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Original article

HYDRATION IN TENNIS PERFORMANCE – WATER, CARBOHYDRATE OR ELECTROLYTE SPORTS DRINK?

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Abstract

Aim. The importance of adequate fluid intake to maintain performance should not be underestimated.

Water is the most essential nutrient as the body can only survive for a few days without it.

Water is a great drink for low to moderate intensity activities that last less than an hour. However, for activities that last more than an hour, a carbohydrate and electrolyte sports drink may be more beneficial.

Carbohydrate electrolyte beverages have been utilized in other sports with varied results and different opinions. The inclusion of low concentrations of carbohydrate in sports drinks can serve to offset such losses and therefore may serve to prolong exercise duration and maintain exercise intensity.

Sodium is the key electrolyte and main extracellular mineral lost in sweat and should be increased in most competitive tennis player's diets to help minimize the risk of heat illness and muscle cramping. Sodium supplementation is recommended in regular diet (e.g. sodium-rich foods), or sodium supplementation to fluid ingested before, during, and after tennis play.

Conclusions. Water is the best fluid replacement during tennis in the heat, for low to moderate intensity activities that last less than an hour. Carbohydrate and electrolyte sports drink may be more beneficial for activities that last more than an hour. The inclusion of low concentrations of carbohydrate in sports drinks can serve to offset such losses and therefore may serve to prolong exercise duration and maintain exercise intensity.

Keywords: hydration, electrolyte, heat, acclimatization.

Introduction

The aim of this article is to explore the tennis literature and to provide relevant information of the on hydration and dehydration in an attempt to assist coaches, trainers to prepare tennis players to perform at a high level.

Tennis matches are played in hot or humid conditions which increases thermal stress and can lead to heat and hydration concerns for tennis players both from a performance standpoint and a health and safety perspective.

Whether at the junior or adult professional level, it is understood that the restoration of carbohydrate stores, along with fluid and electrolyte levels in match or after are vital to performance, health and safety.

Tennis played at the top level is a sport with an increased media impact, but the recommendations on the tennis player's hydration in training or matches at warm temperatures are not clear. The difficulty with recovery hydration research and subsequent guidelines is the need to account for multiple variables including: muscle and liver glycogen changes, individual sweating rates and electrolyte losses, movement efficiency, environment, individual anthropometric characteristics, and level of physical training. In sport discipline the frequency, duration and intensity of the activity session all contribute to determining an athlete's fuel needs (Ene-Voiculescu, Ene-Voiculescu, 2016).

When playing in hot and humid environments, it is important that the athlete becomes acclimatized to perform at optimum levels. The acclimatized athlete will begin to sweat earlier, will have a higher sweat rate for a given core temperature and can maintain a higher sweat rate for a longer time period (Hue, Voltaire, Galy et al., 2004).

An acclimatized player also loses fewer electrolytes in sweat than a player who is not acclimated (Kirby, Convertino, 1986; Allan, Wilson, 1971).

Dehydration

Dehydration and heat stress are a common occurrence in tennis.

Small levels of dehydration can have a negative effect on performance in training and competition. Even athletes who drink regularly during training often find it difficult to match the losses that occur during exercise. A key point to remember is that we

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can minimize the effect of dehydration by addressing fluid intake before exercise starts.

Tennis is often played in hot, humid environments, and it has been shown that tennis players can sweat approximately 2.5 L/h (Bergeron et al., 1995a), and some players have been recorded with sweat rates greater than 3.0 L/h (Bergeron, 2003).

The performance is influenced by many other factors, like the conditions of the environment where the practice takes place. When the temperature and humidity of the environment are high**,** the capacity of doing exhausting exercises is reduced (Popa, 2008).

Dehydration of as little as 1-2% of body weight (only 1.5-3 pounds for a 150 lb. athletes) has been shown to reduce performance.

A review by (Judelson et al., 2007)found that 3-4% hypohydration reduces muscular strength by approximately 2%.When a tennis player loses 3% of body weight due to sweating, it can result in an increase in core body temperature of more than 1°C and an increase in heart rate of between 10-20 beats per minute. This results in an athlete needing to work more than 10% harder to accomplish the same amount of work as when he is fully hydrated (USTA Sport Science 2008).

During hot weather training, dehydration occurs more frequently and has more severe consequences: heat cramps, heat exhaustion or heat stroke.

Clinical signs:

- Day to day body weight changes are an acute estimate of hydration changes, if careful baseline measures are obtained and confounding factors are controlled (Cheuvront et al., 2002).
- Clinical signs and symptoms such as thirst, dizziness, headache, tachycardia, oral mucosal surface moisture, skin, trembling should not be ignored, but are too generalized and too imprecise to accurately assess the presence of hydration or dehydration in an athlete (Barkin and Ward, 2002 & Engel et al., 1995).
- Urine-specific gravity, urine color, and urine osmolality are useful screening measures of hydration status (Adolph, 1947; Armstrong et al., 1998).
- Urine colour (dark), smell (strong) and volume (small).

Side effects of dehydration in tennis include:

- Poor concentration, co-ordination and reaction time;
- Increased body temperature resulting in increased risk of heat stress/exhaustion;
- Exercise is perceived as being more difficult;
- Increased use of carbohydrate (glycogen stores) leading to quicker fatigue;
- Increased heart rate/cardiovascular strain;
- Nausea and gastrointestinal upset;
- Muscle cramping.

Exercise induced muscle cramping has multiple factors, and it has been shown that dehydration and electrolyte loss are not the sole reasons for muscle cramping (Jung et al., 2005).

These other reasons have still not been fully determined, but psychological stress in competitive situations is a plausible contributor to the onset of muscle cramping during play.

It would be appropriate, therefore, for tennis players to supplement with Na^+ to help prevent electrolyte imbalances (Kovacs, 2006).

Potassium loss in sweat duringexercise is rather small, relative to whole-body K+ stores and,

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consequently, has minimal physiological or performance consequence (Pivarnik, Palmer, 1994)

Magnesium sweat loss is also minimal, but reduced levels of Mg+ have been seen in people who suffer from muscle cramping; therefore, a non-causation link has been made (Shirreffs, Armstrong, Cheuvront, 2004)

Dehydration is not only a health concern, but it also reduces a tennis player's on-court performance.

Hydration – water, carbohydrate or electrolyte beverages?

Water has a number of functions within the body, circulation of nutrients around the body, the removal of waste products and, very importantly, **helps** to keep our body temperature stable. It is the best fluid replacement during tennis in the heat, for low to moderate intensity activities that last less than an hour.

Hyponatremia is a form of water intoxication, when an athlete consumes only water and sweats out large amounts of sodium, which results in diluting the fluid throughout the body. If the athlete is sweating a lot, it is important to rehydrate with fluids that contain enough electrolytes, so as not to dilute the fluids in the body.

Hyponatremiais not as common in tennis play as in other sports such as marathon running (Kovacs, 2008).

Carbohydrate and electrolyte sports drink may be more beneficial for activities that last more than an hour (USTA Sport Science, 2008).

It has also been suggested that 200ml of fluid every 15 minutes is an adequate rate to maintain body fluid balance at a warm environment 27 °C (MacLaren, 1998).

In warm and hot environments, electrolyte-enhanced fluid should be consumed at greater than >200 mL per changeover and ideally closer to 400 ml per changeover. (Kovacs, 2008).

Players who ingest more than 1.25 L/hr may feel gastrointestinal discomfort as they compete (Coyle and Montain,1992 & Neufer et al., 1989).

Drinking carbohydrate-electrolyte beverages enhances performance compared with drinking the same volume of water during prolonged (45–50 min) exercise or in high intensity, intermittent exercise (Coyle and Montain, 1992; Utter et al., 1997; Felig et al., Kang et al., 1996; Mitchell et al., 1992.; Ferrauti et al., 1997)

The administering amino acids beverages during physical training may contributes to the increase performance (Ene-Voiculescu, Ene-Voiculescu, et al., 2015).

No performance benefit has been shown with CHO ingestion during tennis play with sessions lasting less than three hours, even though ACSM guidelines recommend CHO supplementation 30-60 g/h for "intense exercise lasting longer than one hour" (Convertino et al., 1996).

Therefore, a general recommendation could be made that there is no apparent benefit in including CHO's in fluid-replacement drinks during less than approximately two hours of tennis play (Kovacs, 2006).

The importance of the addition of sodium to fluid consumed during, and especially after training or competition has been shown to be vital for improved rehydration.

In a tennis tournament or repeated days of practice in a hot and humid environment, the cumulative effect of repeated high Na^+ losses over several days may result in a low extracellular Na^+, especially if daily Na^+ ingestion is low. This is a reason why some players may cramp in the latter rounds of tournaments or toward the end of a strenuous training or match day (Kovacs, 2006).

Inclusion of sodium 0.5-0.7g./1liter in the rehydration solution ingested during exercise lasting longer than 1 h is recommended.

Exercise induced muscle cramping has multiple factors, and it has been shown that dehydration and electrolyte loss are not the sole reasons for muscle cramping (Jung et al., 2005).

For recovery after effort must using the right dose of glucose and power drinks (Georgescu, et al, 2008).

These other reasons have still not been fully determined, but psychological stress in competitive situations is a plausible contributor to the onset of muscle cramping during play.

It would be appropriate, therefore, for tennis players to supplement with Na^+ to help prevent electrolyte imbalances (Kovacs, 2006).

Sport drinks vs Water

	Sports drinks	**Water**
Flavor	Sweet flavor encourage athletes todrink more fluid.	Lack of flavor may limit individual's drinking tolerance.

Carbohydrates	Drinking carbohydrate-electrolyte beverages enhances performance compared with drinking the same volume of water during prolonged (45–50 min) exercise or in high intensity, intermittent exercise.	It is a great drink for low to moderate intensityactivities that last less than an hour. Provides no energyfor long duration Exercise.
Electrolytes: Sodium	Sodium supplementation is recommended to fluid ingested before, during, and after tennis play. Increases the thirst mechanism(makes athletes drink more) and alsokeeps more water in the system, instead of losing it through urination.	Contains no electrolytes. Water alone stimulates kidneys to increase urine production more than if sodium was added. Does not replace electrolytes.

Hydration before match

The American College of Sports Medicine's recommendation for athletes to consume between 400 to 600 mlof water 2 hours before exercise should be used as a minimum standard for tennis players to help promote euhydration.

Hydration during a match

A competitive tennis player who has a normal sweat rate of 2.0 L/hr would need to drink 0.25 L on each changeover (assuming five changeovers per hour) to replace just 62.5% of the hourly lost fluid (Bergeron, Armstrong, 1995)

Alternatively, 0.30 to0.40 L of fluid should be consumed every 15 minutes of exercise 1.2 to 1.6L/hr (Kovacs MS, 2008).

Hydration after match

Rehydration after exercise has three major purposes: to replace fluid volume to an equal or greater extent than the volume lost while sweating, to ingest liquid and/or solid carbohydrates to aid in glycogen resynthesis (Sherman, 1992) and to replace electrolytes lost during sweating. Water cannot be the only fluid consumed after tennis play because the athlete is typically in a hypo hydrated state and an increase in plain water will dilute the lowered electrolyte concentration in the blood and plasma even further (Kovacs MS, 2008).

In *Nutritional Recovery for Tennis*, Susie Parker-Simmons says that the two key factors to analyze on the "Fluid Balance Chart" are:

1. Percent Body Weight Change: % Dehydration = 100 x [pre-exercise wt (kg) – post-exercise wt (kg)]/pre-exercise wt (kg). Players should be able to keep their % body weight around 1% or less for a 2-hour session.

2. Total Sweat Loss: total sweat loss (ml) = 1000 x [pre-exercise wt (kg) – postexercisewt (kg)] + ml fluid consumed + solid food consumed – ml urine excreted.

This provides information on sweat loss and, in turn, aids the athlete in determining his/her individual fluid requirements based on his/her sweat loss. Athletes should be encouraged to perform this test in different environmental conditions (Susie PS, 2010)

Conclusion

Tennis players need to perform their own studies to gain individual knowledge of their sweat rates during different environmental conditions and should be on an individualized hydration schedule, consuming greater than 300- 400 ml of fluid every changeover.

Water is the best fluid replacement during tennis in the heat, for low to moderate intensity activities that last less than an hour.

Carbohydrate and electrolyte sports drink may be more beneficial for activities that last more than an hour. The inclusion of low concentrations of carbohydrate in sports drinks can serve to offset such losses and therefore may serve to prolong exercise duration and maintain exercise intensity.

Sodium is the key electrolyte and main extracellular mineral lost in sweat and should be increased in most competitive tennis player's diets to help minimize the risk of heat illness and muscle cramping. The inclusion of sodium is recommended as it enhances the palatability of the drink, maintains

thirst and promotes greater associated with fluid retention.

Athletes should be encouraged to perform test "Fluid Balance Chart" in different environmental conditions.

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References

Armstrong LE, Herrera Soto JA, Hacker FT, Casa DJ, et al., 1998, Urinary indices during dehydration, exercise, and rehydration. Int J Sport Nutr, 8:345–355.

Adolph EF, 1947, Physiology of Man in the Desert. New York: Interscience;

Allan JR, Wilson CG. 1971, Influence of acclimatization on sweat sodium concentration. J Appl Physiol.;30:708-712.

Barkin RM, Ward DG, 2002, Infectious diarrheal disease and dehydration. In Rosen's Emergency Medicine: Concepts and Clinical Practice. Edited by Walls R, Hockberger R. Philadelphia: Mosby;:2315–2326.

Bergeron MF, Armstrong LE, 1995, Fluid and electrolyte losses during tennis in the heat.Maresh CMClin Sports Med. Jan; 14(1):23-32.

Bergeron MF, 2003, Heat cramps: fluid and electrolyte challenges during tennis in the heat. J Sci Med Sport. Mar; 6(1):19-27.

Casa et al., 2005, American College of Sports Medicine Roundtable on hydration and physical activity: Consensus statements.May, Volume 4, Issue 3, pp 115–127

Convertino V, Armstrong LE, Coyle EF, Mack G, Sawka MN, Senay L, Sherman WM, 1996, American College of Sports Medicine position stand: exercise and fluid replacement. Medicine and Science in Sports and Exercise 28, i-vii [PubMed]

Coyle EF, Montain SJ, 1992, Carbohydrate and fluid ingestion during exercise: are there trade-offs? Med Sci Sports Exerc, 24:671–678.

Cheuvront SN, Haymes EM, Sawka MN, 2002, Comparison of sweat loss estimates for women during prolonged high-intensity running. Med Sci Sports Exerc, 34:1344–1350.

Engel DB, Maller O, Sawka MN, Francesconi RF, et al., 1995, Thirst and fluid intake following graded hypohydration levels in humans. Physiol and Behavior, 40:229–240.

Felig P, Cherif A, Minagawa A, Wahren J, 1982, Hypoglycemia during prolonged exercise in normal men. N Eng J Med, 306:895–900.

Ferrauti A, Weber K, Struder HK, 1997, Metabolic and ergogenic effects of carbohydrate and caffeine beverages in tennis. Journal of Sports Medicine and Physical Fitness 37, 258-266 [PubMed]

Georgesu A, Negrea V, Musat G, 2008, The recovery of the human body after sportive efforts, ICPESH PITESTI - PROCEEDINGS

Hue O, Voltaire B, Galy O, et al., 2004, Effects of 8 days acclimation on biological and performance response in a tropical climate. J Sports Med Phys Fitness.;44(1):30-37.

Jung AP, Bishop PA, Al-Nawwas A, 2005, Influence of Hydration and Electrolyte Supplementation on Incidence and Time to Onset of Exercise-Associated Muscle Cramps.Dale RBJ Athl Train. Jun; 40(2):71-75.

Judelson DA, Maresh CM, Anderson CP, et al., 2007, Hydration and muscular performance: Does fluid balance affect strength, power, and high-intensity endurance? Spots Med.;37(10):907-921.

Kang J, Robertson RJ, Goss FL, DaSilva SG, et al., 1996, Effect of carbohydrate substrate availability on ratings of perceived exertion during prolonged exercise of moderate intensity. Perceptual Motor Skills, 82:495–506.

Kirby CR, Convertino VA, 1986, Plasma aldosterone and sweat sodium concentrations after exercise and heat acclimation. J Appl Physiol.;61(3):967-970. ports Med Phys Fitness. 2004;44(1):30-37.Kovacs MS. (2006) Hydration and temperature in tennis - a practical review. J Sports Sci Med.;5:1-9.

Kovacs MS, 2008, A Review of Fluid and Hydration in Competitive Tennis, International Journal of Sports Physiology and Performance, 413-423 © 2008 Human Kinetics, Inc.

MacLaren DPM, 1998, Nutrition for racket sports. In: Science and racket sports II. Lees A., Maynard I., Hughes M, Reilly T., editors. London: E & FN Spon.43-51

Mitchell JB, Cole KJ, Granjean PW, Sobczak RJ 1992, The effect of a carbohydrate beverage on tennis performance and fluid balance during prolonged tennis play. Journal of Applied Sport Science Research 6, 96-102

Neufer PD, Young AJ, Sawka MN, 1989, Gastric emptying during exercise: effects of heat stress

and hypohydration.Eur J ApplPhysiolOccup Physiol.; 58(4):433-9.

Pivarnik JM, Palmer RA, 1994, Water and electrolyte balance during rest and exercise. In: Wolinsky I, Hickson JF, eds. Nutrition in Exercise and Sport. Vol. 2nd ed. Boca Raton: CRC;245–262.

Popa C, 2008, The effects of releasing water and rehydration of human body on performing physical practice, Anale FEFS, Constanta, http://www.analefefs.ro/anale-fefs/anale-2008-vol-viii-cuprins-si-abstract-engleza-1.pdf

Susie P-S, 2010, Nutritional Recovery for Tennis MS, RD, Tennis Recovery: A Comprehensive Review of the Research Copyright © United States Tennis Association Inc. ISBN 978-0-692-00528-6

Sherman WM, 1992, Recovery from endurance exercise. Med Sci Sports Exerc.; 24:S336–S339.

Shirreffs SM, Armstrong LE, Cheuvront SN.(2004) Fluid and electrolyte needs for preparation and recovery from training and competition. J Sports Sci.;22:57–63.

Utter A, Kang J, Nieman D, Warren B, 1997, Effect of carbohydrate substrate availability on ratings of perceived exertion during prolonged running. Int J Sport Nutr, 7:274–285.

USTA Sport Science, 2008

Ene-Voiculescu V, Ene-Voiculescu C, 2016, Operative systems specify to the training in military pentathlon KBO, The 22th International Scientific Conference „Knowledge Based Organisation", 9-11 iunie 2016, conference@armyacademy.ro, Sibiu, Romania, pag.33-36;

Ene-Voiculescu V, Ene-Voiculescu C, Lazar I, 2015, The use of amino acids before effort "Mircea cel Batran" Naval Academy Scientific Bulletin, Volume XIX – 2016 – Issue 1

Wilmore JH, Morton AR, Gilbey HJ, Wood RJ, 1998, Role of taste preference on fluid intake during and after 90 min of running at 60% of VO2max in the heat. Med Sci Sports Exerc 1998, 30:587–595.