Sodium Loading

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Introduction to Body Fluid

Most athletes know that water is the most important nutrient for the human body and performance can be greatly affected by internal fluid stores. It comprises approximately 60% of body weight and can fluctuate between 45-75% based on age and body composition. The amount of body water depends on factors such as age, gender, body composition and overall body size. Water is stored in different locations in the body including fat (10%), bone (22%), muscle (70-80%) and blood plasma (90%).

Total body water is separated into two different compartments in the body: intracellular fluid (ICF), which stores about 65% of the total body water, and extracellular fluid (ECF), where the remaining 35% of total body water can be found. The major cation (positively charged ion) in the ECF is sodium and the major anions (negatively charged ions) are chloride and bicarbonate. The composition in the ICF is quite different. The major cation in the ICF is potassium and phosphate and protein are the major anions. Sodium is present but in much smaller concentrations. These different compositions between the ECF and ICF are important for the transport of fluid and electrolytes across cell membranes.

While there are differences in composition between these two spaces, the total concentration of solutes (osmolarity) is the same. If the concentration in either compartment changes, a shift is seen. Water is lost during times of heavy sweating and there is change in plasma volume which results in a higher concentration of sodium in the plasma. The cells shrink in response to this because water has to be shuttled outside of the cell to create balance in the plasma.

Fluid and Electrolyte Loss

In warmer conditions, adult athletes can lose between 1.0-2.5 liters of sweat per hour. In severe conditions, this can increase to 3.5 liters per hour. Sweat is mostly water but contains many other compounds including sodium, chloride, potassium, calcium, magnesium, iron, ammonia, copper, creatinine, iodine, phosphorus, urea and manganese.

Athletes who are acclimatized to heat typically have lower sweat sodium concentrations. Research has shown these can range from 115-2,300 milligrams of sodium lost per liter of sweat. However, with athletes who have high sweat rates, this can approach 5,000 milligrams of sodium lost per hour. During longer competitions, this could equal 15-30% less sodium in the body that is available to maintain fluid balance.

In addition to what may be lost during competition, a “clean” daily diet can also be problematic. This type of eating is becoming more and more popular among athletes and can significantly impact sweat sodium loss and performance. Clean eating is characterized by eating more whole foods such as fruits, vegetables, grains and protein and less processed and refined foods. This often leads to a lower overall daily salt intake and while beneficial from a health perspective, it can have a significant impact on sodium levels in the body before a race. Since this method of eating is gaining momentum, it is often recommended to implement a sodium loading regimen before a race and follow through with a higher sodium intake during a race. After competition, the athlete returns to the normal “clean” eating daily diet again.

Sodium Loading

There has been research on sodium loading and the basic premise behind the mechanism is in the expansion of plasma volume, which is important to cardiovascular function and endurance exercise performance. Expanding plasma volume, termed hypervolemia, may reduce cardiovascular and heat strain seen with exercise, thus improving an athlete's ability to perform. While there are a few ways to increase plasma volume, sodium loading is easy to implement and has shown good results, including in warmer conditions.

Drinking fluids that provide a higher sodium concentration before exercise can create a hypervolemic response that can be somewhat preserved during exercise and can thus improve exercise tolerance in warmer conditions. This ergogenic benefit is related to the degree of pre-exercise hyponatremia but current knowledge is unclear regarding the specific mechanism, be it cardiovascular and/or thermoregulatory or something else. Interestingly, in one study (2007) in trained males, this performance enhancement after sodium loading was found with no fluid consumption during a 70% VO2max run to exhaustion. The loading phase was begun 105 minutes before exercise and were separated into smaller doses over 60 minutes.

Similar results were found in a similar study (2007) conducted in moderately trained women cyclists. Increased plasma volume was experienced which led to a reduction in thermoregulatory strain and increased exercise capacity following the same protocol as the study mentioned previously. This was a positive finding since it is believed that women may be compromised more because of the central and peripheral effects of the female sex hormones.

Sodium Consumption During a Race

The American College of Sports Medicine recommends consuming 500-700 milligrams of sodium per liter of fluid per hour of exercise while other researchers have recommended a higher range, 1700-2900 milligrams of sodium per liter of fluid per hour. There is a large discrepancy, mostly due to different losses and requirements of individual athletes. However, it has been my observation that most athletes under consume sodium during a race which typically has negative consequences. It is important to determine sodium needs during training in similar environments and intensities of competition to further pinpoint individual sodium needs.

Sodium loading has been shown to work in a laboratory setting and has been yielding good results for athletes during actual competitions. It is recommended to try this approach during more intense training that mimics similar conditions of which your race will be.