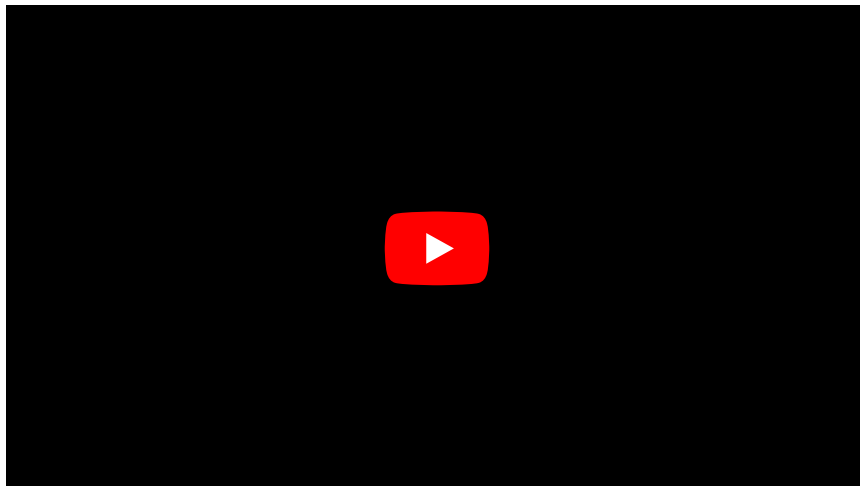
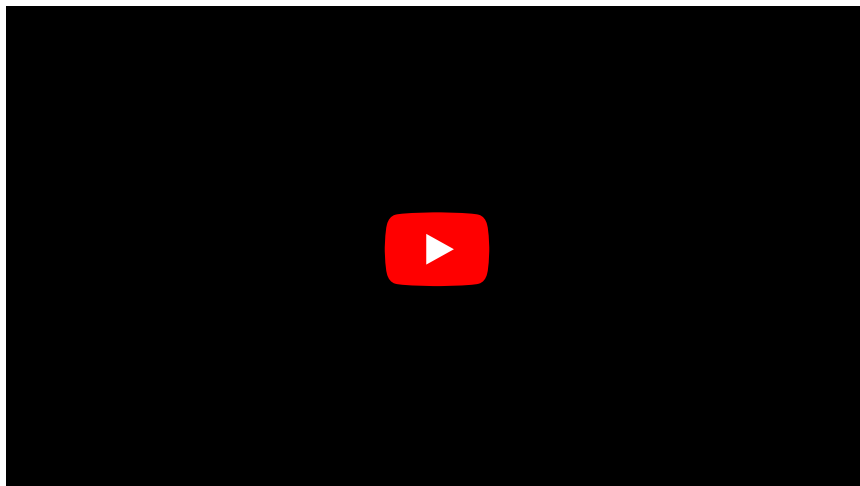


Dehydration

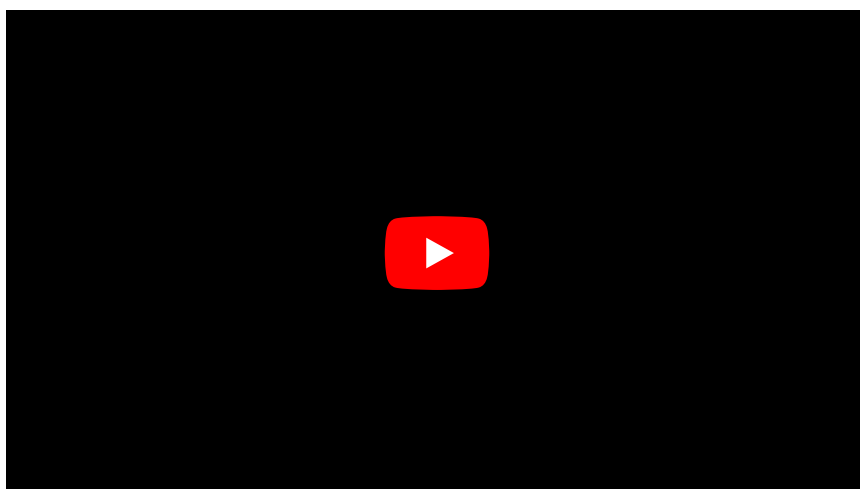
isotonic dehydration



hypotonic dehydration



hypertonic dehydration



Definition:

Dehydration is a deficiency of water. It is a state of negative fluid balance due to decreased fluid intake, increased fluid loss, or both. It is a net loss of total body water that results in a state of hypertonicity. Dehydration is further defined as a rapid loss of at least 3% of body weight that is associated with water and electrolyte disturbances. Although the term “dehydration” is often used to describe simple volume depletion of extracellular fluid, true

dehydration is distinguished by hypertonicity that is the result of water loss. Dehydration may or may not be accompanied by significant volume depletion. Some sources describe three types of dehydration, but only hypertonic dehydration is a true reflection of this definition. All types will be described in this article, with emphasis on hypertonic dehydration.

1. Isotonic dehydration: This is an equal loss of sodium and water and results in hypovolemia. Laboratory findings indicating this type of dehydration include normal serum sodium 135-145 mEq/L, serum osmolality > 290 mOsm/L, and urine osmolality > 500 mOsm. Usual causes include vomiting and diarrhea. 2. Hypotonic dehydration: This type of dehydration occurs when salt loss is greater than water loss. Laboratory findings consistent with hypotonic dehydration include serum sodium < 120 mEq/L, serum osmolality < 290 mOsm/L, and urine osmolality > 500 mOsm. Causes include diuretics, renal compromise, and diminished fluid intake. 3. Hypertonic dehydration: This occurs when water loss is greater than salt loss. Laboratory values reflecting this type of dehydration include serum sodium > 150 mEq/L, serum osmolality > 290 mOsm/L, and urine osmolality > 400 mOsm. This is caused by water deficit due to loss or insufficient intake.

Detailed pathophysiology at cellular, tissue, organ, and system levels:

Hypertonic dehydration is the deficit of total body water content due to pathological fluid losses, diminished water intake, or both. Total body water is regulated by osmoreceptors in the hypothalamus and by antidiuretic hormone (ADH). In dehydration, the water deficit or hypertonicity caused by elevated sodium levels stimulates these osmoreceptors. The osmoreceptors in turn stimulate the posterior pituitary gland to release ADH which acts on the permeability of the tubular cells of the kidneys. This results in greater reabsorption of water so that water deficit and hypertonicity is corrected and homeostasis is maintained. In isotonic dehydration and volume depletion, baroreceptors in the atria and larger blood vessels sense pressure changes and stimulate the same mechanism.

As cell membranes are mostly water soluble, water readily moves via osmosis and hydrostatic forces into and out of cells and among body compartments. When there is water loss, regulatory mechanisms as described above assist the body in compensating. The osmotic gradient also causes water to move from the intracellular space to the extracellular space to level out sodium concentration. It is important to note that in hypertonic dehydration, cells may shrink and become dehydrated as intracellular fluid shifts to correct extracellular hypertonicity. The most significant effects of this are seen in the central nervous system as brain cells shrink. There is not necessarily an actual intravascular volume deficit. A volume deficit and the associated circulatory compromise are more likely to occur with isotonic dehydration.

Genetics:

Dehydration is not genetically linked, however, some conditions that predispose individuals to dehydration may have a genetic component. Diabetes mellitus is an example.

Epidemiology:

Children under the age of 5 are at the greatest risk for experiencing dehydration. The elderly are also at increased risk. Individuals with decreased cognition or mental illness are also at risk due to potential self-care deficit. Any person with underlying diabetes is at a greater risk.

Infants and children: Infants and children are at heightened risk for dehydration due to decreased body weight and increased rate of fluid and electrolyte turnover.

Elderly: In older adults, total body water is approximately 40% - 50% of body weight compared to 60% in younger adults. A loss of 3% body weight in water is a more significant proportion in older adults. Compounding factors include decreased renal function, thirst sensation, renin activity, aldosterone secretion, urine concentration, muscle mass, and level of body fluid which may all decline with age. Decreased functional and cognitive ability can lead to immobility and self-care deficits that increase the risk of dehydration. Older adults are more likely to be taking medications that increase risk of dehydration, including diuretics, vasodilators, beta-blockers, aldosterone inhibitors, angiotensin converting enzyme inhibitors, and lithium.

People in hot climates: Heat leads to increased loss of fluids through perspiration.

Disease described:

Dehydration is a deficit of water in the body due to states or diseases that disrupt fluid balance and homeostasis.

The body can lose salt and fluids in many ways: perspiration, urination, respiration, vomiting, diarrhea, and insufficient intake of fluid. Causes include infectious diseases that cause prolonged vomiting and /or diarrhea, as in gastroenteritis. Other causes include prolonged physical activity without adequate rehydration, high altitude, hot climate, fever, shock, burns, malnutrition, diuretics, and some diseases including diabetes.

Signs & Symptoms:

Early or mild dehydration: May be asymptomatic or symptoms may include: headache, thirst, weight loss, fatigue, oliguria, concentrated urine, dry skin, sunken eyes, prolonged capillary refill time, dry mucous membranes, and decreased skin turgor, although skin turgor may not be a consistent indicator in older adults due to normal changes in skin elasticity.

Moderate to severe dehydration: The above symptoms may be accompanied by lethargy, muscle cramping, altered mental status, impaired kidney function, and oliguria progressing to anuria. Symptoms of hypovolemia may also be present including hypotension, tachycardia, decreased or weakened pulse, syncope or near-syncope, and postural

hypotension. In infants, sunken fontanelles, tearless crying, listlessness, and decreased wet diapers are signs of dehydration. As the condition becomes more severe, convulsions may occur.

Severe dehydration: Signs and symptoms of shock may be present including cyanosis, feeble pulse, profound hypotension, anuria, and decreased consciousness. This level of dehydration can quickly become fatal.

- Most signs and symptoms listed above signify volume depletion and circulatory

compromise that would most often be due to a loss of sodium and water that occurs with isotonic dehydration, rather than hypertonic dehydration. In severe hypertonic dehydration, signs and symptoms may include muscle twitching, hyperreflexia, confusion, coma, and convulsions. Neurological changes can occur due to cerebral hemorrhage. Shortness of breath and auscultation of crackles in the lungs may occur due to pulmonary edema as water moves from the intracellular space into the interstitium.

Diagnosis:

In addition to physical assessment for signs and symptoms, laboratory diagnosis may include: Increased urine osmolality Increased urine specific gravity Elevated hemoglobin and hematocrit may indicate water loss in the vascular space. Serum sodium: may be elevated in hypertonic dehydration or it may be normal or decreased in isotonic or hypotonic dehydration. Elevated serum osmolality: Due to fluid loss, extracellular fluid is hyperosmolar. High serum osmolality occurs with moderate dehydration and can become even more elevated as dehydration worsens. Elevated blood urea nitrogen and increased BUN to creatinine ratio.

Treatment:

Treatment for dehydration is determined by the isotonic, hypotonic, or hypertonic nature of the condition, the severity of the dehydration, and the individual ability to tolerate oral intake. The basic premises are to stop the fluid loss and replace what has been lost. Strict intake and output must be monitored.

If the dehydration is mild to moderate, oral rehydration with a solution that has a total osmolality of 245 mOsm/L and combines sodium with glucose for better absorption, is appropriate. The World Health Organization and the American Academy of Pediatrics recommend oral rehydration over intravenous rehydration whenever possible in children. Oral rehydration can be started immediately, spares the child pain, encourages parents to treat dehydration early, and is most often as effective as more invasive treatment.

In moderate to severe dehydration, electrolyte imbalance, and/or when oral intake is not possible, intravenous (IV) administration of appropriate fluids is the preferred treatment.

IV replacement of fluids should not be administered too quickly in hypertonic dehydration as this can cause rapid movement of water into brain cells resulting in cerebral edema, injury, and death. D5W or 0.45% saline are appropriate solutions and are given until serum sodium levels return to normal.

Providing education to patients or parents is a key in preventing future episodes of dehydration. Teaching elderly patients to drink appropriate amounts of fluid even when not triggered by thirst may be helpful. Educating on early signs and symptoms of dehydration in infants and children as well as causative factors can help empower parents to initiate early rehydration.

Links to evidence-based practice and reliable websites:

Cinahl information systems: Evidence-based care sheet: Hydration: Maintaining oral rehydration in older adults. Find at: <http://www.questushealth.com/wp-includes/handouts/Hydration.pdf>

<http://rehydrate.org/dehydration/>

Related articles:

For a detailed description of hypertonic dehydration see:

Bhave, G. & Neilson, E.G. (2011). Volume depletion versus dehydration: How understanding the difference can guide therapy. *American Journal of Kidney Disease*, 58(2), 302-309. Doi: 10.1053/j.ajkd.2011.02.395

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Spital, A. (2007). Dehydration versus volume depletion – and the importance of getting it right. *American Journal of Kidney Disease*, 49(5), 721-722. Doi: [dx.doi.org/10.1053/j.ajkd.2007.03.012](https://doi.org/10.1053/j.ajkd.2007.03.012)