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A Brief Study on the Facts And Figures of Body Temperature

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ABSTRACT: Heat is a form of energy and is required for the functions of different organs of the body. Every food stuff contain heat in the form of carbohydrates and glucose. The heat is released during the digestion of food stuffs (calorific value of food) taken by human beings and animals. Even when we are sleeping heart and lungs are functioning using the help of heat delivered by the food stuff. Heat is the cause and the temperature is the effect. Temperature can be measured with thermometer. Heat cannot be measured directly and is sensed by touching. For the survival human beings and animals, the maintenance of the temperature is a must. Excess of body temperature causes fever(caused by virus)and deficiency of body temperature causes fits(body shivering). There is a mechanism called hypothalamus in brain which regulates the temperature properly. In this paper we have discussed briefly how the body temperature is regulated by different mechanism, variation of body temperature due to different factors and the reactions taking place in our body due to sudden change in temperature.

KEYWORDS: Homeothermic, poikilothermic, oral and surface temperature, hypothalamus, heat gain and heat loss centers, sweating, hyperthermia, hypothermia, saliva, panting, metabolic activities, hemorrhage, hypopituitarism, hypothyroidism, hyperthyroidism, diabetes, insipidus, hormones.

I.INTRODUCTION

Based on body temperature let us first classify the living organism. The living organisms can be classified into two groups depending upon the maintenance (regulation) of body temperature namely **homeothermic** and **poikilothermic** animals. In homeothermic animals, the body temperature is maintained at a constant level irrespective of the environmental temperature. Birds and mammals include man belong to this category. They are also called **warm blooded** animals. In poikilothermic animals the body temperature is not a constant. It varies according to environmental temperature. Amphibians and reptiles are the poikilothermic animals. These animals are also called **cold blooded** animals.

Most of us are thinking that the measured temperature is constant throughout the body and is also common for age groups, sex and time duration but measured temperature is not a constant throughout the body and differs at different parts of the body. It also depends on the factors like age group, sex, time duration. etc.

Body temperature can be measured by placing the clinical thermometer in different parts of the body such as mouth (oral temperature), axilla (axillary temperature). On the skin (surface temperature) and rectum (rectal temperature).The normal body temperature in human is 37 ^{0}c(98.6 ^{0}F), when measured by placing the clinical thermometer in the mouth (oral temperature). It varies between 35.8^{0}c (96.4^{0}F) and 37.3^{0}c (99.1^{0}F).

Axillary temperature is slightly lower (about 0.37^{0}c or 1^{0}F) than the oral temperature . And ,the rectal temperature is slightly higher (about 0.37^{0}c or ^{0}F) than oral temperature. The superficial temperature (skin of surface temperature) varies between 29.5 C (85 ^{0}F) and 33.9 ^{0}C (93 ^{0}F).The average temperature in deeper tissues of the body is called core temperature .The core temperature is always more than oral or rectal temperature. It is about 37.8 ^{0}C (100 ^{0}F).

II.VARIATIONS OF BODY TEMPERTURE DUE TO DIFFERENT FACTORS

Here we are going to discuss the facts and figures about the variations of the body temperature due to different factors like age, sex, time duration, different functioning of the body.

S.No	Factors		Variation of temperature	Reasons

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1	**Age**	a) Adult	No variation (37^0 c)	Due to **normal working** conditions of heat regulation in hypothalamus.
		b) Infants	Slightly above normal by $.5^0$C (37.5^0 c)	Since **heat regulating** system does not **function properly** due to increase in activities.
		c) Old age	Temperature is reduced	Due to **less heat** production.
2	**Sex**	Female	Body temperature is less than male.	due to **low basal metabolic** rate when compared to male.
3	**Time duration**	a) Early morning	Temperature is 1^0 c less.	Due to **loss of heat** to bed by conduction.
		b) Afternoon	Reaching the maximum i.e., 1^0 c above normal	Due to effective functioning of heat regulating system.
		c) After meals	It rises slightly by 0.5^0 c	Due to **heat release** by **calorific value** of food stuffs.
4	**Exercise**		Body temperature rises	Heat produced due to **muscle refluxes**.
5	**Sleeping**		Body temperature reduces by 0.5^0 c	Due to reduced activity of **heat regulation** system.
6	**Emotions (Anger, Weeping, over joy)**		Body temperature increases suddenly	Due to **improper heat** regulation
7	**Pathological factors**			
	Hyperthemia (abnormal increase in temperature)	**1.Hyperthyroidism**	Temperature may increase from 98.6 ^{0}F to 105^0F	Due to **virus** or **bacterial infection**, toxic substances (pyogens) released by bacteria or parasites.
		2. In diabetes insipidus	Increase in temperature	Due to **increase** in sugar level
	Hypothermia (abnormal decrease in temperature)	**1. Hypothyroidism**	Temperature decreases	Due to **decrease** in percentage of thyroid
		2. Lesion (Small tumor in hypothalamus)	Temperature decreases	Due to decrease in temperature regulation system.
		3. Hemorrhage in some parts of brain (pons)	Temperature decreases	Due to the interaction with temperature regulating system.

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Heat balance (Temperature regulation):

Normally a temperature body is maintain at a constant level by some mechanisms in the body. This is done by adjusting the heat production is equal to the heat loss. The balance between heat production in the body and heat loss in the body is known as heat balance.

Heat Gain:

The gain of heat produced in the body by some factors are summarized in the following tabular form.

Sl.No	Factors	Source of heat	Nutrients and their heat contents or reasons
1	**Metabolic activities**	Heat produced during digestion of food stuffs (Calorific value)	1). 9 calories/gm of heat is produced from **fa**t.
			2). 5 calories/gm of heat from **carbohydrates.**
			3). 5 calories/gm of heat from proteins.
2	**Activity of muscles**	Heat produced during activities and rest.	1). 40% percent of heat produced by **respiratory muscles**.
			2). 60% of heat produced by the activity of **skeletal muscles**.
3	**Harmones**	Increase of heat production by harmones like adrenaline and thyroxine.	By increase in metabolic activities.
4	**Radiation of heat from environment**	Increase of temperature or gain of heat from environment(summer).	Passage of heat through **skin and hair** of the body
5	**Shivering**	Heat is produced by the contraction of musles expose to very cold condition.	Shivering is **compensating mechanism** in a body during which large amount of heat produced.

III.HEAT LOSS

Let us now summarize the heat loss from the body through some transmission process. They are listed below.

S.No	Transmission process	Amount of heat lost	Medium or process of transmission
1	**Conduction**	Heat lost by 3-4%	By conduction from the body to the objects like bed, chair, etc.
2	**Convection**	Heat lost by 15%	By convection current from the body to air (surroundings).
3	**Radiation**	Heat lost by 6-7%	By transfer of heat in the form of IR radiation from the body to surrounding air.
4	**Evapouration**	Heat lost by 20-22%	Since animals have no sweat glands and hence heat is lost by evaporation of water only from mouth. Due to the evaporation of water from skin and lungs called insensible water loss (perspiration) during summer by secretion of sweat at the rate of 50ml per hour. If sweating is more heat loss is more.
5	**Panting (for animals)**	Heat is lost to surroundings.	Due to evaporation of water from lungs and saliva by means of panting represented by rapid and shallow breathing associated with dripping of more saliva.

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IV.BEHAVIOURAL AJDUSTMENTS IN COLD AND HOT ENVIRONMENTS

Cold Environment:

Sl.NO	Activities	Reason
1	**Muscular contractions**	Heat is produced by muscular contraction through hand rubbing, put stamping, sporting activities, etc.
2	**Use of garments**	By using winter garments like woolen or thick cotton so that body heat will not escape through non conductor.
3	**Behavioral methods**	Curling and huddling (reduction of exposed part of the body), sitting close to fire and using hot drinks.
4	**Taking food stuff**	By eating food stuff having more protein (high calorific value).

Hot environment:

Sl.No.	Activities	Reason
1	**Muscular activities**	By decreasing the muscular and sporting activities thereby preventing muscular contraction.
2	**Use of garments**	Wearing thin and bright coloured (white) shirts that will reflect the heat rays.
3	**Behavioral adjustments**	1). Lying on cold floor with bare body. 2.) By taking bath in cold water. 3).Taking rest under a tree.
4	**Food stuffs**	By taking cool drinks, less food intake (protein food).
5	**Animals**	Since animals like snake and frog not having hypothalamic thermostat system, they go inside a hole in the earth and reside by the side of water resources (ponds and rivers)

REGULATION OF BODY TEMPERATURE BY HYPOTHALAMUS (BIOTHERMOSTAT):

The body temperature is regulated by hypothalamus. There are two centers in hypothalamus which are connected with temperature regulation

V.HEAT LOSS CENTER AND HEAT GAIN CENTER

HEAT LOSS CENTER:

This center is situated in preoptic nucleus of **anterior hypothalamus**. The neurons of this nucleus are sensitive to heat when body temperature is increased the warm blood stimulates the heat sensitive neurons. Now this center reduces body temperature by two methods.

1. INCREASING THE SWEAT SECRETION:

The anterior hypothalamic center (heat loss center) sends inhibitory impulses to the sympathetic center in posterior hypothalamus. Normally, this sympathetic centers causes constriction of blood vessels in skin. when these centers are inhibited, there is peripheral vasodilatation. Now blood flow through skin increases, causing excess **sweating**. Evaporation of water from sweating increases the heat loss thereby decreasing the body temperature.

2. DECREASING HEAT PRODUCTION:

The mechanisms involved in heat productions like shivering and chemical (metabolic) reaction are inhibited.

HEAT GAIN CENTER:

This is otherwise known as **heat production center**. This is situated in **posterior** hypothalamic nucleus. This part of hypothalamus has neurons, which are sensitive to cold when body temperature is reduced this center plays important role in maintaining the temperature by preventing heat loss from body and by increasing heat production.

When body temperature becomes low, the heat gain center in posterior nucleus of hypothalamus is simulated. This activates the sympathetic centers which in turn cause vasoconstriction in skin and reduction in blood flow. Due to reduce blood flow to skin, sweat secretion is decreased and thereby heat loss is prevented.
Increase in the production of heat is done by two processes: 1. Shivering, 2. Increased metabolic reactions.

1. Shivering:

The primary motor center for shivering is situated in posterior hypothalamus. This is activated by heat production center when the body temperature is low at once shivering occurs producing enormous heat due to severe muscular activities. Hence body temperature rises.

2. Increased metabolic reactions:

The sympathetic centers which are activated by heat production stimulate the secretion of adrenaline and nonadrenaline. These hormones increase the heat production by the acceleration of cellular metabolic activities. Simultaneously hypothalamus stimulate thyroid to release hormones from pituitary. This in turn, release thyroxin from thyroid. This thyroxin accelerates metabolic activities so that heat production is increased.

VI.CONCLUSION

So far we have briefly discussed about the maintenance of body temperature by different mechanism like heat loss control and heat gain control which are located in hypothalamus in brain. We have also discussed briefly about the variation of body temperature by due factors. The maintenance of temperature regulation is an important factor through our over life for the regular work, sleep, rest etc, and is clearly being done by hypothalamus.

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