Heat losses from the body

By

Dr. Suha Shayal Abdul-Hassan

Heat Losses from the Body

- Homeothermic: warm-blooded, birds and mammals, constant body temperature
- Poikilothermic: cold-blooded, other animals, variable body temperature
- Heat is generated in the organs and tissues of the body
- The temp. of the body depends on the:

1-Time of the day (lower in the morning)

2-Environment temp.

3-The amount of clothing

4-Health of the person

5-On his recent physical activity.

- Heat is lost mostly by-

Radiation, Convection, Evaporation

- Most of those heat are released at the skin's surface
- The hypothalamus in the brain can control the body temp.
- The production of heat in the body for 2400 kcal/day(assumeing no change in body weight)=1.7kcal/min=120j/sec=120w.

The heat losses depends on many factors:

1-The temp. of the surroundings

2-Humidity

3-Motion of the air

4-The physical activity of the body

5-The amount of the body exposed

6-The amount of the insulation of the body(like clothes and fat)

Transfer of heat by radiation

Net radiative heat loss,

$$Hr = kr\ Ar\ e(Ts - Tw)$$

where

Hr is the rate of heat energy loss or gain

Ts: skin temperature in Celcius

Tw: wall temperature in Celcius

Kr = 5.0 kcal/m2 hr °C for man

Ar: effective body surface area

e is the emissivity of the surface which is nearly=1

Transfer of heat by convection

Convection: transfer of heat by gas or liquid in motion (in body's case, between skin and the surrounding air).

It is dependent on :

- ΔT between skin and air

- Speed of the air

convective heat loss without wind,

$$Hc = kc\ Ac\ (Ts - Ta)$$

Where

Hc: is the amount of heat gained or lost be convection

Ts: skin temperature in Celcius

Ta: air temperature in Celcius

Ac: effective body surface area

Kc = 2.3 kcal/m2-hr-°C

when the air is moving kc increases according to the equation:

$$Kc = 10.45 - v + 10\sqrt{v}$$

where v is the wind speed in m/sec

for wind speeds of 2.23 ~ 20 m/s

Transfer of heat by evaporation

- Under normal temp. and in the absence of hard work , heat loss mainly by radiation and convection.
- Under extreme conditions of heat and exercise, a man may sweat more than 1 liter of liquid per hour.
- 1g of water that evaporate carries high heat of evaporation: 580 Cal. (1 liter carries 580kcal)
- Heat losses by perspiration about 7kcal/hr equivalent to 7% of the body losses even if the body dose not feel sweaty.
- A similar loss of heat is due to the evaporation of moisture in the lungs.
- Under typical conditions the total respiratory heat losses is about 14% of the body's heat loss.

Sweat is our body's primary cooling mechanism - We cool down when sweat evaporates off our skin.

- We sweat a max. of 1L/h - 1.5 L/h
- The higher the humidity, the more difficult it is for us to sweat – hot, humid days are more uncomfortable than hot, dry days