

The Science of Fluid Absorption

Key Points:

There are 3 main factors that affect absorption of fluids:

1. Volume of fluid: the more fluid ingested, the quicker one can rehydrate.
2. Simple carbohydrates will increase the speed of fluid and electrolyte absorption.
3. Osmolality, or concentration of particles (carbohydrates & electrolytes) will enhance fluid absorption rates.

The concentration of fluids and ingredients found in fluids can have a large impact on how quickly energy is delivered to working muscles, affecting performance. There are three main areas of consideration with fluid replacement that affect the speed at which the body absorbs fluids:

1. **Volume of fluid:** The amount of fluid in the stomach at any time is directly proportional to the rate of gastric emptying, or how quickly fluids leave the stomach (very little fluids and nutrients, if any, are absorbed from the stomach).¹ This means that larger volumes of fluid in the stomach will 'push' fluid out into the intestines, where it is then absorbed into the bloodstream. Consuming larger portions of fluid will increase the rate of hydration.²
2. **Energy content:** Carbohydrate is the fuel of choice for energy replacement in sport beverages.³ Glucose will enhance water and sodium absorption from the intestines into the bloodstream.⁴ Carbohydrates in fluid replacement have two divergent effects in the digestive system. Initially, carbohydrates in fluids will slow gastric emptying, however these same carbohydrate fluids will be rapidly absorbed in the small intestine.^{5,6} There is a net gain in rate of overall uptake attributed to the small intestines, which increases with the concentration of carbohydrate. Optimal carbohydrate concentrations of fluid replacement beverages are typically suggested to be 5% to 10% of volume.⁷
3. **Osmolality:** Osmolality is defined as the total concentration of solutes (dissolved particles including electrolytes and fuel sources) in a liquid medium. Similar to energy concentration, increasing osmolality will have a slight inhibitory effect on the rate at which fluids leave the stomach, but the overall increased rate of absorption in the small intestine (driven by the carbohydrate solutes in the beverage) offsets the delayed gastric emptying rate.⁸ Overall, osmolality exerts little on the total fluid balance.

Another factor that is often considered important in hydration is the type of exercise. However, contrary to popular opinion the the type of exercise has little effect on fluid absorption as long as the intensity between activities is the same. Minimal exertion-type exercise does not affect fluid absorption whereas intensities above 70% maximal exertion, fluid absorption may be slightly decreased. Taste and temperature have no perceptible effect on fluid absorption either, although they can affect the desired to drink and therefore the volume of fluid consumed which is one of three major factors in the realm of hydration and energy delivery.

The American College of Sports Medicine's position on fluid replacement suggests ingesting 30 to 60 grams of simple carbohydrate each hour, in a liquid concentration (including sodium) of 4% to 8% for optimal energy and hydration replenishment.⁹

¹ Karel L. (1948). Gastric Absorption. *Physiol. Rev.* 28: 433-450.

² Noakes TD, Rehrer NJ, Maughan RJ. The importance of volume in regulating gastric emptying. *Med Sci Sports Exerc.* 1991 Mar;23(3):307-13.

³ Von Duvillard SP, Braun WA, Markofski M, Beneke R, Leithauser R. Fluids and hydration in prolonged endurance performance. *Nutrition.* 2004 Jul-Aug;20(7-8):651-6.

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Research compiled by Dr. Jason Barker, N.D.

Dr. Jason Barker holds a doctorate in naturopathic medicine and a bachelor's degree in exercise and sport science. In addition to maintaining a private practice, Dr. Barker serves as a consultant to those in the nutraceutical and sports medicine industry. He is a published author and has lectured internationally on nutraceutical applications in medicine.

Gleukos Key Points:

Gleukos provides a 7% carbohydrate (glucose) solution for a total of 17 grams of carbohydrate per serving that includes 40 milligrams of sodium and 175 milligrams of potassium for optimal energy and fluid replenishment.