Current Perspectives on Benefits of Adequate Hydration for Healthy Outcomes

Bob Murray, PhD, FACSM
Sports Science Insights, LLC
Crystal Lake, IL
Pee Your Way to a Healthy Day

Bob Murray, PhD, FACSM
Sports Science Insights, LLC
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DISCLOSURE

Consultant
- Aegis Sciences Corporation
- The Coca Cola Company
- Edelman Public Relations
- GlaxoSmithKline
- New Chapter
- Nike
At the end of this session, the participant will be able to...

1. Make practical hydration-related recommendations that are consistent with a healthy lifestyle.

2. Summarize the current research on how proper hydration might positively influence acute conditions and chronic diseases.
In conclusion ...

- It is always better to be well hydrated than dehydrated (or hyperhydrated.)
- Both extremes of the hydration continuum can be deadly.
  - Dehydration
  - Hyponatremia
- The current US IOM AI values for daily fluid intake are a good starting point for creating hydration recommendations.
  - Adult females: 2.7 L/d
  - Adult males: 3.7 L/d
- The science related to hydration and disease is suggestive of benefits for some acute and chronic conditions, but is not conclusive.
- With minimal risks and potentially plentiful benefits, we should recommend that people drink enough each day to avoid dehydration.
Hydration is in the news.
Hydration is in the news.

“Drink just one more glass of water a day and you can make a real difference for your health, your energy, and the way you feel.”

Michelle Obama
September 2013
Hydration is in the news.

The Centers for Disease Control and Prevention estimates that 43 percent of adults drink fewer than four cups of water each day, and 7 percent don't drink any at all. The AP, on the other hand, notes a boost in overall water consumption.
“There really isn’t data to support this,” said Dr. Stanley Goldfarb of the University of Pennsylvania. “I think, unfortunately, frankly, they’re not basing this on really hard science. It’s not a very scientific approach they’ve taken. … To make it a major public health effort, I think I would say it’s bizarre.”
Hydration-disease tough to study.

- Few good studies
- Long-term studies needed
- Large n needed
- Tough to assess fluid intake
- Compliance difficult to monitor
- Hydration status constantly changes
- Hydration difficult to measure
- Daily fluid requirements vary widely
- Diseases are multi-factorial
- Many differences among diseases

No doubt hydration is important.
We are constantly leaking.

<table>
<thead>
<tr>
<th><strong>IN</strong></th>
<th><strong>OUT</strong></th>
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</thead>
<tbody>
<tr>
<td>Beverages and foods (water + salt)</td>
<td>Respiration (water)</td>
</tr>
<tr>
<td>Water from metabolism (water)</td>
<td>Transpiration (water)</td>
</tr>
<tr>
<td></td>
<td>Saliva (water + salt)</td>
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<td>Sweat (water + salt)</td>
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<td>Feces (water + salt)</td>
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<td>Metabolism (water)</td>
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<td>Lactation (water + salt)</td>
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<td>Menstruation (water + salt)</td>
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What is the evidence?
What is the evidence?

- Spotty evidence for hydration-disease link.
- But does lack of evidence mean lack of association?
- Hydration is central to all physiological functions.

With little risk and many potential (but unsubstantiated) benefits ... Why not recommend more drinking?
What is the current thinking?

European Food Safety Authority
2.0 L/d female, 2.5 L/d male

Adequate Intake (AI)

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The daily variation is huge.

< 2 L/d

> 20 L/d
The daily variation is huge.

Water is the largest single constituent of the human body and is essential for cellular homeostasis and life. Total water intake includes drinking water, water in beverages, and water that is part of food. Although a low intake of total water has been associated with some chronic diseases, this evidence is insufficient to establish water intake recommendations as a means to reduce the risk of chronic diseases. Instead, an Adequate Intake (AI) for total water is set to prevent deleterious, primarily acute, effects of dehydration, which include metabolic and functional abnormalities.

Approximately 19 percent of total water intake. Canadian survey data indicated somewhat lower levels of total water intake. As with AIs for other nutrients, for a healthy person, daily consumption below the AI may not confer additional risk because a wide range of intakes is compatible with normal hydration. In this setting, the AI should not be interpreted as a specific requirement. Higher intakes of total water will be required for those who are physically active or who are exposed to hot environments.
What is the current thinking?

CONDITIONS WITH (POSSIBLE) LINKS TO HYDRATION

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## Death can be serious.

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Extremes of hydration can be deadly.

Hypohydration

Hyperhydration
1. Hypohydration & heat tolerance
2. Hyperhydration risks
3. Kidney stones
4. Practical recommendations
Coming up ...

1. Hypohydration & heat tolerance
2. Hyperhydration risks
3. Kidney stones
4. Practical recommendations
Dehydration + heat = cardiovascular stress
Dehydration + heat = greatest risk

U.S. weather fatalities per year

- HEAT-RELATED
- COLD/WINTER
- FLOOD
- TORNADO
- HURRICANE
- LIGHTNING

Average fatalities over 22-year period (1988-2010)
Dehydration + heat = greatest risk

Dehydration is a risk factor.

- Not heat directly
- Not dehydration directly
- Combination → deadly CV stress
Dehydration increases the risk of heat illness.
Dehydration impairs function.

**INCREASED**
- Incidence of gi discomfort
- Plasma osmolality
- Blood viscosity
- Heart rate
- Resting core temperature
- Skin temperature
- Brain temperature
- Core temp at which sweating begins
- Core temp at which skin blood flow increases
- Core temp at a given VO\textsubscript{2}
- Carbohydrate oxidation
- Muscle & liver glycogenolysis
- Thermal discomfort

**DECREASED**
- Plasma volume
- Blood flow to internal organs
- Central blood volume
- Central venous pressure
- Cardiac filling pressure
- Stroke volume
- Cardiac output
- Skin blood flow at a given core temp
- Maximal skin blood flow
- Muscle blood flow
- Sweat rate at a given core temp
- Maximal sweat rate
- Glycogen synthesis in muscle & liver
- Physical & mental performance
Regular physical activity improves function.
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- Enhanced endothelial regeneration
- Angiogenesis
- Healthy inflammatory response
- Greater neuroplasticity
- Enhanced neurogenesis
- Reduced plasma triglycerides
- Lower blood pressure
- Autophagy & apoptosis
- Improved glucose metabolism
- Increased RMR
- Muscle regeneration
- Greater muscle strength
- Increased LBM
- Better bone health

All-cause mortality
Cardiovascular disease
Hypertension
Stroke
Metabolic syndrome
Type 2 diabetes
Breast cancer
Colon cancer
Depression
Falls
Post-surgery survival
Quality of life
Life expectancy

Hydration supports physical activity.

Exercise capacity improved
Exercise feels easier
Heart rate is lower
Recovery is faster
1. Hypohydration & heat tolerance
2. Hyperhydration risks
3. Kidney stones
4. Practical recommendations
Too much of a good thing is a bad thing.

- Bladder lesions - the bursting bladder
- Hyponatremia - abnormally low blood sodium concentration
  - Psychogenic polydipsia
  - Forced drinking
  - Exercise-associated hyponatremia
  - Clinical hyponatremia
  - Recreational over-drinking
Example 1

“... a healthy 40-year-old woman consumed 3 L of tap water during 3 hours to hasten micturation for a urine drug test, and developed severe hyponatremia ([Na] = 121 mEq/L).”

- January 2007 -
Woman Dies After Holding Wee for a Wii

Jennifer Strange, mother of 3, dead at 28
Coming up ...

1. Hypohydration & heat tolerance
2. Hyperhydration risks
3. Kidney stones
4. Practical recommendations
Hydration reduces risk of kidney stones.

- Increased daily fluid intake
- Higher urine output
- Less risk of stones
Kidney stones: hydration is just one factor

- Sex
- Age
- Genetics
- Diet
- Stone type
- Medications
- Dietary supplements
- Obesity
- Hydration status
Coming up ...

1. Hypohydration & heat tolerance
2. Hyperhydration risks
3. Kidney stones
4. Practical recommendations
There is no “normal” hydration status.

Over-hydrated

DEHYDRATED

Dehydrated

± 0.2% BW
Dehydration should be brief and self-limiting.

- ✓ Thirst-driven drinking (osmotic- and volume-driven)
- ✓ Spontaneous drinking (meals, meetings, parties)
- ✓ Easy availability of water & beverages
Dehydration is common.
Dehydration is common.

✓ School children
✓ Older adults
✓ Athletes
✓ Workers
✓ Soldiers
✓ Warm weather
Hydration affects quality of life.

✓ Gastrointestinal function
✓ Constipation
✓ Frequency of urination
✓ Incontinence
✓ Medications
✓ Mental acuity
✓ Hospital admissions


Regularly replace lost fluid.

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L/d indicates liters per day.
Keep an eye on hydration status.

How?
Hydration status is difficult to monitor.

- Isotope dilution
- Neutron activation
- Bioelectrical impedance
- Body weight
- Plasma osmolality
- Urine osmolality
- Urine specific gravity
- Urine color
- Urine conductivity
- 24-h urine volume
- Salivary flow
- Ratings of thirst

Practical recommendations

### Pee Chart

- **Hydrated**
- **Dehydrated**

#### How thirsty are you?

- Extremely
- Very
- Somewhat
- Slightly
- Not at all

#### Hydration guidelines

- Drink 8 oz after waking
- Drink 12 oz at breakfast
- Drink 8 oz before lunch
- Drink 12 oz at lunch
- Drink 8 oz before dinner
- Drink 12 oz at dinner
- Drink 8 oz before bed

#### Morning body weight

#### Urine specific gravity (or color)

#### Rating of thirst

#### Hydration apps

When fluid intake should be limited ...

- congestive heart failure
- renal failure
- hypoalbuminemia
- endocrinopathies
- some chemotherapy (e.g., cisplatin)
- hyponatremia
In conclusion ...
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THANK YOU!

bob@sportsscienceinsights.com
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The fact that the human body is 60% water (range: 45% - 75% of body weight) is a clear indication of the importance of water to normal body function and health.

Water is a unique molecule and that uniqueness is why water is the body's most biologically active molecule. Consider this ...

- Water is most often found as a liquid, yet the water molecule is lighter than most common gases such as oxygen, nitrogen, and carbon dioxide.
- Water molecules are small -- one quart contains one septillion molecules (1 x 10^24) -- and water molecules are bipolar, two characteristics that help make water life's universal solvent.
- Water is critical to life because it's multi-talented -- it's a solute, a solvent, a carrier, a coolant, a catalyst, a reactant, a lubricant, a controller, a messenger, an ionizing agent, a shock absorber, and a volumetric agent.
- Water makes everything in the body work. Enzymes, proteins, DNA, and RNA can not function without water.
- We survive heat waves and vigorous exercise because water has a high heat capacity, a high thermal conductivity, and a high latent heat of evaporation.

As long as we have easy access to drinking water and other beverages, the body is physiologically capable of regulating its water content to within ± 0.2% of body weight. Yet dehydration is a common occurrence in both free-living and clinical settings.

Dehydration reduces blood volume and compromises cardiac output during heat exposure and physical activity, increasing the risk of heat illness and life-threatening cardiovascular stress in those with CV disease. In addition, dehydration affects the potency of medications and has been linked by some research to an increased risk of urinary tract infections, kidney stones, gallstones, kidney failure, kidney disease, constipation, blood clots (?), arrhythmias, and colon cancer.

Daily fluid needs in adults can vary from 2.0 liters (quarts) per day in small, sedentary people living in cool environments to over 20 L/d in those who sweat throughout the day for occupational or athletic reasons.

Consuming water and other beverages at regular intervals throughout the day can help ensure normal physiological functions important to daily living and long-term health.