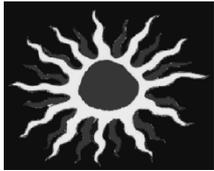


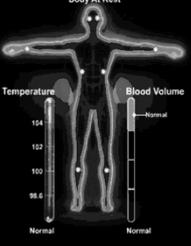
Overview

-  **Physiology of Heat Stress**
-  **Causal factors**
-  **Heat Disorders & Health Effects**
-  **Control**



Physiology of Heat Stress

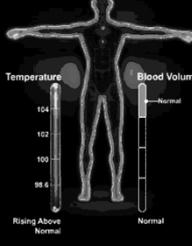
Body At Rest



During both rest and activity, the human body tries to maintain an internal temperature of 98.6 F.

Physiology of Heat Stress

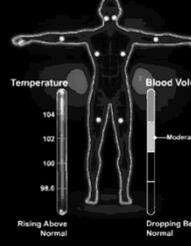
After 1-2 Hours



- Hot weather, heat sources, and hard work raise the body's core temperature.
- Heated blood is pumped to the skin's surface, where body heat transfers to the environment, if cooler.
- If heat has to be shed faster, sweat carries it outside skin and evaporates to aid cooling.

Physiology of Heat Stress

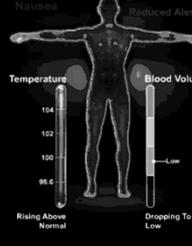
After 2-3 Hours: Initial Stage



- During heavy work, a body can lose 1-2 liters of water per hour.
- After 2-3 hours of fluid loss, a person is likely to:
 - Lose endurance
 - Become uncomfortable
 - Feel hot
 - Become thirsty

Physiology of Heat Stress

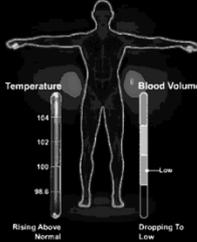
After 3-6 Hours: Heat Cramps/Heat Exhaustion



- The longer a body sweats, the less blood there is to carry excess heat to skin or oxygen and nutrients to muscles.
- After 3 hours, a dehydrated worker may experience:
 - Headaches
 - Muscle fatigue
 - Loss of strength
 - Loss of accuracy and dexterity
 - Heat cramps
 - Reduced alertness
 - Nausea

Physiology of Heat Stress

After 3-6 Hours: Heat Cramps/Heat Exhaustion



- Water is key to cooling body and combatting heat stress.
- Without fluid replacement during an extended period of work, the body is at risk of exhaustion.
- Untreated heat exhaustion may lead to heat stroke.

Causal Factors

- ☀️ Age, weight, degree of physical fitness
- ☀️ Degree of acclimatization, metabolism
- ☀️ Intercurrent illnesses (eg. HTN)
- ☀️ Drug therapy (phenothiazines, diuretics, alcohol)
- ☀️ Type of clothing
- ☀️ Prior heat injury predisposes an individual to additional injury

Acclimatisation

- Occurs over a period of weeks
- Adaptive mechanisms:
 - Stimulation of the sweating mechanism with increased sweat volume and reduced sweat sodium content
 - Sec. hyperaldosteronism to maintain body sodium balance

Heat Disorders & Health Effects

- ☀️ Heat Stroke
- ☀️ Heat Exhaustion
- ☀️ Heat Cramps
- ☀️ Heat Collapse
- ☀️ Heat Rashes
- ☀️ Heat Fatigue



Temperature (F) versus Relative Humidity (%)

°F	90%	80%	70%	60%	50%	40%
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				146	133	121
110						135

HI	Possible Heat Disorder:
80°F - 90°F	Fatigue possible with prolonged exposure and physical activity.
90°F - 105°F	Sunstroke, heat cramps and heat exhaustion possible.
105°F - 130°F	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
130°F or greater	Heat stroke highly likely with continued exposure.

Output & Productivity

NASA Report CR01205-1							
Temp	75	80	85	90	95	100	105
Loss In Work Output	3%	8%	18%	29%	45%	62%	79%
Loss In Accuracy		5%	40%	300%	700%		

HEAT STROKE

- ☀ Occurs when the core body temperature rises above 40°C
- ☀ This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict
- ☀ Heat stroke is a medical emergency, severe and life threatening condition



- Headache, nausea, vomiting
- Coarse muscle tremor
- Confusion; aggression; LOC; convulsions
- Loss of sweating (due to failure of thermoregulatory mechanisms), hot and dry skin

Heat stroke - complications

- Hypovolaemic shock
- Lactic acidosis
- Disseminated intravascular coagulation
- Rhabdomyolysis
- Hepatic and renal failure
- Pulmonary and cerebral oedema

Heat stroke - Treatment

- Should be managed in ICU
- Rapid cooling by spraying with water, fanning, and ice packs in the axillae and groins
- Cold crystalloid iv. fluid replacement with monitoring
- Sedation with benzodiazepines may be required
- Investigation done to assess the complications

HEAT EXHAUSTION

- Core body temperature is between 37°C and 40°C
- Occurs after prolonged exertion in hot and humid weather, profuse sweating and inadequate salt and water replacement

Heat Exhaustion

- ☀ Signs and symptoms
 - Headache, nausea, vertigo, weakness, thirst, tachycardia, irritability, fatigue



Heat exhaustion - Treatment



- Removed from the hot environment
- Fluid replacement eg. oral rehydration solution (both salt and water) – adult patients may require 5 litres or more positive fluid balance in the first 24 h
- Active cooling eg. cool sponging
- Untreated heat exhaustion may progress to stroke

HEAT CRAMPS

- Painful muscle contractions, most commonly in the legs of young people following vigorous exercise and profuse sweating in hot weather
- No elevation in core temperature
- Mechanism: extracellular sodium depletion

Heat cramps

Treatment:

- Symptoms usually respond rapidly to salt replacement

Prevention:

- Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments

HEAT SYNCOPE

- Similar to vasovagal faint
- Related to peripheral vasodilatation
- The brain does not receive enough oxygen because blood pools in the extremities
- The onset of heat collapse is rapid and unpredictable

Heat Rashes



Most common problem in hot work environments



Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive

Heat Rashes



Heat Rashes

- ☀ Prickly heat occurs in skin that is persistently wetted by unevaporated sweat,
- ☀ Heat rash papules may become infected if they are not treated
- ☀ In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat Fatigue

- ☀ A factor that predisposes an individual to heat fatigue is lack of acclimatization

Heat fatigue Signs & Symptoms

- ☀ The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs

Heat fatigue - Treatment

- ☀ There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.



Control

- ☀ The five major types of engineering controls
 - Ventilation
 - Air cooling
 - Fans
 - Shielding
 - Insulation

