MPCC-102: PHYSIOLOGY OF EXERCISE

UNIT 5 – Climatic conditions and sports performance and ergogenic aids:

5.1 Thermoregulation:

Thermoregulation is a process that allows your body to maintain its core internal temperature. All thermoregulation mechanisms are designed to return your body to homeostasis. This is a state of equilibrium.

Thermoregulation is the ability of an organism to maintain a core body temperature, which is 37° C (98°F) within an optimal physiological range. Thermoregulation is also called as the heat regulation.

Body temperature is regulated mainly by the anterior and posterior hypothalamus centers. The anterior center control heat dissipation events by causing vasodilation in the blood vessels of the skin while at the same time stimulating activities of the respiratory center **and the Sweat gland. The posterior center controls heat conservation events by causing vasoconstriction** in the skin blood vessels, **shivering** activities and the **erection of skin hairs** (purpose of increasing the insulation of the skin).

Releasing epinephrine and norepinephrine hormones from the adrenal medulla by **increasing the metabolic rate** and vasoconstriction in the skin blood vessels **regulates the body temperature** by both heat loss and heat conservation events.

When exercising in hot weather, temperature regulation involves vasodilation and sweating whereas work in cold weather includes vasoconstriction and shivering.

5.2 Sports performance in hot climate, Cool Climate, high altitude:

- **Exercise and sports performance in cold climate:**

Increasing year-round participation in Such Sporting activities as the Triathlon, Scuba diving, Running, Cycling and long distance swimming has sparked new interest in and concern about exercise in the cold. Some occupations require employees to work in cold conditions that can limit their performance. For these reasons, understanding the physiological responses and health risks associated with cold stress are important issue in exercise science.

Exercise in cold climate involves vasoconstriction and shivering. Vasoconstriction of the skin blood vessels reduces heat loss by reducing heat transfer from the deep core to the skin surface. On the other hand shivering increases heat production.

Cooling muscles causes it to become weaker. The nervous system responds to muscle cooling by altering the normal muscle fibre recruitment patterns. Some researchers have suggested that these changes in fibre section for force development decrease the efficiency of the muscles action. **If clothing insulation and exercise metabolism is sufficient to maintain the athlete's body temperature in the cold, then exercise performance may be unimpaired. However as fatigue sets in and muscle activity shows body heat production gradually decreases. Long distance running, swimming and skiing in the cold can be exposed the participant to such Condition.**

- **Exercise and sports performance in hot climate:**

Temperature Regulation during exercise in hot climate climates involves vasodilation and sweating as a function of the anterior hypothalamus of the brain. Vasodilation increases blood flow and **enhances the transfer of metabolic heat** from the deep core to the skin surface. On the other hand, **secretion of sweat** provides water **for evaporative cooling**.

General increase in blood flow from the deep core to the skin and limbs by the circulatory system allows for a greater moment of heat to be lost by conduction, convection, radiation and evaporation.

When environmental temperature rise above the skin temperature (Normally around 34^0C), the body is actually gaining heat by radiation and convection. Thus only means for heat loss temperatures above skin temperature is by evaporative sweating. At the same time, however, if the rate of metabolism is increased by exercise, sweating must be called upon at lower temperature.

Hot and dry climate:

When a person works or plays in hot and dry climate cooling of the skin is brought about by evaporation of sweat, because dry air can observe considerable moisture. The loss of body fluid or sweating can lead to dehydration. This drop of body fluid (dehydration) is accompanied by an **increase in body temperature, reduction in cardiac output, stroke volume, blood volume, and velocity of blood flow and a fall in blood pressure. All of these can and will adversely effect of Athletic performance.**

Hot humid climates:

In hot and humid climate, evaporative cooling is impaired by the air Moisture. Under these conditions no heat dissipation can occur. So the metabolic heat accumulates and rises body temperature until death occurs (108^o F - 110^o F). In this climate **heart has to work much harder** than normal **because the amount of blood flowing through the skin is generally increased** (due to vasodilation) **and highly saturated with oxygen**. **Under these conditions less oxygen is available to the working muscles** and hence lactic acid starts to accumulate in the blood at a much lower intensity of work. It can have an adverse effect on athletic performance in some events.

Hot and humid climate is considerably more stressful for the athletic performance than the hot and dry climate.

- **Exercise and sports performance in high Altitude:**

It is an established fact that at altitude for over 5,000 feet (1524 M), the ability to perform physical work is affected - the higher the altitude, the more severe the effects.

1. Decrease in total barometric pressure:

At high altitude the total **barometric pressure decreases because of the decreased weight of the atmosphere**. The **force of gravity is somewhat smaller at high altitude than at sea level. The energy required to lift the body as in the pole vault and high jump would be theoretically decreased.**

2. Decrease in partial pressure of oxygen (Po_2):

The decreased oxygen pressure at high altitude decreases the arterial oxygen saturation of blood which, in turn, decreases the amount of oxygen available to the working tissue. Physiologically the decreased PO2 is the most critical factor of high altitude because the **individual's work capacity depends largely upon his ability to take in and utilise oxygen rapidly.**

3. Decrease in density of air:

Decreased density of the air reduces the resistance of the airways to the flow of air into and out of the lungs. The reduced density of the air acts in favour of those performance in which air resistance is a factor (Sprint type activities, Jumping, Pole-vaulting, Weight throwing and other high velocity events which are powered largely by anaerobic metabolism). In the 1968 Olympic Games in Mexico City, the four throwing event had theoretical advantage of: 6 cm for the Shot put; 53 cm for the Hammer throw; 69 cm for the javelin and 162 cm for the discus.

4. Cooler and Dryer air:

At high altitude the cooler temperature makes work more pleasant and in fact can help performances involving prolonged exertion, the **dry air increase the water loss** from the respiratory tract which may contribute to the **dehydration** of exercise and also the dryness of the throat.

5. Sunburn and Snow Blindness:

It is common for **Skiers and mountaineers to experience Sunburn and Snow blindness at high altitude**. **Solar radiation is much more intense at high altitude than at sea level** and because the skin tends to be Dryer at high altitude.

There is no doubt that in all aerobic types of events, in which prolonged exertion is involved there is a decrement in performance at high altitude. In swimming this means that a decrease in performance takes place at any event over 200 metres, and in running, at any distance of 800 metres or more. **Thus, anaerobic activity** (any activity that can be performed before the depletion of readily available energy stores in the body) **will not be affected by the decreased Po_2 at high altitude, whereas those activities requiring energy from the aerobic (with oxygen) pathways are affected significantly.**