Water, Sports Drinks and Energy Drinks: Facts, Fables and Fibs

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Recommended Readings: Kravitz, L. (2008). Water: The science of nature's most important nutrient. IDEA Fitness Journal, 5(10), 42-49.
Mayo, J.J. & Kravitz, L. (2008). Sports & energy drinks: Answers for fitness professionals. IDEA Fitness Journal, 5(9), 17-20

I. Intro on water (two hydrogen atoms and one oxygen atom). Overview and pseudo science of water

II. Water 101: The basic facts

A. 60% of body weight (range is 45%-75%); muscle is ~74% water, fat~10%; survive 7 days without
B. Helps form proteins and glycogen, solvent for minerals, vitamins, amino acids and nutrients
C. Is organic (contains no carbons). There is no life (as we know it) without water
D. Dehydration: loss of body water (due to exercise, illness, etc.) essential for normal body function
E. Euhydration: normal body water content
F. Hydration: supply water to restore or maintain fluid balance
G. Hypohydration: water content below normal; Hyperhydration: water content above normal
H. Hyperthermia: body produces or absorbs more heat then it can dissipate
I. Hyponatremia: an abnormally low concentration of sodium in the blood. Too little, cells malfunction
J. Water functions: regulates body temperature, carries oxygen and nutrients to cells, lubricates joints and protects spinal cord, flushes out waste products through kidneys and liver, serves as the medium for all energy reactions in the body, cushions organs and tissues, promotes digestion and helps prevent constipation, transports minerals throughout cells of the body

K. How is water stored in body? Stored in intracellular (ICF) fluid (65%); stored in extracellular (ECF) fluid (35%), water in plasma and lymph, brain and kidney regulate, chloride, potassium and sodium work to maintain ICF and ECF levels

III. What is the origin of the "Drink Eight 8-ounce Glasses' of water each day? Valtin, H. (2002). American Journal of Regulatory, Integrative and Comparative Physiology. 283: R993-R1004

A. Eight 8-ounce glasses=1,893 milliliters=2 quarts=1/2 gallon or about 1.9 liters
B. No scientific evidence on the '8x8' recommendation; comes from 1945 Food and Nut. Board
C. Original Quote: "A suitable allowance of water for adults is 2.5 liters (which is approximately eight 8-ounce glasses) daily in most instances."

IV. Current daily water recommendation

A. Each day we lose about 1 liter of water from breathing, perspiring and stool
B. Lose another 1.5 liters in urine
C. 1 liter=33.8 ounces (one cup=8 ounces)
D. Institute of Medicine (IOM) 'Adequate Intake' (AI) recommendation (19-50 years)
E. Fluids should be 81% (19% fluids from food)
F. Men: 101.4 fluid ounces (13 cups); Women: 74.4 fluid ounces (9 cups)
G. Healthy elderly can follow these recommendations; exercise adds to fluid needs
H. Adequate intake (AI) for girls (14-18 yrs) = 2.3 liters (77 ounces or 9.5 cups), from IOM
I. Adequate intake (AI) for boys (14-18 yrs) = 2.4 liters (81.1 ounces or 10 cups), from IOM
J. Pregnant women: Expanding extracellular space plus needs of fetus, and the amniotic fluid
K. An extra 296 mL (or 10 ounces or 1.25 cups)
L. Lactating woman: 87% of milk is water, and average milk production during first 6 months of lactation is about 750 ml/day. An extra 739 mL (25 ounces or 3.1 cups)
M. Young children. Eisenmann et al. (2003). Journal of Adolescent Health, 33(3), 147-153
N. 3-day activity (2 week, 1 weekend) of 415 boys and 356 girls aged 10-19

O. 1.5 ml/kcal (ranges); very little activity (37-39 kcal/kg/day), moderately active (43-46 kcal/kg/day), very active (52-56 kcal/kg/day). Example calculation: 45 kg x 53 kcal/kg/day = 2388 kcals/day
P. 1.5 ml/kcal x 2385 kcals/day = 3578 ml/day (15 cups)

V. Water, health and disease: What do we know?
A. Kidney Stones: Portis & Sundaram (2001). American Family Physician, 63(7), 1329-1338.
B. "The MOST important factor influencing kidney stone formation is a decrease in fluid intake."
C. Kidney stones high in persons with low urinary volume
D. When urinary volume is increased to allow for volumes of 2-2.5 L/day (without other dietary changes), there is a marked reduction in kidney stones
E. Persons at risk should take 250 ml (8.4 ounces; ~1 cup) fluid with meals, between meals, before bedtime and when they get up at night to void (to ensure fluid intake throughout day)
F. Fluid intake needs to be increased in hot weather and after vigorous exercise
G. Cancer of Bladder & Lower Urinary Tract: Altieri et al. (2003). European Journal of Clinical Nutrition, 57(Suppl. 2), s59-s68
H. Causes of bladder cancer include cigarette smoking and occupational exposure to aromatic amines (air contaminated by wild fires and coal)
I. Very clear that decreased water intake is associated with bladder and lower urinary tract cancer
J. Hypothesis: decreased fluid intake results in a greater concentration of carcinogens in contact with bladder membranes and urinary track membranes
K. Colorectal Cancer: Altieri et al. (2003). European Journal of Clinical Nutrition, 57(Suppl. 2), s59-s68
L. Colorectal cancers develop slowly over a period of years
M. Researchers theorize that low fluid intake increases the risk, by increasing bowel transit time, and carcinogen contact with mucous membranes in colon and rectum
N. Breast Cancer: Kleiner, S.M. (1999). Journal of the American Dietetic Association, 99, 200-206
O. More research needed. Hypothesis is chronic dehydration compromises intracelluar water concentrations, affecting specific metabolic enzymes, inhibiting carcinogen removal
P. Mental Health and Cognitive Performance: Grandjean, A.C. (2007). Journal of the American College of Nutrition, 26(90005), 549s-554s. Not fully studied at this time
Q. The research shows that decrements in visuomotor (visual perception by the brain), psychomotor and cognitive performance occur when ≥2% of body wt. lost (due to water restriction, heat or exercise)

VI. Water and physical performance. Murray, B. (2007). Journ. of the American Coll. of Nutrition, 26(5), 542-548
A. Began 1800's. Decrease in water below normal can inhibit center nervous system (CNS), metabolic reactions, thermoregulatory control mechanisms; dehydration as little as 1% body weight impairs
B. Critical level of dehydration for physical performance is ≥2%, especially in warm/hot weather
C. Dehydration effect on CV system: decrease in cardiac output, decrease in heart filling, decrease in skin blood flow, decrease in blood volume, decrease in plasma volume, increase in blood viscosity, decrease in stroke volume, increase in blood plasma osmolality. Williams, M.H. (2005). Nutrition for Health, Fitness and Sport 7th edition. McGraw Hill Higher Education
D. Signs of dehydration include light-headedness, loss of appetite, flushed skin, dry sticky mouth, fatigue, dry eyes, muscle weakness, and burning sensation in stomach. As worsens, symptoms include clumsiness, dim vision, numbness of skin, and muscle spasms. The ONE effective treatment for dehydration is to replace lost fluids with cool water
E. The three heat syndromes
F. Heat cramp: painful cramps that occur during exercise or in a hot environment

G. Usually involve muscles fatigued by hard exertion. Proposed mechanism is a disruption of sodium and potassium ICF and ECF balance. Rest and drink an electrolyte-containing sports drink, with massage and stretching of the affected muscles

I. Stop: Why is sodium so important? Sodium is essential to nerve impulses and contraction of muscles, helps to maintain acid-base balance, reduces the risk of heat cramps during exercise, balances fluids in the tissues, maintains blood volume at higher levels, helps to regulate heart beat, reduces risk of hyponatremia

J. Heat exhaustion: occurs when dehydrated between 3% and 5% of body weight

K. Hypovolemic shock: state of decreased blood plasma and volume (pale, cool clammy skin with rapid heart rate and shallow breathing), nausea, heavy sweating, fever, headache, weak blood pressure

L. Intervention: get person into a shady or air-cooled location, lie person down and elevate legs, cool off person by spraying/sponging with water, have person sip cool water, medical assistance if worsen

M. Heat stroke: escalation of heat cramps and heat exhaustion, life-threatening when body temperature is >104 degrees F (40 degrees C), sweating often stops as body temperature gets so high, resting pulse may rise ≥130 beats/min, seizures, loss of consciousness, hallucination. Immediate medical

VII. What is the proper fluid replacement to sustain endurance exercise? Sawka, M.N. (2007). Medicine & Science in Sports & Exercise, 39, 377-390 (ACSM Position Statement on Exercise and Fluid Replacement)

A. Pre-hydrating: can begin progressively up to 2-4 hours before workout

B. 5-7 mL/kg; Example with 68 kg person; 7 mL x 68 kg = 476 mL of fluid

C. Since 8 ounces = 237 mL, 476 mL is about 16 ounces or two glasses of water or ½ L

D. Consuming 230-570 milligrams of sodium or a sodium-containing snack will help retain the fluid

E. Hydrating during exercise: Goal: to prevent excessive water loss and electrolyte imbalances for sustained exercise ≥1hours

F. Hydration guidance is quite variable to person's sweat rate, mode of exercise, duration, weather, training status, intensity, heat acclimatization, metabolic efficiency

G. There is NO 'one-size-fits-all' hydration advice. Ranges from 0.4 to 0.8 liters/hours of exercise

H. Best to individualize by calculating sweat loss and sweat rate. Replace in a 1:1 ratio with fluid loss

I. Example how to calculate sweat loss & sweat rate
   a. Pre-exercise: 59 kg (130 lbs)
   b. Post-exercise: 57.5 kg (126.5 lbs)
   c. Change in body weight: 1.5 kg or 3.5 lbs or 56 ounces, or 1.65 liters
   d. Drink volume during workout: 16 ounces or 0.5 liters
   e. Urine volume: 0 ounces
   f. SWEAT Loss: (c + d – e) = 72 ounces or 2.1 liters
   g. Exercise time; 1 hour
   h. Sweat rate (f divided by g): 2.1 liters/hr

J. Rehydrating after exercise

K. Need to replenish sodium to retrain fluid, stimulate thirst, stimulate urine

L. Sodium losses very hard to quantify. Sports drink or beverage/snack containing sodium

M. If dehydrated, drink ~1.5 L of fluid for each kg lost during the exercise (gradually for best retention)

VIII. Sports Drinks: Sawka, M.N. (2007). Medicine & Science in Sports & Exercise, 39, 377-390 (ACSM Position Statement on Exercise and Fluid Replacement)

A. Sports drinks offer carbohydrates (CHO), electrolytes, vitamins, proteins and amino acids

B. Science has consistently validated the use of CHO and electrolytes

C. So, the 3 main ingredients needed in a Sports Drink are water, CHO, and electrolytes

D. Primary benefit: better exercise performance by maintaining hydration and providing extra energy

E. CHO: mixture of simple sugars (glucose, sucrose, fructose) most effective for absorption, CHO oxidation and no GI distress
F. Sports drink with CHO concentration of 6-8%
G. CHO of 30-60 grams/hour maintains blood glucose and sustains exercise (14-16 grams/237 mL or 14-16 grams/8 ounces)
H. Beverages with more than 8% may delay gastric emptying and lead to GI disstress
I. Sports drinks: Electrolyte essentials. Sodium is the most critical electrolyte lost in sweat
J. Need about 70 mg/237 ml or 70 mg/8 ounces
K. What about potassium, calcium and magnesium needs for exercise performance?
L. Potassium loss is very small and calcium and magnesium loss is very little
M. Encourage clients to get these essential minerals through a balanced diet
N. What about flavors? First select a rehydration beverage with correct ingredients, next opt for flavor

IX. ABC's of energy drinks

A. Caffenie and sugar are the primary ingredients plus a 'cocktail' of supplemental ingredients including herbal extracts (ginseng, guarana, and ginko bilboba), amino acids, derivatives (such as taurine and carnitine) and B vitamins.
B. Open discussion of efficacy of energy drinks

X. Questions on water, hydration and dehydration

A. What is the composition of sweat? 99% water plus sodium ions and chloride ions. Other minerals lost in trace amounts include calcium, potassium, magnesium, iron, zinc, copper and chromium
B. Will drinking water help with weight loss? Some evidence suggests water intake with a meal helps to promote satiety. However, water has no caloric value
C. How do I get a hydration color chart for my clients? Use any search engine and type in 'urinary chart on hydration status'
D. Why do some athletes wet their body during endurance competition events? This is a skin wetting technique that gives a feeling of performance enhancing but not shown to reduce core temperature or improve performance
E. Is cooler water absorbed faster in the body then warm water? Yes
F. Why do you need to drink more water with air travel? Re-circulated air on airplanes has less moisture, travel time at high altitudes increases water loss too. Suggestion is to drink an 8-ounce class (236 ml) of water for each hour of flight
G. Can you drink too much water? Called water intoxication, though this is rare. Kidneys unable to effectively excrete urine. Will happen if too much water is taken at one time. May lead to greater exposure to pollutants and hyponatremia
H. What is an electrolyte? A substance in solution that conducts an electric charge in water, can be positive (cation) or negative (anion), electrolytes can activate enzymes in some metabolic processes
I. What are the sweat rates of athletes? Sweat rates vary a lot, but research shows from 0.5 to 2.0 L/hr
J. Is there a gender different in seat rates? Yes, women typically have lower seat rates and electrolyte losses than men due to smaller body size and lower metabolic rates
K. Do older adults have decreased thirst sensitivity? Yes, with age (≥65 years) there is an age-related blunting of the thirst response. Encourage to hydrate during and re-hydrate after exercise.
L. Does caffeine give you a performance edge? Research has shown that 200 mg of caffeine (there are 50 mg of caffeine in a 12-ouce cola and 125 mg in 12 ounces of coffee) taken before endurance exercise improves the exercise capacity of most subjects. Keep in mind that responses vary widely
M. Do aqua exercisers need to be concerned about hydration?
N. What % of the average human brain is water? 77-78%