THERMOREGULATION – TEMPERATURE HOMEOSTASIS

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Abstract

Humans are homoeothermic, which means that internal body temperature is physiologically regulated to keep it nearly constant even when environmental temperature changes. Although a person’s temperature varies from date to date, and even from hour to hour, these fluctuations are usually no more than about 1°C. only during prolonged heavy exercise, fever due to illness, or extreme conditions of heat or cold due body temperatures deviate from the normal range of 36.1 to 37.8°C. Body temperature reflects a careful balance between heat production and heat loss.

The preoptic-anterior area of the hypothalamus houses the thermoregulatory center. It acts as a thermostat, monitoring temperature and accelerating heat loss or heat production as needed.

Keywords: thermoregulation, acclimation, acclimatization, body heat.

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Introduction

The stresses of psychical exertion often are complicated by environmental thermal conditions. Performing in extreme heat or cold places heavy burden on the mechanism that regulate body temperature. Although these mechanisms are amazingly effective in regulating body temperature under normal conditions, mechanisms of thermoregulation can be inadequate when we are subjected to extreme heat or cold. Fortunately our bodies are able to adapt to such environmental stresses with continued exposure over time, a process known as acclimation or acclimatization.

- Acclimation – which refers to a short – term adaption;
- Acclimatization – the proper term when we are referring to adaption gained over long periods of time.

In the following discussions, we focus on the physiological responses to acute and chronic exercises in both hot and cold environments. Specific health risks are associated with exercise in both temperature extremes, so we also discuss the prevention of temperature – related illness and injuries during exercise.

Body temperature regulation:

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fever due to illness, or extreme conditions of heat or cold due body temperatures deviate from the normal range of 36.1 to 37.8 °C. Body temperature reflects a careful balance between heat production and heat loss. Whenever, this balance is disturbed body temperature changes.

Only a small part of the energy the body produces is used for physiological functions such as muscle contraction, the rest is converted to heat. All active tissues produce metabolic heat that must be intricately offset by heat loss to the environment to maintain the internal temperature of the body. If the body’s heat production exceeds its heat loss, as it often does during moderate-to-heavy-intensity aerobic activity, the internal temperature increases.

People’s ability to maintain a constant internal temperature depends on their ability to balance the metabolic heat they produce and the heat they gain from the environment with the heat their body loses.

Increase in the body’s metabolic rate from the minimal amount needed to maintain basic vital bodily processes increase the production of heat. There are quite a few things that can affect this metabolic rate and cause basic heat production including exercise, hormones, nervous system, body temperature, and ingestion of food, age as well as others. Now let’s examine the mechanisms by which heat is transferred between a person and his or her surroundings. For the body to transfer heat to the environment, the heat produced in the body must move from deep in the body to the skin, where it has access to the outside environment. The heat is moved from the core to the skin by the blood. Only when heat reaches the skin can it be transferred to the environment by any of four mechanisms: Conduction; Convection; Radiation; Evaporation.

There are also ways to cause basic heat loss such as radiation (heat loss infrared radiation emissions), evaporation (every gram of water removed removes heat from body, around 0.58 Cal per gram of water, around 22% of heat loss occurs due to this), conduction (transfer of heat through physical contact, around 3% heat loss), and convection (transfer of heat by movement of liquid or gas between areas of temperature). Around 40% of heat loss is due to evaporation, conduction and convection.

1. **Conduction**

Conduction is the process of losing heat through physical contact with another object or body. For example, if you were to sit on a metal chair, the heat from your body would transfer to the cold metal chair. During exercise, conduction is usually negligible as a source of heat exchange because the body surface area in contact with solid object is small.

2. **Convection**

Convection is the process of losing heat through the movement of air or water molecules across the skin. The use of a fan to cool off the body is one example of convection. The amount of heat loss from convection is dependent upon the airflow or in aquatic exercise, the water flow over the skin. The primary heat loss process for aqua enthusiasts is convection, however, in an outdoor pool on hot day evaporation will also play a primary role in heat loss.

3. **Radiation**

Radiation is a form of heat loss through infrared rays. This involves the transfer of heat from one object to another, with no physical contact involved. For example, the sun
transfers heat to the earth through radiation. At normal room temperature the nude body losses about 60% of its excess heat by radiation. The heat is given off in the form of infrared rays which are a type of electromagnetic wave.

4. **Evaporation**

The last process of heat loss is evaporation. Evaporation is the process of losing heat through the conversion of water to gas (evaporation of sweat). Evaporation accounts for about 80% of the total heat loss when one is physically active and is therefore an extremely important avenue for heat loss. Even at rest, evaporation accounts for 10% to 20% of body heat loss since some evaporation occurs without our awareness.

**Thermoregulatory control**

The human body regulates temperature by keeping a tight balance between heat gain and heat loss. Your temperature regulation system is more analogous to the operation of a home furnace, as opposed to the function of an air conditioner. Humans regulate heat generation and preservation to maintain internal body temperature or core temperature. Normal core temperature at rest varies between 36.5 and 37.5 °Celsius (°C). Core temperature is regulated by the hypothalamus (in the brain), which is often called the body’s thermostat. The hypothalamus responds to various temperature receptors located throughout the body and makes physiological adjustments to maintain a constant core temperature. For example, on a hot day, temperature receptors located in the skin send signals to the hypothalamus to cool the body by increasing the sweat rate.
When body temperature is elevated, the preoptic anterior hypothalamus is stimulated to increases blood flow to the skin and produce sweat to eliminate excess body heat. These signals are sent through the sympathetic nervous system to skin arterioles and eccrine sweat gland. As heat loss occurs and body temperature then decreases, negative feedback lessens the sympathetic nerve out flow initiated by the hypothalamus.

During all types of exercise the body’s ability to thermoregulation is challenged. Heat is produced as a bi-product of metabolism. However, the human body is only 25% efficient; therefore you lose approximately 75% of energy as heat. During exercise, heat is produced mainly from working muscle contractions and core temperature can go above 40 °C.

Conclusion

To sets of thermoreceptors provide temperature information to the thermoregulatory center. The peripheral receptors in the skin relay information about the temperature of the skin and the environment around it.

Central receptors in the hypothalamus, other brain areas, and spinal cord transmit final information about the internal body temperature. Central thermoreceptors are far more sensitive to temperature change than peripheral receptors.

REFERENCES