

Influence of high temperatures on human organism

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Introduction

High temperature of a human organism is by definition a temperature above normal, so before talking about the influence or effects of high temperature on a human we must define what "normal" body temperature is.

"Normal" human blood temperature, or normothermia, is dependent on the location of the measurement as well as time of day and activity level of the person being measured. The reason why location affects the definition of normothermia is because different parts of the body have different measured temperatures. Measurement taken from inside the body cavity, such as rectal and vaginal, often are higher than external measurements such as skin temperature. The reason why time of day is also important to consider is that the body temperature of a healthy person varies throughout the day by roughly 0.5 °C with slightly lower temperatures in the morning and slightly higher temperatures later in the afternoon and in the evening, as the body's needs and activities change.

Although the normal human body temperature is variable, the widely accepted average core body temperature is 37.0 °C

Fever

Fever (otherwise known as pyrexia) is one of the most common medical signs and is defined by an increased measured body temperature above the normal (36.5-37.5) caused by an increase of the set point in the thermoregulatory system. This increase in set-point triggers increased muscle tone and chills.

As one's temperature is increased in general, despite the increase, a feeling of being cold. Then when the body temperature is raised to the new set point there is a contrasting feeling of warmth.

A fever can be the result of a wide variety of medical conditions which range from practically harmless to potentially serious. Some studies have argued that a fever is advantageous as a defence mechanism since the body's immune response can be strengthened at increased temperatures; On the other hand, there are also arguments against the proclaimed usefulness of a fever and the issue is deemed a controversial topic of debate. Not including hyperpyrexia conditions, as a general rule treatment isn't required to handle a fever although antipyretics can be used to increase patient comfort.

Fever is different to hyperthermia in that hyperthermia is an increase in body temperature over the body's thermoregulatory set-point whereas in a Fever the set point is changed to above normal conditions.

Definition

The specific defined measured states of fever are as follows;

- Rectal temperature is at or over 37.5–38.3 °C
- Oral temperature at or over 37.7 °C
- Axillary or otic temperature is at or over 37.2 °C

Main Types of Fever:

- Continuous fever: temperature remains constant through a 24 hours period not fluctuating more than 1 degree
- Intermittent fever: the temperature elevation is only seen for a certain period cycling back to normal later, subtypes include Quotidian, Tertian and Quartan fever.
- Remittent fever: same as continuous however temperature does fluctuate more than 1 degree in 24 hours.

Signs and Symptoms:

A fever often accompanies sickness behaviour which involves:

- Lethargy
- Depression
- Anorexia
- Sleepiness
- Hyperalgesia
- Inability to concentrate

Hyperthermia

Hyperthermia defines a process, in which the body heats up to significantly above normal Temperature ($>37.5^{\circ}$), because of failure of the organism's thermoregulation. The most common type of Hyperthermia is the so called Heat stroke.

A Heat stroke occurs, when the body is not able to properly dissipate heat by radiation or evaporation of sweat. This may be the case during exertion, very high outdoor air temperature, dehydration or air humidity. As a consequence, the organism starts to warm up to or above 41.1° . This state affects the body biochemically: Enzymes and other proteins will begin to function slower as they start to denature as a result of the extremely high temperature of the body. As a result of this Enzyme driven reactions (such as metabolic pathways) will not function properly. Since 1995, 33 football players died because of a heat stroke, stated by the University of North Carolina.

Consequently typical Symptoms of a heat stroke are a dry skin, small pupils and a high body temperature. It gets clear, that the symptoms compared to the much more common heat exhaustion are completely different. Heat exhaustion is defined by a normal body temperature accompanied with moist clammy skin. Everyone, who has ever participated in sport or other physical activities during a hot day knows these issues, which are not harmful for the body, but affecting performance output.

Hyperpyrexia

Hyperpyrexia is a state where the body temperature is extremely above normal, specifically greater than or equal to 41.5°C (106.7°F). A body temperature this high is considered a medical emergency as it may indicate a serious underlying condition or lead to severe side effects. Hyperpyrexia differs from hyperthermia in that in hyperpyrexia the body's thermoregulatory system sets the body temperature above the normal temperature, then generates heat to achieve this temperature, while in hyperthermia the body temperature rises above its set point as a result of an external source; to put it simply hyperthermia isn't caused by a fever whereas hyperpyrexia is just an example of an extreme fever.

The most common cause is an intracranial haemorrhage. These affect the body initially the same way as Heat Stroke and develop into severe symptoms which include:

- Sickness behaviour
- Dry, hot, red skin
- Extreme confusion
- Fast shallow breathing
- Weak, fast pulse
- Dilated pupil's
- Loss of consciousness
- Seizures.

These are symptoms caused by extreme vasodilation and the shutting down of metabolic pathways as a result of inhibited enzyme action. Since the body's thermoregulatory system isn't functioning properly during hyperpyrexia it is often fatal.

Sources

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