A Review of Research on the Effects of Hydration Status on Health and Athletic Performance in Athletes

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Abstract

The importance of hydration status as an important influence on athletic performance and health status has received increasing attention from athletes and coaches. This paper provides a detailed review of three aspects of factors affecting hydration status and the effects of hydration imbalance on athletic performance and health. Factors affecting athletes' hydration status were found to be education, exercise intensity, ambient temperature, sports rehydration fluid (dose and composition), training frequency, gender, medication, fasting, and race; hydration imbalance mainly affects athletes' aerobic endurance, although the mechanism is not clear, while the effect on anaerobic strength is debated; the main health effects of hydration imbalance are hyponatremia, cerebral infarction , body metabolism, cognitive function, immune function, cardiovascular health, gastrointestinal health, oral health, and urinary tract health.

Keywords

Hydration Status, Health, Exercise Performance,Sports Tonic Liquid.

1. Introduction

Water is the most important nutritional element in the body and plays an important role in dissolving and regulating cell volume in the body cycle, as well as in regulating body temperature and bodily functions.The importance of water implies the need to maintain a good balance of water in the body, i.e., the balance between water intake and water output of the body. According to the relationship between water intake and water output, there are three states: Hydration, Hypohydration, and Hyperhydration, Euhydration.The body maintains a balance between water intake and water output, which is the normal hydration state; water intake is greater than water output, which is the high hydration state; and water intake is less than water output, which is the low hydration state. After exercise, it is called "voluntary dehydration" when an athlete is unable to compensate for water loss through water intake, but this term has since been changed to "involuntary dehydration" to express the reluctance of the dehydrated individual to hydrate even though he or she has sufficient water to do so.However, it is important to note that dehydration and hypohydration are closely related, but they are not the same. Dehydration is a process of acute water loss, i.e., dehydration is the loss of water from the body, and hypohydration is the result of water loss.Similarly, the same is true for the normally hydrated and highly hydrated states, all three of which are outcomes rather than processes.

In sports training and athletic competition, hydration status has been recognized as a factor affecting athletic performance.Normal hydration is the optimal state of water content in the human body, other than that, both low hydration and high hydration can cause some damage to human health and sports performance.Research has proven that water intake and output do not have to be exactly equal to maintain optimal body function, which means that the optimal stable range of water intake and output is ±1%.At the same time, there is a clear "threshold" for dehydration when an athlete starts training in a normal state of hydration, which is when dehydration reaches 2% of body mass,the body's function will start to be impaired to a certain extent.For example: cardiovascular strain、impaired cognitive function、physical function etc.Although this threshold has become the recommended threshold for fluid intake to stabilize normal hydration, according to the published articles to date, this threshold has shown varying degrees of individual variation in different athletes.Then it is especially necessary for coaches and related practitioners to correctly understand the factors influencing athletes' hydration status and the effects of different hydration status on athletes' health and sports performance in order to develop individualized hydration strategies for athletes. Therefore, this paper will make a detailed compilation from these two aspects in order to provide some reference for the relevant practitioners.

2. Factors influencing the hydration status of athletes

2.1. Effect of education on hydration status

Hydration knowledge education can significantly improve the hydration status of athletes.Research has demonstrated a significant positive correlation between knowledge, attitudes and behavior, meaning that the more hydration knowledge athletes know, the better their hydration status and hydration practices.However, it is worth noting that there is no significant correlation between educational interventions on hydration status and hydration status test indicators.Compared to high school athletes who are not educated about hydration, educated high school athletes have a higher fluid intake, a heightened awareness of thirst, and less loss of urine specific gravity and body mass.Kavouras et al. found that young athletes underwent significant changes in their hydration behavior after receiving a lecture on hydration.Sobana also confirmed this effect of educational interventions through changes in athletes' drinking behaviors and knowledge and attitudes towards hydration after the educational interventions with college athletes.

There is not much disagreement among scholars that educational interventions can ultimately improve athletes' hydration status, but some scholars have stated that educational interventions do not directly affect athletes' hydration status. cleary stated that after educational interventions, athletes know that hydration can improve athletic performance, then they will be more likely to hydrate before severe dehydration occurs, but because athletes' learned behaviors of individual differences can have an impact on the rehydration process, so education about hydration alone is not enough to improve the athletes' athletes' hydration status and hydration behavior; therefore, a supportive intervention based on the implementation of an educational intervention is necessary to completely improve the athletes' hydration behavior。Abbasi found a significant decrease in pre-training urine color and a significant increase in HAQ (Hydration Knowledge Questionnaire) scores in indoor

basketball and volleyball athletes after the educational intervention, but no significant changes in pre-training urine specific gravity, post-training urine specific gravity, post-training urine color, changes in body mass and sweating rate compared to the pre-intervention period,which means that although the athletes' hydration knowledge increased, their hydration habits did not change.The same corroborates Cleary's point.

It then becomes a question of how to add supportive interventions to educational interventions to better maintain athletes' hydration status.Ditia, through observations and data analysis of three experimental groups and one control group (receiving education-water supply, education only group, water supply only group, and no intervention), suggests that a combination of education and provision of water can result in water consumption and hydration status Suggestions for a good improvement. Cleary, on the other hand, suggests individualized hydration programs for athletes to improve their hydration status by observing them during four periods (control period, educational intervention, prescribed hydration intervention, and observational follow-up).

2.2. Effects of exercise intensity and environment on hydration status

Water loss and perspiration are influenced by the environment, and even if the athlete is in a quiet state, changes in ambient temperature can affect the athlete's hydration status.Changes in temperature induce physiological changes in the body's response to water intake. When an athlete is in a cold environment without any exercise, the body will be less willing to take in water,and will also cause a slight diuretic effect due to the decrease in skin temperature and the constriction of the peripheral blood vessels.This state will gradually decrease as the temperature rises, and when the temperature rises to 25 °C and above, the willingness to ingest water will increase significantly.However, at the same time, blood flow to the brain decreases in a hot environment, leading to changes in electrical activity in the brain, a significant decrease in the ability to maintain voluntary contractions, and an increase in sensory exertion.In a warm environment, evaporation of sweat is the primary heat dissipation mechanism; therefore, sweating is critical to maintain body temperature in warm conditions, and if the rate of sweating is greater than the rate of water intake, it can lead to dehydration, which can affect the maintenance of body temperature and heat transfer for muscle work in athletes.

3. Effect of hydration status on exercise performance

3.1. Endurance Performance

The effect of dehydration on endurance performance during endurance sports is usually studied by inducing some degree of dehydration in the athlete's body during the start of the exercise or by the development of dehydration during the exercise. In a detailed review of the effects of dehydration on performance, Cheuvront concluded that dehydration of 2%-7% of body weight during exercise reduces endurance performance. However, the magnitude of the reduction in endurance performance was greater for different testing methods, ranging from 7% to 60%It is important to note that under cool conditions, when athletes train for less than 90 minutes, dehydration levels below 2% of body weight have no effect on endurance performance,but endurance performance is impaired when exercise lasts longer than 90

minutes.When exercising in a hot environment, water loss up to 2% of body weight endurance performance is impaired,certainly with no or little rehydration.When combined with heat stress, the decline in endurance performance is further exacerbated.In conclusion, according to current research, dehydration affects athletes, making them more difficult to tolerate in hot environments, and is the main reason for their early onset of fatigue.The hypohydrated state limits or impairs endurance performance through multiple mechanisms, with underhydration elevating core temperature,skeletal muscle glycogen use,fatigue/discomfort,respiratory alkalosis,afferent feedback,skeletal muscle motor unit recruitment 、 and brain function.Although the exact mechanism of action is a topic of debate in current research, one of the more widely accepted claims is that the presence of both absolute and relative hypovolemia is a prerequisite for hypohydration to impair aerobic capacity. Both types of hypovolemia increase cardiovascular stress, so it is thought that challenges in blood pressure regulation may often be the "key" mechanism by which hydration impairs aerobic performance.Although hypohydration reduces endurance performance, hyperhydration shows no significant endurance improvement in endurance sports and even increases the risk of hyponatremia.

In summary, being in a hypohydrated state decreases the endurance performance of the athlete, and the degree of endurance performance increases as the degree of dehydration increases. In particular, in a hot environment, the effects of dehydration and heat stress are superimposed on each other to further reduce the athletes' endurance performance. There are a number of mechanisms by which hydration imbalance causes a decrease in endurance performance, and even more so, they interact with each other, so the exact mechanisms are not yet clear and need to be studied in depth. In addition, the effect of endurance performance in a hyperhydrated state remains to be determined.

3.2. Strength Performance

Based on the current literature on the effect of needle hypohydration on strength, a portion of researchers have indicated that hypohydration has an effect on reducing strength. The loss of water to 7% of body weight does not produce a reduction in maximum isometric contraction.If the dehydration is caused by chronic inadequate intake of food and fluids, the likelihood of reduced strength will be greater.The mechanism may be that insufficient body water can have some effect on electromyography (EMG)and muscle membrane excitability.However, it is more likely that perhaps the loss of body water may have a monastic effect on some components of the neuromuscular system.However, some studies have shown different results for anaerobic sports such as sprinting and jumping. Firstly, the effect of low hydration status on the performance of 50m and 200m sprinters was studied for different types of sprinting. The study induced a change in hydration status by administering diuretics to the athletes, resulting in a 1.7kg reduction in water, but ultimately found no significant change in either performance or finish time.Similarly, when athletes were tested at 3*30m, it was still found that low hydration status did not have a significant effect on.However, there are conflicting findings for jumping-type exercise. Jumping performance has often been studied as a means of assessing the effect of body water loss on muscle strength, with levels of weight loss ranging from 1% to 3% in most studies,although studies have shown 6% weight loss when energy restriction is combined with dehydration,and most of these studies have not found a significant effect of weight loss on jumping ability or

height.However, it has been suggested that hypohydration may lead to improved jumping ability,but it has also been suggested that hypohydration does not affect jumping ability,perhaps because the decrease in muscle strength is offset by the decrease in body weight due to the hypohydrated state.

In summary, the results of the tests were not the same between different types of programs, or even contradictory between the same types of programs. Combining the results of the current study, it is not possible to determine whether hypohydration or dehydration has an effect on muscle strength, although such conflicting results may be due to exercise patterns, body weight lost, and recovery time. As dehydration occurs, body mass decreases, which in turn allows the athlete to exercise with less "weight", which can promote improved performance, which may mask any potential negative effects of hypohydration on strength performance. This means that if hypohydration does not reduce muscle strength, then it is possible that hypohydration will improve strength performance.

4. Summary and Prospect

4.1. Summary

Unbalanced hydration status of athletes can seriously interfere with their training effects and athletic performance, and leaving it untreated can seriously affect the health status of athletes and even threaten their lives - especially for endurance athletes. Therefore, athletes need to be properly hydrated. When rehydrating athletes, a variety of factors need to be considered, such as ambient temperature, rehydration dose, rehydration composition, exercise volume, and athlete perception. In addition, when an athlete is found to have been in a state of chronic hydration imbalance, a detailed examination of the athlete's health needs to be focused on to avoid unavoidable sports and/or health injuries.

4.2. Prospect

In summary, it is easy to find that some of the current research findings are still lacking or poorly understood, which has some hidden dangers for athletes' training. In the future, in-depth studies can be conducted on the following aspects: 1) long-term monitoring of hydration status in athletes' training under different environmental conditions, in order to identify the symptoms of long-term hydration status and formulate long-term rehydration strategies; 2) in-depth research on the mechanisms of hydration imbalance that are harmful to athletes' health and sports performance research on the mechanisms of hydration imbalance that are detrimental to athletes' health and athletic performance, so as to optimize the hydration imbalance of athletes from the root; 3) research on the prediction of hydration imbalance to avoid the impairment of athletic performance and health status when athletes lack appropriate sports rehydration.

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