improving performance, delaying fatigue, and increasing buffering capacity (82). Carbohydrate is stored in the body as blood glucose and muscle glycogen and has the advantage of producing more ATP per volume of oxygen (O2) compared to fat, but depletion of liver and muscle carbohydrate stores is associated with fatigue, reduced performance, and impaired concentration (83, 84). This is the feeling that athletes usually refer to as "hitting the wall". Therefore, carbohydrate fueling strategies are critical both before and during the race (80). Additionally,

consuming carbohydrates during prolonged exercise (2 to 6 hours) preserves glycogen and blood sugar stores and delays fatigue (5). Therefore, these drinks can improve the athlete's recovery during and after exercise by supplying the fuel needed by the body, including carbohydrates and minerals. A practical sport drink helps the athlete's body to stay hydrated and provides his health (55).

Improved Cognitive Function

Mental fatigue is defined as a change in a person's psycho-physiological state, which is characterized by a decrease in the ability to pay attention (18). Mental fatigue eventually leads to a decrease in sport performance, so it is very important to maintain cognitive performance in sports. Sport drinks reduce mental fatigue and improve sport performance by maintaining alertness and wakefulness (85). The active substances used, including caffeine and L-carnitine, in some sport drinks maintain the athlete's cognitive performance. Therefore, it can be concluded that some special sport drinks can improve the cognitive performance and finally the sport performance of the athlete (86).

Maintenance of Blood Glucose

Maintaining blood sugar and preventing it from dropping during exercise is crucial for athletes. Evidence suggests that during prolonged endurance training and intense exercise, the athlete's body loses a lot of water. As a result, blood glucose level and muscle and liver glycogen stores may also decrease (43). Since sport drinks contain carbohydrates, consuming them at the right time can maintain blood sugar level and prevent them from dropping (5).

Increase in Strength and Power

On average, consuming 8-10 grams of carbohydrates per kilogram of body weight optimizes strength performance and hypertrophy in anaerobic exercises. Therefore, regular carbohydrate consumption in athletes can directly affect their strength (87). In general, it seems that the consumption of certain sport drinks, due to their content of ingredients such as carbohydrates, caffeine and creatine, has a positive effect on maximum voluntary handgrip contraction force, although unsubstantiated findings have also been reported. Also, in another study that examined speed swimmers, results showed that a sport drink containing a significant amount of caffeine (3 mg per kilogram of body weight) can improve grasping performance in the right hand, but not in the left hand, suggesting a more subtle ergogenic effect that may be related to neural coordination (6).

Reduced Muscle Cramps

Exercise-associated muscle cramps (EAMC) are an involuntary, unpleasant contraction of skeletal muscle in athletes that occurs during or after exercise. This type of cramp usually occurs in multi-joint muscles, such as the quadriceps, that are used most during exercise (88). Muscle cramps commonly occur in athletes who do not have sufficient ATP stores in their muscle fibers. In this state, the muscle fibers remain in a contracted state, preventing the release of actin and myosin chains, thus leading to muscle cramps (89). Magnesium deficiency (serum magnesium level less than 0.4 mmol/L) leads to coronary artery spasm and muscle cramps (90). Fluid intake (whether water or in the form of a sport drink) increases plasma volume and restores blood osmolality and is one of the most effective strategies for reducing EAMC (88). Therefore, during intense and prolonged exercise (usually more than 1.5 hours), it is recommended that athletes consume isotonic sport drinks to replace lost water and electrolytes and provide the necessary energy (91). Since these drinks contain carbohydrates and mineral salts with an osmotic pressure similar to blood, facilitating rapid absorption of their components, it is recommended to use standard sport drinks instead of water before, during, and after prolonged exercise to prevent dehydration, provide the body with the electrolytes and vitamins it needs, delay fatigue, maintain athletic performance, and prevent muscle cramps (92).

Supporting Glycogen Resynthesis

In physical exercise lasting less than an hour, drinking water before, during, and after is sufficient to maintain adequate hydration, but in intense, prolonged exercises or exercises in a very hot environment, the body rapidly loses water and electrolytes through sweating and increases energy expenditure, resulting in decreased blood sugar concentration and glycogen stores (93). Sport drinks are used to quickly restore fluids and electrolytes lost through sweating during exercise and to provide carbohydrates (sugar) to replace glycogen stores and thus maintain performance. In addition, muscle and liver glycogen restoration takes about 6 hours after exercise and is activated under conditions of consuming 1 gram per kilogram of carbohydrate, so in long-term and intense exercise, consuming sport drinks to contain carbohydrates is very important for athletes who need faster recovery (43). Therefore, factors such as blood glucose level, body and environmental temperature, previous hydration status and fluid intake during exercise, mineral and electrolyte balance can affect strength capacity, fatigue, and overall athletic performance (81).

Considerations

Certainly, the standard concentration of carbohydrates and salt is one of the main considerations of sport nutritionists in the formulation of sport drinks (18). The high concentration of carbohydrates in the sport drink delays the emptying of the stomach, thus reducing the absorption of the nutrients in the drink. If the concentration of carbohydrates in the sport drink is high, it also causes water to be secreted into the intestines, thereby temporarily increasing the possibility of dehydration (94). Therefore, in high concentrations of sugar (more than 10%); the risk of gastrointestinal disorders increases. In addition, most carbohydrate-electrolyte drinks that are suitable for consumption during exercise have low electrolyte content, and the sodium concentration is usually in the range of 20-25 mmol/L (95). Therefore, high sodium levels may cause increased blood pressure and dehydration in athletes. In general, when more than 2% of body mass and weight is lost due to dehydration during exercise, athletic performance is impaired. For sports longer than 1.5 hours, it is better for athletes to choose drinks with a combination of carbohydrates and electrolytes, so that the carbohydrates and fluids necessary to improve sport performance reach the athlete's body. (7).

Future Directions and Research Needs

Since most major sport events, including the World Cup and the Olympics, are held in the summer and hot season with temperatures exceeding 30 degrees, heat stress can impair an individual's physiological and athletic performance. As each individual's sweating rate and nutritional needs are different, their nutritional plans and even supplements will also be different. Therefore, a specific strategy must be considered to prevent athletes from impaired performance. The rate of sweating and electrolyte loss varies greatly from person to person. A personalized approach to hydration can overcome this problem and meet the needs of each individual. The Personalized Hydration Strategy (PHS) is an effective and promising approach to fluid balance and athletic performance that is based on the analysis of the individual's sweat composition and requires further studies and research to design personalized supplements and sport drinks (96).

Conclusion

Sport drinks were shown to play an important role in providing hydration and nutritional needs of athletes, especially in long-term and intense sports. In addition to providing energy, their standard composition helps achieve optimal performance, increase endurance and strength, reduce fatigue and muscle cramps; and improve recovery. Considering the type of sport, duration and intensity of training, as well as the individual needs of the athlete, sport drinks can improve athlete performance. Sport drinks are very effective in restoring muscle glycogen, delaying fatigue, reducing muscle cramps, and maintaining blood sugar. Therefore, it can improve the performance of athletes, especially endurance sports. Athletes should consult a nutritionist to benefit from the benefits of sport drinks. The effect of sport drinks in sports lasting more than 90 minutes is undeniable. As a result, with the advancement of sport nutrition science, more functional sport drinks with better formulations should be provided to improve athlete performance, while future researches are still needed.

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Authors' Contribution

Conceptualization by MA.I. and M.D.; Software by MA.I.; Analysis by S.M. and MA.I.; Draft writing by MA.I.; Review and editing by F.D., S.M. and M.D.; and Supervision by MA.I. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

None to declare

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