



**DES MOINES  
ORTHOPAEDIC SURGEONS, P.C.**

---

**DMOS – West**  
6001 Westown Parkway  
West Des Moines, IA 50266  
**515-224-1414**  
**800-245-6129**

**DMOS – East**  
Penn Medical Plaza  
1301 Pennsylvania Ave., Suite 213  
Des Moines, IA 50316  
**515-263-9696**  
**800-688-3980**

**DMOS – Carroll**  
405 S. Clark St., Suite 250  
Carroll, IA 51404  
**712-792-2093**  
**877-284-1428**

## **Heat Illness and Treatment Tips**

**Nicholas J. Honkamp M.D.**  
**Des Moines Orthopaedic Surgeons, P.C.**

### **Overview**

Heat illness is a spectrum of syndromes that can range from minor conditions such as muscle cramps, to life-threatening emergencies involving heat stroke. Each year, approximately 4,000 people in the US die of heat stroke.

### **Heat Exhaustion and Heat Stroke**

Heat exhaustion and heat stroke represent a continuum of symptoms due to heat-related illnesses. Heat exhaustion occurs first, and can include symptoms such as headache, nausea, muscle cramps, and dizziness. The body temperature can be normal or elevated, but is typically under 105°F (normal body temperature is around 98-99° F). Clinical symptoms of dehydration are present and include rapid heart rate, lowered blood pressure, and profuse sweating.

Heat stroke involves worsening symptoms of heat exhaustion as well as symptoms of hyperthermia (elevated temperatures above 105°F) and altered mental status (confusion, inability to carry on a conversation).

The key to differentiating heat stroke from heat exhaustion is that central nervous system dysfunction (confusion, delirium, seizure, inappropriate behavior) is not present in heat exhaustion. The part of the brain most sensitive to heat is the cerebellum, which controls movement. Altered or uncoordinated movements are often one of the first features of heat stroke.

### **Body Response to Heat**

The body has several mechanisms to dissipate heat. The most important are radiation and evaporation. Radiation occurs when heat is directly transferred from the body to the cooler external environment. However, this occurs only when the air temperature is lower than the body temperature. Once the external temperature reaches 95° F, the body can no longer cool itself by radiation.

The body's best way to then dissipate heat is through a process called evaporative cooling (sweating). When the body sweats, it exudes a salt solution through the skin rich in the electrolytes sodium and potassium. The heat in the body is transferred to this salt solution which then evaporates into the air (taking the heat with it). Consequently, when an athlete becomes hot, they begin to sweat and "look flush." This flushing is the body dilating the blood vessels in the skin in order to better transfer heat from the blood to the

sweat forming on the skin. However, this process of evaporation is sensitive to the humidity (the higher the humidity, the harder it is to evaporate sweat off the body). Thus, both the temperature and the humidity both determine how efficiently the body can cool itself. The heat index takes into account both the temperature and the humidity, and should be monitored closely by anyone looking after athletes who are competing in a hot environment (Figure 1).

### Risk Factors for Heat Illness

The most obvious risk factor is failure to replace the water and electrolytes in the body prior to resuming physical activity. Athletes that play multiple games or exercise for an extended period (ex. Marathon running) are at risk for heat illness because they have difficulty replacing the lost water and electrolytes that they are losing through sweating and evaporative cooling. Obesity is a risk factor as well because these individuals have more fat insulation and less capacity for dissipating heat from the blood through the skin. Additionally, certain medications can increase the rate of heat illness. Diuretics (which include caffeine) promote more urine production from the kidneys, thus increasing the chance of water loss (dehydration). Recreational drugs such as amphetamines can also increase this risk because they are stimulants which increase muscular heat production.

### Treatment

The best way to avoid heat illness is to remain hydrated. Well hydrated athletes generally do not experience muscle cramps or nausea. In addition, monitoring urine output (amount and frequency) and concentration (darker urine is more concentrated and may be related to dehydration) can also be a clue to hydration status. For activities lasting an hour or less, the electrolyte loss through sweating is relatively low and water can safely replenish the water loss. For athletes participating in multiple events or for a prolonged (> 1hr) period of time, sports drinks (Ex. Gatorade, Powerade) can be helpful. These sport drinks contain water, sugar, and electrolytes. The sugar content can vary significantly between different products but are generally 6-8 percent sugar. These drinks are generally healthy, but the sugar content can be detrimental to teeth.

Energy drinks are newer products that are touted to give a burst of energy. Their “energy” comes from two main ingredients: sugar and caffeine. Excessive sugar can actually be detrimental to an exercising athlete, as it can result in less ability to sweat. Caffeine, as mentioned above, can also be detrimental as it increases heat production and urine output, both of which can worsen heat illness. For that reason, energy drinks are not good for fluid replacement during exercise.

In an athlete who is exhibiting symptoms of heat exhaustion, removal from athletic activity should be done immediately. They fluids should be replaced with water and salt tablets or a sports drink. They should be placed in the shade, their clothes should be removed (to aid radiation of heat off the body), and they should be sprayed with a medium temperature solution (to aid evaporative cooling). Fans and ice packs can also be helpful to aid evaporative and radiation cooling, respectively, as well. Failure of the athlete to feel better within 30 minutes should prompt an evaluation by a health care provider.

### Review

- Heat exhaustion and heat stroke exist on a continuum, with heat stroke patients exhibiting signs of central nervous system dysfunction.
- Radiation and evaporation are two of our most important ways to cool ourselves. The heat index involves both temperature and humidity, both of which determine how well we can cool our bodies.
- Water and sport drinks are effective rehydration drinks. Energy drinks are not.

Dr. Honkamp practices at DMOS – West; he specializes in sports medicine, including shoulder and knee injuries. Dr. Honkamp is also skilled in joint replacements. To reach Dr. Honkamp or to schedule an appointment please call 515-224-5205.

**Figure 1-Heat Index Chart (Temperature & Relative Humidity)**

<b>R H (%)</b>	<b>Temperature (° F)</b>															
	<b>90</b>	<b>91</b>	<b>92</b>	<b>93</b>	<b>94</b>	<b>95</b>	<b>96</b>	<b>97</b>	<b>98</b>	<b>99</b>	<b>100</b>	<b>101</b>	<b>102</b>	<b>103</b>	<b>104</b>	<b>105</b>
<b>90</b>	119	123	128	132	137	141	146	152	157	163	168	174	180	186	193	199
<b>85</b>	115	119	123	127	132	136	141	145	150	155	161	166	172	178	184	190
<b>80</b>	112	115	119	123	127	131	135	140	144	149	154	159	164	169	175	180
<b>75</b>	109	112	115	119	122	126	130	134	138	143	147	152	156	161	166	171
<b>70</b>	106	109	112	115	118	122	125	129	133	137	141	145	149	154	158	163
<b>65</b>	103	106	108	111	114	117	121	124	127	131	135	139	143	147	151	155
<b>60</b>	100	103	105	108	111	114	116	120	123	126	129	133	136	140	144	148
<b>55</b>	98	100	103	105	107	110	113	115	118	121	124	127	131	134	137	141
<b>50</b>	96	98	100	102	104	107	109	112	114	117	119	122	125	128	131	135
<b>45</b>	94	96	98	100	102	104	106	108	110	113	115	118	120	123	126	129
<b>40</b>	92	94	96	97	99	101	103	105	107	109	111	113	116	118	121	123
<b>35</b>	91	92	94	95	97	98	100	102	104	106	107	109	112	114	116	118
<b>30</b>	89	90	92	93	95	96	98	99	101	102	104	106	108	110	112	114