

THEORIES ON FATIGUE OCCURRENCE

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Fatigue is a physiological, reversible state of the body that occurs after a strenuous effort (significant volume and intensity), manifested by a diminished capacity for psychophysical effort.

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Fatigue occurs based on the diminution of the general functional capacity or of some somatic or psychic components (Bougoignon). Fatigue is a “multifactorial nature” state (Brătilă F., 2002), that causes the diminution of the capacity for performance. Being an unpleasant physiological reaction, of general or local discomfort, this one may be diminished and even solved by means of rest.

Generally, fatigue state may occur after some important physical and/or psychical activities, against the background of some special situations, such as:

- precarious state of health;
- hard living and labour conditions;
- unfavourable factors of the physical and socio-professional environment;
- additional requests for performing physical and/or psychical efforts (sports effort).

The experts in this field were interested in defining the fatigue concept. Thus, the fatigue state may be defined as follows:

- “reversible diminution of the physical and/or psychical performance capacity that allows you to continue the effort at the cost of a considerable energetic super price and of the diminution of the physical precision” (Weineck J., 1995);
- “as a reversible physiological state, manifested by the diminution of the physical or psychical performance capacity occurred after a strenuous effort and that disappears through rest” (Bota C., 2000);

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- “physiological reaction, protection by inhibition at the level of the CNS that, according to a scientific law and logically, follows a psycho-physiological activity of a certain duration and intensity” (Drăgan I., 2002);
- “reversible physiological process that protects the body against a total exhaustion” (Gurău A., 2004).

Theories on Fatigue’ Occurrence

The arguments used for a precise elucidation of fatigue mechanisms are multiple, as this state has to be multilaterally approached, as the human body functions and behaves as a cybernetic, complex, open, progressive system, capable of regulation and autoregulation. The studies on fatigue’ mechanisms led to the creation of new theories.

Energetic Material Exhaustion’ Theory (Schiff)

Schiff states that fatigue occurs when the energetic substances that maintain the muscle contraction are exhausted, respectively the muscle (as in case of an engine) runs out of fuel. The quantity of ATP, phosphogene, glycogen gradually diminishes and when it is exhausted the muscle does not contract anymore.

This theory proved to be incomplete, as a muscle that “worked” under a current of a certain intensity and that, when the fatigue occurs this one is exhausted, it may resume the contraction if it is stimulated by a higher current than the first one. The conclusion is that the muscle would not have contracted again if the energetic substances had been entirely exhausted. It may be considered that fatigue occurs before the exhaustion of the substances that ensure the muscular contraction.

Specific Toxin Theory (Weichardt)

According to this author, fatigue occurs due to a specific toxin named conotoxin. Weichardt, who detected this toxin, stated that injecting it to rested animals caused visible signs of fatigue, even if these ones weren’t doing any physical activity. Also, there was stated that, based on conotoxin, there were prepared antitoxic salts that had visible results in the disease treatment.

The presentations and works on this toxin, that were announcing the perspectives of this great discovery, were widely published in newspapers at the beginning of the 20th century. The prepared salts had no results and that toxin could not be obtained by other chemists, doctors, physiologists or pharmaceutical chemists, so this theory clearly proved to be ungrounded.

Intoxication with Muscle Metabolism Products' Theory (Hill and Pflüger)

It is well known that physical activity produces toxic substances that are not totally eliminated so, gradually, these substances diminish the capacity for supporting the effort. When there is a great quantity of toxins, the muscle contraction ceases.

The authors of these theories stated that if an exhausted muscle is washed with physiological serum, this one recovers and it contracts again – the washing eliminated the toxic substances. They also demonstrated that a muscle treated with lactic acid gets tired without doing any physical activity (it is well known that during muscle effort there is produced lactic acid). Also, there was proved, based on experiments, that the muscle gets tired before the toxic substances, produced by the muscle metabolism, are accumulated in great quantities. This theory, even if it is accepted by many experts, did not prove the occurrence of fatigue.

Excitation – Inhibition Equilibrium' Theory (Pavlov and Secenov)

Another theory states that fatigue is directly related to the activity of the cerebral cortex: an intense muscle activity represents also an intense activity at the level of the brain motor centres, this disturbing the excitation/inhibition equilibrium, especially the inhibition that disturbs the reflex processes and disturbs muscle coordination.

Insufficient Supply of Oxygen' Theory (Verwon)

According to this theory, fatigue occurs as a consequence of working without oxygen or with a small quantity of oxygen; the theory is incomplete as the muscle is capable of working if there is no oxygen or in case of a small quantity.

Heterochronism' Theory

Heterochronism occurs when between the nerve and the muscle there is no normal sequence, being exceeded certain limits; the excitation (command) brought through the nerve does not take place and the contraction is not produced. This theory states that fatigue forbids the transmission of the nerve impulse to the muscles, disturbing the normal sequence (isochronism) between the nerve and the muscle.

Researches proved the importance of the excitability for the good operation of the neuromuscular system, emphasizing, in the same time, that fatigue depends not only on the relation nerve-muscle but also on other component systems of the body. The previous theories did not take into consideration this phenomenon of body unity and they worked on muscles isolated from the rest of the body, ignoring the most important organ, the nervous system.

The progresses obtained in physiology, especially related to the functions of the central nervous system, allowed also to explain the causes that lead to fatigue.

At present, this phenomenon is treated as a normal physiological state that diminishes the effort capacity. The moment when the fatigue occurs depends on more factors, among which: individual particularities, activity characteristic, environmental conditions, activity' intensity and volume, the way it continues along the time etc.

To the heterochronism theory there is also added the fact that fatigue is not due only to the relation between the nerve and the muscle, as the muscle contractions produce significant modifications in the entire body, the muscles involving all the functions of the organism.

The effort capacity and, related to this one, the moment the fatigue occurs, is controlled and conditioned by the CNS and, especially, by the cerebral cortex.

Thermo-Regulation' Theory

The thermo-regulation process (the equilibrium between heat' production and loss) is disturbed due to the fact that the body heats due to the effort, this leading to the disturbance of body' homeostasis. The theory does not have enough arguments, because there are not explained the other biologic modifications.

The presented theories unilaterally explained the fatigue state by local phenomena installed at the neuromuscular level.

For a correct approach of all the states of human body there is taken into consideration the close relation between all the components of the body, as elements of the same open system, that are permanently exchanging substances, energy and information. The human body, as a system with automatic regulation, disposes of some measures that are put in motion for settling and resettling its operation and equilibrium. Fatigue occurs gradually, body mechanisms interfering for the equilibrium of the human body, this leading to a delay in the occurrence of the fatigue.

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