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How We Fight Summer Heat

Physiological mechanisms

The summer is coming and our thermo-regulation system will be once again pushed to the limits. Did you know that the human body is more resistant to cold than it is to heat? The fact is that we have physiological mechanisms more effective for combating the cold than the heat. Temperature is a parameter characterizing the heating stage of a physical system while heat represents the energy transferred from one body to another via a thermal process. In other words, we have a constant temperature of about 37o C, which we maintain by losing or gaining heat, depending on the case and necessities. How do we lose heat? Physically, thermoregulation consists of conduction (heat transport and its transfer to colder systems), convection (the transfer of gas with different temperatures), radiation (the loss of heat via infrared radiation, depending on the surface of the body) and evaporation via sweating. At room temperature (20o C), the first three factors dominate. At higher temperatures, sweating turns into the main cooling mechanism. The skin is packed with sweat glands. On a square centimeter of skin, there are 6 million cells, 5,000 receptors, 15 sebaceous (oil) glands, 200 pain detecting nervous terminations (making a total of 4 m or 13.3 ft), 10-25 touch and thermal receptors, 1 m (3.3 ft) of blood vessels and over 100 sweat glands. And to think that the skin has 1.5 square meters (15,000 square cm). The sweat glands are of two types: eccrine and apocrine. Eccrine glands have three segments: a twisted sector, resembling a kidney glomerulus, a sweat excretory canal, and a sweat route. The higher the amount of blood that has reached the glomerulus, the higher the amount of sweat. Heat receptors located in the skin, viscera and brain can detect temperature variations of less than 0.1o C. The brain has thermo-sensitive neurons in the hypothalamus. They detect variations of temperature in the blood, and if they are too drastic, the blood is directed towards the skin where the sweating will be intensified, cooling the organism. The sweat is actually an ultra-filtered blood, containing not just water, but also sodium chlorine, potassium, ammonia (that gives it the urine like scent), uric acid and others. Normally, we produce a little over 0.5 liters of sweat in 24 hours. In the desert, we can sweat over one liter of water per hour. The apocrine glands develop at puberty and are much more complicated than the eccrine sweat glands. For long, it was thought that only animals produce pheromones. Recent researches proved that the apocrine glands produce human pheromones. The sweating is effective as long as the air is not too humid (that is, too charged with water vapors). In a dry environment, the human body can stand temperatures of up to 130o C by sweating, while in a wet environment 49o C are too much to stand even if only for a few minutes. 100% humidity of the air means the maximum water vapor amount that can be contained in the air without the vapors turning into a rainfall. The evaporation of 2 grams of water is enough to decrease by 1o C the rest of 998 grams of water in a liter. Besides the nervous control of the thermoregulation, there is also the hormonal control, via the hypophysis, thyroid and adrenal glands. Thermoregulation itself is very complex. For example, the hypothalamus makes us eat more at lower temperatures than at higher temperatures. Turns out the patrons of restaurants who provide a nice and refreshing coolness in their placement are really smart guys...

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