

Hot Stuff: Thermoregulation

During hot summer weather, we need to be aware of how hot, humid conditions affect our ability to train. Being informed and on the lookout for potential problems is an important part of being a good Spinning® coach and prudent fitness professional. Since hot, humid conditions exist in our training studios every day, we can use these tips year-round.

How does the body sense and regulate temperature conditions?

The hypothalamus, located in the center of the brain, regulates body temperature and keeps it in balance (or in homeostasis). Sensors (central thermoreceptors) in the hypothalamus monitor the temperature of your blood as it circulates through the brain. You also have sensors (peripheral thermoreceptors) in your skin that monitor external environmental temperatures. They work together to help the body respond to changes in body temperature to keep our internal system in balance.

There are four ways we transfer heat:

1. Conduction - transfer of heat from one material to another (deep internal heat to the skin)
2. Convection - transfer of heat from one place to another by the movement of gas or liquid across a heated surface (environmental air moving across skin)
3. Radiation - transfer of heat through infrared rays (body heat transferred into clothing or sunlight transferred into the ground or a person's body)
4. Evaporation - heat transfer by conversion of water (sweat) to vapor

During exercise, evaporation is the body's method of dissipating heat. As we exercise, we generate up to 15 times the amount of internal heat we generate at rest, which causes our body's internal temperature to rise. The hypothalamus sends a signal to the blood vessels under the skin to vasodilate to lose more heat through the skin by sweating. As sweat reaches the skin, it evaporates and cools you off.

Other Environmental Conditions

Humidity is simply water vapor content in the air around us, and it's a big factor in heat transfer and sweat evaporation. If the air around you has a high concentration of water vapor, it greatly decreases sweat evaporation. This creates additional stress on the body as the skin stays wet and heated. Sweat must evaporate to cool and sweat that drips off the skin will not provide a cooling effect.

At this point, it is also important to note three things. First, heat dissipation is largely dependent on the gradient between the temperature outside the body and the temperature inside the body. Second, if it is hotter externally with a breeze blowing than internally, the breeze will "cook" you instead of cool you (remember the gradient between the body and the environment?). Think of how a convection oven blows heated air to cook faster. Third, the Heat Index Chart (below) combines the temperature of the air with the relative humidity (expressed as the Dew Point) to determine how it actually feels around you.

Paying attention to the external environmental conditions is important during the hotter months of the year, not just for good performance when we train, but also to head off any



heat-related health complications that can result from exposure to excessive heat and humidity.

How does the body deal with heat and humidity during exercise?

Sweating is one of our body's responses to heat. When we sweat, our body has to increase blood flow to the skin, as sweat is a filtrate of blood plasma, which is about 99% water. The increased blood flow to the skin means that there is less blood flow to the working muscles. Since sweat is a blood plasma filtrate and plasma is primarily water, increased sweat means that the plasma levels decrease and blood becomes thicker, sticky and harder for the heart to pump. Thicker blood creates a cardiovascular response of a higher heart rate as the heart tries to compensate for the sticky, hard-to-circulate blood, resulting in decreased oxygenation of the working muscles. Hot, humid conditions can create a battle between getting the working muscles the nutrients and oxygen they need for activity, and cooling the body down through sweating. Being overheated leads to fatigue. Anything that interferes with cardiovascular response and heat dissipation will decrease endurance performance, increase fatigue, and increase your chance of experiencing heat-related health complications.

What are heat-related health complications, their signs, and treatment?

Heat cramps are caused by dehydration, sweating, and losing minerals like calcium through sweating in the working muscles. They are treated by stopping activity, moving to a cooler location, and administering fluids.

Heat exhaustion is more serious, and is caused when heat cannot be dissipated quickly enough because of reduced blood volume from dehydration. Symptoms include breathlessness, fatigue, dizziness or fainting, vomiting, a weak, rapid pulse, and either hot, dry or cold, clammy skin. Treatment for heat exhaustion requires stopping activity immediately, having the person lie down with feet elevated in a cooler environment, and administering a saline drink or, if the person is unconscious, administering saline through an IV. People who are not acclimated to heat or are deconditioned are the most susceptible to heat exhaustion, and if heat exhaustion is not treated, heat stroke can result.

Heat stroke is a result of failure of the body's cooling mechanisms, needs urgent medical attention, and can be fatal. The symptoms are an internal temperature of 104° F or greater; cessation of sweating; hot, dry skin; rapid pulse and breathing; high blood pressure; confusion; and unconsciousness. If it is not treated, it results in coma and possible death. Treatment of heat stroke involves immersing a person's body in cold water or ice and fanning the body.

Can we deal with the heat?

Yes. The good news is that some of the effects of endurance training are: an increase in blood plasma, which helps create more sweat to cool the body; increased heart stroke volume, so the heart can pump more blood with each stroke to help move blood where it needs to go; and a tendency to sweat sooner, which combats rising internal heat. Training in the heat increases our body's sensitivity to it and makes the thermoreceptors in the skin more responsive to the high temperatures. Sweating happens sooner. It takes a minimum of 10-14 days (possibly more) of training in hotter conditions to acclimate the body to heat. Sitting in a sauna or a



steam room beforehand for 2 weeks will not be enough to acclimatize to the heat during exercise. A person has to be actively training in the hotter conditions to acclimate to them. Expect to slow down the pace and drink plenty of fluids during the acclimation period and any time you train in hotter than normal conditions.

Heat Index Chart

Temp Dew Point (F)

(F) 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0

65:	62.7	63.8	65.0	66.6				
70:	67.8	68.7	69.8	71.1	72.6			
75:	73.1	73.9	74.8	75.9	79.2	80.7		
80:	79.8	80.6	81.6	82.8	84.4	86.9	90.9	
85:	83.5	84.7	86.1	88.0	90.5	94.0	99.0	106.6
90:	87.9	89.4	91.2	93.6	96.9	101.2	107.2	115.6
95:	92.9	94.5	96.7	99.6	103.4	108.4	115.2	124.3
100:	98.1	99.9	102.4	105.6	109.8	115.3	122.7	132.3
105:	103.4	105.4	108.1	111.6	116.1	122.0	129.7	139.7
110:	108.7	110.9	113.8	117.5	122.3	128.4	136.3	146.5

Any value less than 80 is considered **comfortable**.

Any value greater than 90 is considered **extreme**.

Any value greater than 100 is considered **hazardous**.

Any value greater than 110 is considered **dangerous**.

What steps can we take to deal with heat and humidity while we train?

Aim to heed ACSM's recommended studio temperature of 60-68° F.

Exercise should improve our health, not impede it. As a coach, you have the power to promote safe practices in hot conditions.

Resources: "Heat Stress & Exercise Guidelines", Gary Westlund, ACSM H/FI Physiology of Sport and Exercise, Jack H. Wilmore, David Costill

Spinning® Instructor News, June 2003, Vol. 7, Issue 6

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