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Effects of Warming-Up on Human Body System: A Physiological Point of View with Theoretical Approach

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Abstract

There are several research has been done regarding effects of Warming up on human body in various system. Warming up was not a preventive intervention but a matter of survival. In this hostile environment with scarce food and ubiquitous dangers, human genes were selected to optimize aerobic metabolic pathways and conserve energy for potential future famines. Cardiac and vascular functions were continuously challenged by intermittent bouts of high-intensity physical activity and adapted to meet the metabolic demands of the working skeletal muscle under these conditions.

Warming up has been shown to have effects on nervous system ,cardiovascular system ,respiratory system , digestion system glucose metabolism, skeletal muscle function, ventilator muscle strength, bone stability, locomotors coordination, psychological well-being, and other organ functions.

Introduction

Warming up is a short time activity carried out prior to any severe or skilled activity. It is important to warm up before exercising which is usually done by including ten minutes of light activities, such as slow jog, calisthenics and stretching. Through such a workout, we try to bring the group of muscles expected to take part in the activity to follow, in a state of readiness to respond efficiently. It makes the body more flexible and thus we can avoid injuries resulting from sudden strain etc. When we stretch our muscles slowly, it results in increased blood flow and prevents injuries to the muscles, tendons, ligaments. Warm up exercises are not supposed to be done vigorously. Any light exercise such as spot jogging, cycling at slow pace, walking can be done. Warming up also prevents fatigue, muscle pulls and soreness

Effects of Exercise

Metabolic Rate

Warming up that involves intense bursts of energy also stimulates the release of thyroxin from your thyroid gland. Exercise can help you control or reduce your weight because testosterone and thyroxin speed up your metabolism.

Blood Sugar

Blood insulin levels begin decreasing after 10 minutes of Warming up might increase your sensitivity to insulin at rest, says Bodybuilding.com.

Blood Flow

The adrenal medulla releases epinephrine during Warming up and increases epinephrine levels at higher exercise intensities. Epinephrine increases the amount of blood that your heart pumps. Epinephrine also enhances your ability to use muscles during exercise by widening blood vessels, which lets your muscles get more oxygen-rich blood.

Psychological Effects

The effects of Warming up on your endocrine system might positively affect your mental state. Exercise-induced testosterone might increase confidence and libido. Conversely, low testosterone levels might inhibit your motivation, self-confidence, concentration and memory; Endorphins block your sensitivity to pain, and can reduce tension or anxiety by inducing a sense of euphoria.

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Pituitary Gland

A marble-sized gland located at the base of the brain, the pituitary is controlled by the hypothalamus gland. During Warming up, the pituitary gland releases the human growth hormone. This hormone tells the body to increase bone, muscle and tissue production. The thyroid and adrenal glands are regulated by the pituitary gland.

Thyroid Gland

When you begin to Warming up, the thyroid gland, located at the base of the neck, sends out hormones to regulate the body's temperature, heart rate and blood pressure. The level of alertness and concentration necessary to work at an intense level also come from the thyroid gland hormones.

Adrenal Glands

Located on top of the kidneys, the adrenal glands are responsible for the release of cortisol into the bloodstream. Cortisol levels control blood pressure and glucose levels and act as an anti-inflammatory agent. A second hormone released by the adrenal glands during exercise is aldosterone. This hormone is responsible for regulating hydration. Finally, the fight or flight hormone, adrenaline, is produced during exercise. Adrenaline regulates the speed of the heart as well as the strength of its contractions and causes stored carbohydrates to be rapidly turned over into energy.

Pancreas

The secretion of insulin and glucagon, hormones that control sugar levels in the body, comes from the pancreas. Individuals with diabetes are resistant to insulin. Warming up improves insulin sensitivity, allowing many diabetics to reduce their reliance on insulin injections.

Adenosine Triphosphate

Warming up there is an immediate requirement for increased supply of energy and there is only enough ATP stored for 1–2 seconds of work and therefore rapid ways to resynthesize ATP are required.

The Adenylate Kinase Reaction

One alternative source is the adenylate kinase reaction, which results in ATP production from the conversion of two molecules of adenosine diphosphate (ADP) to adenosine monophosphate (AMP) and ATP. However, of greater quantitative importance is the utilization of phosphocreatine stored in the muscle.

Phosphocreatine System

Skeletal muscle stores of PC provide quantitatively the greatest contribution to energy provision in the first 10 s of high intensity activities such as sprinting. PCr stores are rapidly depleted but they provide an important buffer in the first few seconds of Warming up before other aspects of metabolism are activated.

Glycolsis

The conversion of glycogen to lactic acid yields only 3 mol ATP per molecule of glycogen, but this can occur in the absence of oxygen and the maximum rate of glycolysis can be reached within a few seconds of the onset of exercise. In contrast, complete breakdown of glycogen via glycolysis, the Krebs cycle and the ETC yields 39 ATP per molecule of glycogen.

Fat Metabolism

Fat is the preferred substrate and dominates the energy contribution to resting metabolism; carbohydrate stores are available when energy requirements increase, for example at the

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onset of exercise. As exercise continues, however, fat metabolism may become more important, particularly if muscle glycogen stores become depleted.

Respiratory System

During Warming up, ventilation might increase from resting values of around 5–6 litre min^{-1} to >100 litre min^{-1}. Ventilation increases linearly with increases in work rate at submaximal exercise intensities. Oxygen consumption also increases linearly with increasing work rate at submaximal intensities. In an average young male, resting oxygen consumption is about 250 ml min^{-1} and in an endurance athlete oxygen consumption during very high intensity exercise might reach 5000 ml min^{-1}. The increase in pulmonary ventilation is attributable to a combination of increases in tidal volume and respiratory rate and closely matches the increase in oxygen uptake and carbon dioxide output. Breathing capacity, however, does not reach its maximum even during strenuous exercise and it is not responsible for the limitation in oxygen delivery to muscles seen during high intensity activity. Haemoglobin continues to be fully saturated with oxygen throughout exercise in people with normal respiratory function.

Changes in Arterial Blood Gases

During Warming up, when sufficient oxygen for flux through the Krebs cycle is not available, the increased reliance on glycolysis results in increased accumulation of lactic acid, which initially leads to an increase in Pa_{CO2}. However, this is counteracted by the stimulation of ventilation and as a result Pa_{CO2} is decreased.

Changes in Ventilation

Ventilation increases abruptly in the initial stages of Warming up and is then followed by a more gradual increase. The rapid rise in ventilation at the onset of exercise is thought to be attributable to motor centre activity and afferent impulses from proprioceptors of the limbs, joints and muscles. Overall, a number of factors have been suggested for the increase in ventilation, which occurs with exercise. The respiratory rate might remain elevated after heavy exercise for up to 1–2 h.

Circulatory Changes

The increase in blood flow to muscles requires an increase in the cardiac output, which is in direct proportion to the increase in oxygen consumption. The cardiac output is increased by both a rise in the heart rate and the stroke volume attributable to a more complete emptying of the heart by a forcible systolic contraction.

Heart rate and stroke volume increase to about 90% of their maximum values during strenuous exercise and cardiovascular function is the limiting factor for oxygen delivery to the tissues. Oxygen utilization by the body can never be more than the rate at which the cardiovascular system can transport oxygen to the tissues. There is only a moderate increase in blood pressure secondary to the rise in cardiac output. This is caused by stretching of the walls of the arterioles and vasodilatation, which in combination reduce overall peripheral vascular resistance. There is a large increase in venous return as a consequence of muscular contraction, blood diversion from the viscera and vasoconstriction.

Maximum Oxygen Consumption

As work rate is increased, oxygen uptake increases linearly. However, there is an upper limit to oxygen uptake and, therefore, above a certain work rate oxygen consumption reaches a plateau. This is termed the maximal oxygen uptake .

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The Pulmonary System

Pulmonary limitations to are evident in some situations, such as when exercising at high altitudes and in individuals with asthma or other types of chronic obstructive pulmonary disease. However, in most individuals exercising at sea level the lungs perform their role of saturating arterial blood with oxygen extremely effectively as described previously.

Cardiac Output

As described previously, endurance training results in increased cardiac output through increased stroke volume.

Oxygen Carrying Capacity of the Blood

A reduction in the oxygen carrying capacity in conditions such as anaemia produces fatigue and shortness of breath on mild exertion. Some athletes have tried to increase red blood cell levels by removing, storing and then reinfusing them.

Skeletal Muscle Limitations

The ability of the cardiorespiratory system to deliver oxygen to the working muscles rather than the ability of the muscles to consume the oxygen is limiting.

Body Temperature

The hypothalamus is responsible for thermoregulation and it is important that this process is effective. However, during exercise in hot, humid conditions evaporative heat loss through sweating might not be able to remove sufficient heat from the body. Regulation of body temperature may fail and temperatures may be high enough to cause heat stroke.

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