FLEX CEUs

Dehydration

Introduction

The overall purpose of this course is to increase awareness of the importance of hydration and current issues that may arise in its absence. To accomplish this, this course will teach clinicians to analyze the effects of hydration on a physiological, as well as functional, level in individuals of various ages. Additionally, physical therapists and physical therapist assistants will review: (1) the importance of hydration and fluid intake; (2) different presentations of dehydration and its subsequent complications; and (3) ways in which to assess hydration as it relates to various rehabilitation settings.

Each individual will have specific needs with respect to hydration. These needs are based upon one's overall level of function and activity, pre-existing health conditions, and current health status. Overall, staying hydrated and drinking enough fluids, especially water, keeps the body functioning properly.

According to The Harvard Medical School Special Health Report 6-Week Plan for Healthy Eating, benefits to maintaining total body hydration include the following[8]:

- Carries nutrients and oxygen to your cells
- Flushes bacteria from your bladder
- Assists in digestion
- Prevents constipation
- Can assist in stabilizing hemodynamics
- Cushions joints and contributes to shock absorption
- Protect internal organs and tissues
- Regulates body temperature
- Maintains electrolyte balance for nerve conduction

While many sources claim that 4-6 cups of water each day is enough to achieve the aforementioned benefits, experts caution that certain lifestyles, medications, medical conditions, and age can affect this recommendation.[8]

What is dehydration?[2,3,5,7]

A thorough understanding of the cause(s) of dehydration and diagnosis can improve patient care and outcomes. Moreover, dehydration also impacts cognition, mental status, and patient safety which emphasizes its inclusion in all screening and examination procedures, regardless of rehabilitation setting.

Statistics on dehydration

- Recent literature estimates that about 75% of Americans are chronically dehydrated.[7] While this statistic is difficult to confirm for various reasons, it has been proven that dehydration is most common in the elderly population. Current findings report that dehydration occurs in up to 28% of older adults in the United States.[7]
- Dehydration is a common cause of hospital admissions. In addition to this, it is also a primary or secondary cause of morbidity and mortality and has been proven to complicate several existing medical conditions.

- Conversely, dehydration is not an issue that is limited to individuals who are hospitalized. In fact, a study done in the United Kingdom found that one in five people who reside in long-term care homes are either dehydrated or at risk of becoming so.[3] Dehydration is also associated with increased morbidity and mortality rates in this patient population.
- Interestingly, some experts claim that dehydration may be frequently over-diagnosed, thus, leading to inappropriate rehydration treatments that may exacerbate underlying health concerns. Despite this concern, dehydration is easy to treat and largely preventable in most situations.

Definition of dehydration

Dehydration is a clinical term that refers to a deficiency in total body water.

- However, there is no standardized medical definition of dehydration, its existence, or severity.
- Therefore, it is often inadequately diagnosed, managed, and treated as a result of the varying consensus amongst medical professionals. The fact that there is no international agreement on: (1) defining; (2) measuring; or (3) quantifying the severity of dehydration may contribute to this systemic issue.
    - Recently, the American College of Sports Medicine published a statement in which they describe dehydration as a process that will result in a physiological state of hypohydration.[3]
    - This suggests that there are two general perspectives on dehydration:
        - Dehydration is a *medical condition* that results in changes to one's total body water.
        - Dehydration is a *process* that can eventually lead to systemic changes in the body that are characterized as hypohydration.

Conversely, overhydration can occur in patients who ingest excessive amounts of fluids, resulting in an electrolyte imbalance or a failure of the renal system to compensate for higher fluid volume.

- Overhydration, resulting in excess fluid and total body volume, creates a chemical imbalance on an intracellular level.

- When the sodium concentration in the extracellular fluid is diluted from too much water, this causes water to rush from the interstitial space to the cell; thus, resulting in cellular swelling. Ultimately, this causes central nervous system dysfunction.
- Clinically, patients who are overhydrated may present with edematous extremities.

How does the body become dehydrated?

The excretion of water from the body can come from several sources including:

- Urine
- Stool
- Sweat
- Breathing

However, water can also be excreted through the kidneys and intestinal tract. When this occurs and there is not enough water to replace it, dehydration can result.

Generally, symptoms of dehydration can be observed when an individual loses about 2% of his or her total water volume.

Etiology of dehydration[7]

There are several forms of dehydration that can result from a failure to replace water loss.

1. **Isotonic dehydration** - occurs when water and sodium are both lost. This often results from vomiting, diarrhea, sweating, burns, kidney disease, hyperglycemia, or hypoaldosteronism.
2. **Hypertonic dehydration** - occurs when water loss exceeds sodium loss, causing an elevation of sodium in the interstitial fluid. Pure water loss occurs through the skin, lungs, or kidneys and is caused by fever, high respiration rate, or diabetes insipidus.
3. **Hypotonic dehydration** - occurs when sodium loss exceeds water loss, causing dilution of the interstitial fluid. This condition mostly results from taking prescription diuretics.

Each type of dehydration has the potential to cause catastrophic effects on the body and its overall function.

The following medical conditions described in Table 1.1 may arise as a result of water loss from specific areas of the body.

Table 1.1 Common causes of water loss by body part

	CAUSED BY
Water loss from the skin	Heat Exercise Burns Severe skin diseases
Water loss from the kidneys	Prescription medications like diuretics Acute and chronic renal disease Post-obstructive diuresis Salt-wasting tubular disease Addison disease Hypoaldosteronism Hyperglycemia
Water loss from the Gastrointestinal tract	Vomiting Diarrhea Laxatives Fistulas
Intra-abdominal losses	Pancreatitis New ascites Peritonitis

Systemic effects that may result from excess water loss include:

- Altered mental status
- Change to mobility
- Impaired thirst mechanism
- Drug-induced coma

Lastly, dehydration can potentially exacerbate the following medical conditions:

- Sepsis
- Hyperthyroidism
- Medication side effects
- Asthma
- Chronic obstructive pulmonary disease (COPD)

Pathophysiology of dehydration

The body's total volume of water is carefully regulated, despite accounting for 50-70% of total body mass.[5]

- Euhydration is defined as a body mass between ±0.2% in normal-temperature environments and ±0.5% of normal in hot climates or during exercise.[5]
- Hyper- or hypohydration occurs above or below these limits, respectively.

It is important to realize that both large reductions and increases in total body water can lead to adverse medical conditions.

- When combined with ambient temperature and/or humidity, hypohydration can result in heat syncope secondary to changes in hemodynamics within the body and brain.
- Heat exhaustion can also occur due to global fatigue and hypotension.

Water plays a key role in maintaining and contributing to multiple physiological functions within the brain and body.

- On a cellular level, ⅔ of the body's total volume of water is intracellular while the remaining ⅓ is extracellular. ⅕ of the extracellular volume is intravascular.

The process to maintain the body's total volume of water is intricate and extremely complex. Using the following mechanisms, the body is able to regulate total fluid volume and sodium and water concentration in the body.

- Water regulation begins in the brain through osmoreceptors that detect dehydration. When the osmoresceptors are triggered, the thirst center, which is located in the hypothalamus, is stimulated to encourage water/fluid ingestion.
- Osmoreceptors also function to conserve water in the kidneys. When the hypothalamus detects low amounts of water in the body, it triggers the pituitary gland to release antidiuretic hormone (ADH) that stimulates the kidney to reabsorb more water.
- Be aware that hypotension is often seen tangentially with dehydration. This is because, under these circumstances, renin is secreted from the kidneys, which converts angiotensin I to II and encourages the release of aldosterone from the adrenal glands. Aldosterone functions to increase absorption of sodium and water from the kidney, thus, increasing the blood pressure and total body volume.

Effects of dehydration by population

Children and adolescents[2]

- Children and adolescents are more vulnerable to dehydration and their secondary effects due to differences in body-cooling mechanisms and thirst sensations when compared to adults.
- Acute cases of dehydration in children may directly result from gastroenteritis, diarrhea, or vomiting and may be responsible for a large percentage of annual pediatric emergency room visits.
- Sometimes, young children who are not able to fully communicate their emotions, feelings, or problems will exhibit minimal, if any, cognitive signs of dehydration. Therefore, clinicians who work with pediatric populations may need to rely upon observational signs of dehydration like decreased physical activity, drowsiness, or sleepiness.
- In older children and adolescents, fluid intake is strongly correlated with high levels of cognition. Those who drink less than the recommended daily amount of

water may exhibit poorer cognitive performance than those who habitually meet daily recommendations for fluid intake.

Athletes and highly active individuals[4]

- There are many resources dedicated towards describing dehydration and its effects in an athletic and active population. In particular, several sources reiterate the definition of dehydration as a "loss of body fluids" when accompanied by elevations in core body temperature, thus, creating an environment in which the body experiences dehydration and concomitant core hyperthermia.
- Dehydration can have a substantial impact on cardiovascular function and aerobic performance. This scenario becomes concerning when the athlete or individual is engaged in prolonged submaximal exercise in hot climates, which can directly affect heart rate, peripheral resistance, blood volume, mean arterial pressure, cardiac output, and cerebral blood flow. Clinicians should be aware that these hemodynamic changes can be prevented with frequent rehydration and should encourage fluid replacement when working with athletes under these circumstances.
    - Some heat-related illnesses warrant immediate medical attention and fluid replacement.
    - Types of heat-related illnesses include heat stroke, heat exhaustion, heat syncope, and heat cramps.
        - A heat stroke is the most serious heat-related illness in which the body is unable to control its core temperature. This results in a rapid temperature elevation when the body's natural sweat mechanisms fail and the body is unable to regulate its own temperature. Individuals with heat stroke may present with confusion, changes to mental status, slurred speech, dry skin or profuse sweating, body temperatures greater than 104°F (40°C). Heat stroke requires immediate medical attention.[9]
        - Heat exhaustion refers to the body's response to a large loss in water and salt, typically due to profuse sweating. Signs and symptoms of heat exhaustion include headache, nausea, dizziness, weakness, irritability, and mild increases in body temperature.

Individuals suffering from heat exhaustion should be encouraged to take frequent sips of cool water.[9]

- Generally speaking, dehydration has systemic effects and is associated with reduced plasma, interstitial, and intracellular volume in individuals who exercise for long periods of time without rehydrating. Over time, these changes can result in gradual reductions in total fluid volume that have devastating effects on thermoregulation and overall cardiovascular function. Specific changes to systemic blood flow alters mean arterial pressure which may result in core hyperthermia and physiological strain in individuals who are actively engaging in exercise.

Geriatrics[1,2,3,8]

- The importance and role of hydration has been well-described in older adults. Unfortunately, dehydration is one of the most frequent causes of hospitalization in this population. Additionally, there is extensive literature illustrating the incidence of mental confusion, irritability, and sleepiness leading to delirium and dehydration in elderly individuals.
- This age group is particularly susceptible to the effects of dehydration associated with age-related physiological changes and subsequent functional decline. Such characteristics include decreased perception of thirst, diminished thirst response, and a decline in renal responsiveness to dehydration that was described earlier in the course. Other age-related changes that are correlated with dehydration are associated with changes in adipose tissue and total muscle mass.
- Clinicians should be aware that older individuals are at a heightened risk for dehydration with severe health consequences. Primary and secondary effects that may result from dehydration in community-dwelling older adults might include:
    - Reduced participation in social outings
    - Loss of opportunities to socialize
    - Isolation from others
    - Anxiety regarding location of toilets
    - Fears surrounding incontinence

    - Limited mobility

- Frighteningly, the prevalence of dehydration is estimated to be ⅓ of frail and vulnerable adults in addition to those who rely upon others for self-care tasks, like meal preparation.

    - Emphasis should be placed on providing and offering adequate amounts of protein, nutrients, and fluids to meet this population's nutritional requirements. Food and fluid intake should aim to maintain or improve current nutritional and function status.

    - Clinicians should understand the strong correlation between nutritional wellness and patients' capacity for daily function, exercise, and quality of life. Therefore, when appropriate, clinicians should include nutritional counseling or provide the appropriate referrals to optimize patients' functional status and ensure the best possible quality of life.

- In this age group, clinicians should routinely screen for malnutrition and dehydration. Such screens should be performed in all individuals, regardless of diagnosis or clinic setting. Furthermore, because many older individuals seen in rehabilitation settings have dietary restrictions due to functional or cognitive limitations, physical therapists and physical therapy assistants should provide support that enhances positioning, comfort, and accessibility during meals and snack times.

Personal reflection question

In long-term care facilities, checking a patient's fluid restriction or swallowing abilities is easily confirmed with nearby staff or a speech-language pathologist. However, this action may not readily be available, thus, posing as a potential barrier to ensuring the fluid needs of patients in this setting.

As a clinician in the outpatient or community setting, how can you remedy this situation? What policies might you need to put in place in order to remind yourself, as well as other colleagues, to screen for special dietary restrictions?

Gender differences[2]

- According to recent literature, women may be slightly more sensitive to the effects of dehydration than men and experience a quicker onset of symptoms.

- While there are minimal differences in cognitive performance between the two genders, women may be more susceptible to changes in mood, fatigue, headaches, and concentration problems.

Correlation between dehydration and brain health[2,7]

- The correlation between dehydration and brain functioning has been well documented, particularly in elderly and pediatric populations.
- These populations may not be able to manage the effects of dehydration due to age-related changes or limited cognitive reserves (specifically in developing brains) to overcome the effects of dehydration. Moreover, cognitive demands, as seen in school settings, may be heightened for young children and, thus, the effects of dehydration on performance would most likely be more evident.
- Interestingly, studies have not been able to associate detrimental effects of dehydration on cognitive performance in adults or adolescents. Despite this, these individuals will still report confusion, changes to alertness, and mood swings when dehydrated.
- It should be noted that changes in brain function are age-dependent in individuals with mild levels of dehydration. Cognitive impairments in attention, memory, and executive function have been observed in school-aged children. However, research has also found changes in mood, quality of life, and cognitive delay in adults with mild dehydration.

Signs and symptoms of dehydration[3,7]

As discussed previously, maintaining one's fluid volume involves a complex system of mechanisms. In addition to this, blood volume is closely correlated with the regulation of water intake, which makes differential diagnosis of causative factors for dehydration challenging for clinicians.

- Dehydration can present with a wide array of signs and symptoms along with various clinical findings. Some of the most common signs/symptoms include:
    - Fatigue
    - Thirst
    - Dry skin and lips
    - Dark urine or decreased urine output
    - Headaches
    - Muscle cramps
    - Lightheadedness
    - Dizziness
    - Syncope
    - Orthostatic hypotension

    - Heart palpitations
    - Changes in vital signs*

      **Clinicians should realize that hypotension may not appear until severe dehydration is present. Along with hypotension, patients with severe dehydration may also present with tachycardia, fever, and tachypnea.*

- Past medical history may also be a telltale sign that a patient is at a heightened risk for dehydration. Uncontrolled medical conditions may affect the patient's ability to exercise, tolerate heat and humid environments, process medications, or recover from illness. Such factors will indefinitely increase one's risk for dehydration.
    - Hemorrhage, polyuria, vomiting, emesis, drug-induced diuresis, or poor fluid intake can cause dehydration.
    - Clinicians should be aware that the aforementioned conditions may also produce different effects on various individuals that may or may not result in dehydration. Therefore, physical therapists and physical therapy assistants should understand that any of these health concerns will warrant an immediate comprehensive evaluation to inform the most appropriate treatment.
- In cases of severe dehydration, patients may appear to be obtunded or lethargic.

Assessing hydration status[3,7]

While physical therapists and physical therapy assistants are not responsible for assessing hydration status, they should be familiar with the signs and symptoms that may warrant a medical assessment in patients who are currently undergoing rehabilitation. This knowledge is applicable across the continuum of care with all patient presentations.

- A physician assessment with a physical examination is the standard for diagnosing dehydration.
    - Upon the examination, the patient with dehydration may present with:
        - Dry mucous membranes

        - Poor skin turgor
        - Delayed capillary refill
        - Cracked lips
    - Patient reported symptoms may include:
        - Dizziness
        - Thirst
        - Altered mental status
        - Fatigue
        - Changes in appetite

    The physician will determine the most appropriate course of action based upon the patient's medical history, clinical examination, current medication list, clinical monitoring, and laboratory findings.

- When correlated appropriately with the physician assessment and the physical examination, the following factors may indicate urgent fluid rehydration is needed:
    - Systolic blood pressure is less than 100 mmHg
    - Heart rate greater than 90 beats per minute
    - Capillary refill time greater than 2 seconds
    - Respiratory rate greater than 20 breaths per minute
- There is no test that is considered to be the gold standard to diagnose dehydration.
    - Serum and plasma osmolality tests may be used to confirm diagnosis but will also be affected by the type of fluid lost or the acuity of the fluid loss.
    - Any weight loss equal to or greater than 3% over 7 days may also indicate dehydration.[7]
    - Research has not found significant criteria using bioelectrical impedance analysis, urine specific gravity, the osmolality of urine, saliva or tears, tear

volume, number of urine voids, and urine volume to diagnose dehydration in the older population.

- Blood tests show promise but should always be taken in consideration with other clinical findings. Blood urea nitrogen (BUN) to creatinine ratio should be higher than 10:1, but this finding is also correlated with high BUN and low creatinine output commonly seen in upper gastrointestinal bleeding.
- Urine tests can suggest the presence of dehydration secondary to volume depletion. However, these tests may also be abnormal in patients with heart failure, cirrhosis, nephrotic syndrome, and other kidney diseases.
- Other changes in total body fluid volume can be detected through ultrasound, especially in the presence of liver cirrhosis, chronic heart conditions, and mechanical ventilation.

Treatment for dehydration[6,7]

- The gold standard of treatment for dehydration is rapid fluid replacement to restore total fluid volume.
    - Blood pressure, heart rate, blood lactate, hematocrit, and urine output will be closely monitored and assessed to determine the patient's response to fluids.
    - The severity and criticality of the patient's condition will affect treatment type and administration of rapid fluid replacement for dehydration.
    - Children may require unique fluid combinations that include electrolytes. Water, milk, soda, juice, and sports drinks are usually avoided as they do not contain the optimal mixture of water and electrolytes. In some cases, an oral rehydration solution may be indicated, especially if the child has become dehydrated from diarrhea, vomiting, or fever.
    - Infants and babies may require breast milk or oral rehydration solutions.
- Secondary treatment goals are aimed towards identifying the cause of fluid loss.
    - Certain medical conditions, like heart and kidney dysfunction, require a careful approach to treatment and assessment.

        - Certain age groups, like older individuals, may also require additional assessments or evaluations to determine the presence of a multifactorial cause of the dehydration.

- Special considerations

    - For adults with mild to moderate dehydration from diarrhea, vomiting, or fever, their condition may improve by drinking water or diluted juice. Conversely, diarrhea can be worsened by ingesting fruit juice and soft drinks.

    - Individuals who exercise or work outdoors should be encouraged to drink cool water during hot or humid weather in order to reduce the risk of dehydration. Sports drinks containing electrolytes and a carbohydrate solution also may be warranted.

    - Individuals, regardless of age, who are severely dehydrated should be treated in a hospital as they may require timely interventions to lower the risk of negative outcomes.

Complications arising from dehydration

Common complications from dehydration include:

- Inadequate fluid replacement
    - Altered mental status
    - Renal failure
    - Liver shock
    - Lactic acidosis
    - Hypotension
    - Other organ failures
- Excessive fluid replacement causing peripheral edema and pulmonary edema
- Electrolyte imbalance
    - Uremia

- Hyponatremia
- Hypernatremia
- Hypokalemia
- Hyperkalemia
- Metabolic acidosis
- Metabolic alkalosis

Dehydration and exercise[5]

- What happens during exercise?
    - During exercise, increased metabolic heat production leads to increased core temperature. In response to this, the body attempts to initiate cooling to limit an excessive rise in core temperature. This process may, at times, result in fluid loss as the body sweats as part of the cooling process.
    - Hypohydration can result when fluid intake is less than fluid loss. This is commonly seen towards the ends of physical activity. In many situations, post-exercise rehydration is encouraged and required to restore homeostasis and fluid balance.
- Current guidelines recommend structured rehydration intervals if the time between exercise sessions is brief (less than 24 hours) or hypohydration exceeds 5% of the individual's total body mass.
    - Water balance can be restored by having the athlete drink a volume greater than that which was lost during exercise. This roughly correlates with 1.5 liters for every 1 liter of fluid loss during exercise.[5]
    - Athletes should be encouraged to replenish water loss with a low-sodium drink or electrolyte drink to avoid large reductions in plasma sodium levels.
    - Ingesting plain water is not enough to maintain fluid balance during exercise and recovery since this encourages significant changes in plasma sodium levels, ultimately leading to diuresis.
- Interestingly, studies have suggested that many athletes begin exercise in a hypohydrated state, which exacerbates symptoms of fluid loss during

competition. Athletes who continue to exercise in a hypohydrated state will eventually experience changes in performance, especially if the activity period is prolonged or occurs within a hot/humid environment. Some literature states that athletes who play while in a hypohydrated state can suffer changes to performance as soon as fluid loss exceeds 2% of total body mass.

- Role of post-exercise drinks
    - Athletes should be encouraged to ingest drinks with low sodium or electrolytes to avoid large changes in plasma osmolarity. This can also replenish sodium lost through sweat.
    - Post-exercise rehydration should be promoted in order to rehydrate and replenish the volume of fluid lost. Rehydration is most effective when the volume of fluid ingested is greater than the amount of fluid lost.
    - Large volumes of immediate post-exercise hydration should be discouraged as intake should occur over a period of several hours post-activity.

Effects of alcohol, tea, and coffee[8]

- Alcohol, tea, and coffee are well-known diuretics. Ingestion of drinks containing alcohol should be avoided before, during, and after exercise.
- Drinks with high sugar content, like coffee creamer and sugar, can contribute to weight gain and systemic inflammation. They also increase your risk for developing chronic diseases, like diabetes.
- Avoid drinks with caffeine, especially later in the day, as this is known to have a dehydrating effect and act like a diuretic. Additionally, drinks with caffeine, such as some teas and coffee, are stimulants that may affect sleeping patterns.
- For other health reasons, alcohol intake should be limited to one drink per day for women and 1-2 drinks per day for men.

Physical Therapy Implications[2,7]

Because water intake is not usually considered to be a high priority during the average physical therapy visit, it is often overlooked in regards to clinical care. Clinicians should aim to change this practice by encouraging patients' healthy lifestyle choices, including daily hydration, as this has been proven to lead to decreased morbidity, mortality, and complications associated with dehydration.

- Physical therapists and physical therapy assistants should take initiative to increase the attitude towards hydration amongst staff and colleagues.
- Therapists and assistants should provide formal patient education strategies on the signs and symptoms of dehydration, especially during moderate-to-high intensity exercise.
- Physical therapists and physical therapy assistants should understand that dehydration plays a significant role in performance, mental capacity, and patient safety. Performance can be significantly altered in times of prolonged physical activity without hydration or hot/humid environments. Research has shown that, in healthy adults only, dehydration in the absence of underlying medical conditions will not significantly impact performance.
- It is important for clinicians to offer and encourage rehydration before, during, and after rehabilitation. This is to ensure that patients do not begin to exercise in a hypohydrated state that may place them at risk for changes in performance, mental status, injury, or fall risk.

- Physical therapists and physical therapy assistants should be aware that there is no standardized physical therapy assessment or treatment for dehydration because it is a medical condition that requires physician attention. Instead, clinicians should utilize patient education strategies to influence the appropriate hydration status for each patient.
- Clinicians should realize that patients who begin exercise while in a hydrated state will have the lowest risk for developing dehydration during activity. Although fluid loss during exercise is normal, it is most likely restored through normal water and food ingestion following cessation of exercise. Rehydration should only be encouraged with large amounts of fluid loss, prolonged periods of exercise, and shortened recovery points.
- When rehydration is necessary, physical therapists and physical therapy assistants should encourage ingestion of fluids over an extended period of time as opposed to a brief period immediately following activity.
- Ensuring that patients remain hydrated is a responsibility that falls to every member of the healthcare team. Avoid taking a generalized “one-size-fits-all” approach to patients and their hydration needs and encourage patients to seek guidance from their physician, especially if they are taking medications that enhance fluid loss, like diuretics. Some pain medications, antidepressants, and non-steroidal anti-inflammatory drugs encourage fluid retention, which may be a contraindication for additional fluids. Additionally, patients with certain medical conditions (e.g., thyroid, liver, kidney, or heart disease) may have fluid restrictions to avoid aggravation of their health conditions.

Conclusion

This course has highlighted the importance of hydration and potential effects of dehydration on physical therapy. As reiterated throughout the course, ensuring the health and safety of the patients falls to every healthcare professional. This includes ensuring that patients' nutritional and fluid needs are appropriate and met. When in question, contact the patient's primary physician to confirm or discuss signs or symptoms of dehydration that may be developing in your patient. Remember that certain populations, like older adults and children, are particularly vulnerable to the secondary effects of dehydration. When in doubt, refer accordingly and follow-up to ensure transfer of care.

Key Words

Hydration - refers to the process of replacing water in the body

Dehydration - a clinical term that refers to a deficiency in total body water. May also be referred to as a process that will result in a physiological state of hypohydration.

Total body hydration - refers to the total amount of fluid in the human body

Hemodynamics - refers to basic measures of cardiovascular function, such as arterial pressure or cardiac output

Electrolyte balance - refers to the balance of minerals within the body that balance water levels, move nutrients into cells, and remove wasteful products

Isotonic dehydration - occurs when water and sodium are both lost from the body. This often results from vomiting, diarrhea, sweating, burns, kidney disease, hyperglycemia, or hypoaldosteronism.

Hypertonic dehydration - occurs when water loss exceeds sodium loss, causing an elevation of sodium in the interstitial fluid. Pure water loss occurs through the skin, lungs, or kidneys and is caused by fever, high respiration rate, or diabetes insipidus.

Hypotonic dehydration - occurs when sodium loss exceeds water loss, causing dilution of the interstitial fluid. This condition mostly results from taking prescription diuretics.

Euhydration - a body mass between ±0.2% in normal-temperature environments and ±0.5% of normal in hot climates or during exercise

Hyperhydration - a body mass higher than 0.2% in normal-temperature environments and greater than 0.5% of normal in hot climates or during exercise

Hypohydration - a body mass below 0.2% in normal-temperature environments and less than 0.5% of normal in hot climates or during exercise

Heat syncope - a mild form of heat illness that results from physical exertion in hot or humid environments. It can result in dizziness or fainting as a result from overheating.

Heat exhaustion - a heat-related illness that occurs after exposure to high temperatures

Osmoreceptors - sensory receptors that detect changes in osmotic pressure and contribute to fluid balances in the body

Core hyperthermia - refers to a condition in which the individual's core body temperature is elated beyond normal due to failure of normal thermoregulation

Hypovolemia - a decrease in the volume of blood in your body

Diuretics - refer to a family of fluids that function to rid the body of salt and water

Summary

- Clinicians should understand that patients will have specific hydration needs that are based upon level function and activity, pre-existing health conditions, and current health status. To keep the body functioning properly, patients should be encouraged to remain hydrated and ingest the proper amount of fluids to meet their body's needs.
- Sources recommend 4-6 cups of water each day, but experts caution that certain lifestyles, medications, medical conditions, and age can affect this recommendation.
- Dehydration is a clinical term that refers to a deficiency in total body water, but there is no standardization when it comes to its definition, existence, or severity.
- Dehydration can result in various signs and symptoms including fatigue, thirst, dry lips, dark urine, headaches, muscle cramps, lightheadedness, dizziness, and many others.
- Water loss from different parts of the body, such as the skin, kidneys, and gastrointestinal tract can contribute to dehydration. Effects may be felt when total fluid volume in the body drops more than 2%.
- Total water volume in the body is carefully regulated and extremely sensitive to changes. Because of its complex mechanisms, dehydration can affect mental performance, blood pressure, body temperature, and brain health.
- Dehydration is diagnosed by a physician, following a thorough physical examination that correlates with the patient's medical history, clinical examination, current medication list, clinical monitoring, and laboratory findings. Unfortunately, there is no test that is considered to be the gold standard to diagnose dehydration.
- Treatment for dehydration largely consists of rapid fluid replacement to restore total fluid volume.
- In physical therapy practice, clinicians should include questions regarding patients' healthy lifestyle choices, including daily hydration, as this has been proven to lead to decreased morbidity, mortality, and complications associated with dehydration. Furthermore, physical therapists and physical therapy assistants should understand that dehydration plays a significant role in performance, mental capacity, and patient safety. Performance can be

significantly altered in times of prolonged physical activity, especially in those who are hypohydrated at baseline or in hot/humid environments.

- It is important for clinicians to offer and encourage rehydration before, during, and after rehabilitation. This is to ensure that patients do not begin to exercise in a hypohydrated state that may place them at risk for changes in performance, mental status, injury, or fall risk. On the other hand, some pain medications, antidepressants, and non-steroidal anti-inflammatory drugs encourage fluid retention, which may be a contraindication for additional fluids. Additionally, patients with certain medical conditions (e.g., thyroid, liver, kidney, or heart disease) may have fluid restrictions to avoid aggravation of their health conditions. In these situations, clinicians are encouraged to contact the patient's primary care provider to confirm how to proceed so as to not cause harm to the patient's wellbeing.

Case study

Unexpectedly, the air conditioning in your clinic stopped working during a hot week in August. While walking back to the office, you notice that one of the women in the waiting room appears to be slumped over as her companion is fanning her. The companion appears to be worried and states that she thinks "[her] friend is having a "heat stroke."

The patient is a 40-year old woman who is reporting fatigue, generalized dizziness, and a dull headache. She denies being thirsty and is wearing a thin cotton shirt with loose shorts. The patient does not appear to be physically harmed or injured and had just finished her physical therapy session with a different therapist. The other therapist stated that the patient was well hydrated throughout the session but did notice increased peripheral edema in the lower extremities that was not present before today.

Physical exam findings are as follows:

Test and measure	Finding
Level of Responsiveness (LOR)	Alert and oriented x4
Heart rate	90 beats per minute, strong
Respiratory rate	20 breaths, easy to breathe

Temperature	100°F

Discussion on differential diagnosis

1. *Heat stroke* - The patient's temperature and level of responsiveness presently rule this out
2. *Dehydration* associated with the heat - The patient's lack of thirst and history of water intake during her PT session negate this hypothesis
3. *Overhydration*/electrolyte imbalance - Consistent water intake, peripheral edema, and level of responsiveness may indicate overhydration.

Considerations

- The overlap of vague, non-distinguishing symptoms can make differentiating overhydration/electrolyte imbalance from dehydration, heat exhaustion, or heat stroke challenging. Clinicians should be aware that heat stroke is typically accompanied by a fever greater than 104°F (40°C). In this case, the patient's temperature is slightly higher than usual but not majorly concerning. Altered mental status is another key sign of heat stroke or serious cases of overhydration/electrolyte imbalance.
- Sometimes, overhydration/electrolyte imbalance can be misdiagnosed as dehydration or heat exhaustion, which will lead to fluid replenishing treatments that can exacerbate the overhydration/electrolyte imbalance. Therefore, it is imperative that patients be seen by a medical professional who is capable of performing additional testing to confirm or refute potential diagnoses.
- Clinicians should be aware of various differential diagnoses when faced with heat-related illnesses as not all signs and symptoms are indicative of dehydration.

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