**Pennington Nutrition Series**
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# Fluids and Exercise

## Fluid Needs

Water (fluid) needs for an average adult are about 1 ml/kcal expended, which is equivalent to about 8 cups of fluid per day. Athletes need this and generally even more water intake to maintain the body's ability to regulate internal temperature and to keep cool. Most energy that is released during metabolism appears immediately as heat. Heat production in contracting muscles can rise as high as 15 to 20 times above that of resting muscle. Unless the body rids itself quickly of this heat, heat exhaustion, heat cramps, and deadly heatstroke have the potential for occurring.

## Heat Exhaustion

This is the first stage of heat-related illness that occurs due to depletion of blood volume from fluid loss by the body. This increases body temperature and can lead to:

- Headache
- Dizziness
- Muscle weakness
- Visual disturbances

## Heat Cramps

A frequent complication of heat exhaustion. They usually occur in people who have experienced large sweat losses from exercising for several hours in a hot climate and have consumed a large volume of unsalted water. The cramps occur in skeletal muscle, primarily in the legs, and consist of contractions for 1 to 3 minutes at a time. These individuals usually have a normal body temperature.

## Heatstroke

Heatstroke can occur when internal body temperature reaches 105° F. Sweating generally ceases if left untreated, and blood circulation is greatly reduced. Nervous system damage may ensue, and death is likely. Often the skin of the individuals who suffer from heatstroke is hot and dry.

## Heat Index

| Relative Humidity (%) | 70° | 75° | 80° | 85° | 90° | 95° | 100° | 105° | 110° |
|---|---|---|---|---|---|---|---|---|---|
| 100 | 72 | 80 | 91 | 108 | | | | | |
| 90 | 71 | 79 | 88 | 102 | 122 | | | | |
| 80 | 71 | 78 | 86 | 97 | 113 | 136 | | | |
| 70 | 70 | 77 | 85 | 93 | 106 | 124 | 144 | | |
| 60 | 70 | 76 | 82 | 90 | 100 | 114 | 132 | 149 | |
| 50 | 69 | 75 | 81 | 88 | 96 | 107 | 120 | 135 | 150 |
| 40 | 68 | 74 | 79 | 86 | 93 | 101 | 110 | 123 | 137 |
| 30 | 67 | 73 | 78 | 84 | 90 | 96 | 104 | 113 | 123 |
| 20 | 66 | 72 | 77 | 82 | 87 | 93 | 99 | 105 | 112 |
| 10 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 |
| 0 | 64 | 69 | 73 | 78 | 83 | 87 | 91 | 95 | 99 |

Air Temperature (°F)

| Heat Index | Heat disorders possible with prolonged exposure and/or physical activity |
|---|---|
| 80° to 89° | Fatigue |
| 90° to 104° | Sunstroke, heat cramps, heat exhaustion |
| 105° to 129° | Sunstroke, heat cramps, or heat exhaustion likely and heatstroke possible |
| 130° or higher | Heatstroke/sunstroke highly likely |

Adapted from: Perspectives in Nutrition, 5th ed.

Ice packs or cold water is the usual recommended immediate treatment until medical help can be summoned. To decrease the risk of developing heatstroke, athletes should:

- Replace lost fluids
- Watch for rapid body-weight changes (2-3% or more of body weight)
- Avoid exercise under extremely hot, humid conditions

Since dehydration during exercise leads to body-weight loss and sets the stage for heat exhaustion, heat cramps, and potentially heatstroke, athletes must avoid becoming dehydrated.

## Tips on How to Stay Properly Hydrated:

- Freely drink beverages ( water, diluted fruit juice, sports drinks) during the 24-hour period before an event, even if not particularly thirsty
- Drink 1.5 to 2.5 cups of fluid (400 to 600 ml) 2 to 3 hours before exercise. This allows time for both adequate hydration and excretion of excess fluid
- During events lasting more than 30 minutes, consume about 1/2 to 1 1/2 c (150 to 350 ml) of fluid every 15 to 20 minutes as possible beginning at the start of the exercise.
- After exercise, about 2 cups of fluid should be consumed for every pound lost. If the weather is hot and/or humid, 3 cups of fluid per every pound lost may be required.

The recommended goal is a loss of no more than 3% of body weight during exercise. Athletes should first calculate 2 to 3% of their body weight and then by trial and error determine how much fluid they must take in to avoid losing more than this amount of weight during exercise. For best results, the athlete should be weighed before and after the workout.

As stated, for every 1 pound lost, 2 cups (0.5 L) of water should be consumed during exercise or immediately afterwards. Still, most athletes find it uncomfortable to replace more than 75-80% of this sweat loss during exercise.

Percent Weight Loss

| | |
|---|---|
| 0 | -Thirst |
| 2 | -Stronger Thirst |
| 4 | -Economy of movement, impatience, sleepiness, apathy |
| 6 | -Tingling of arms, feet, headache, increase in body temperature |
| 8 | -Dizziness, cyanosis, indistinct speech, mental confusion |

Percent Weight Loss

| | |
|---|---|
| 10 | -Spastic muscles, general incapacity, delirium, failing renal function |
| 15 | -Shriveled skin, inability to swallow, sunken eyes, painful urination |
| 20 | -Cessation of urine formation, cracked skin, bare survival limit<br>-Death |

# Water versus sports drinks

For sports that require less than 60 minutes of exertion or when total weight loss is less than 5 to 6 lbs., the primary concern is replacing the water lost in sweat. In these instances, losses of carbohydrate stores and electrolytes (sodium, chloride, potassium, and other minerals) are not usually too great. For these electrolytes lost in sweat, they could easily be replaced by later consuming normal foods, such as orange juice, potatoes, or tomato juice.

Beyond 60 minutes of exertion, electrolyte and carbohydrate replacement increases in importance. This is especially true in hot weather. Use of sports drinks then provides water for hydration, electrolytes both to enhance water and glucose absorption from the intestine and to help maintain blood volume, as well as carbohydrate to provide energy.


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**Authors:**
Heli Roy PhD, RD
Shanna Lundy, BS
**Beth Kalicki**
**Division of Education**
Philip Brantley PhD , Director
**Pennington Biomedical Research Center**
Claude Bouchard PhD, Executive Director

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**References:**
Wardlaw G., Kessel M.
Perspectives in nutrition.
5th ed. 2002.

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