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Research Article

Physiology Of Exercise and Nutrition

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Abstract:

Physiology is an academic subject that deals with the mechanisms of the human body function. Any kind of activity requires alteration in the normal body function. It is important to understand the normal body function first and then the limits of the functions to understand the exceptional feats performed by the athlete. This understanding is essential to alter the body's functions to suit the needs of sports. Exercise and a good diet are both important for health. A healthy diet includes three main nutrients, namely carbohydrates, proteins and fats. Diet provides the energy we need from the correct proportions of nutrients. It should have a wide variety of different foods and drinks to ensure all the vitamins and minerals.

Keywords: Exercise Physiology, Sports Nutrition, Overtraining Syndrome, VO2 Max, Glycogen and Energy Metabolism

Introduction

Physiology' is an academic subject which deals with the mechanism of human body functions. Any kind of activity requires alteration in the normal body function. It is important to understand the normal body function first and then the limits of the functions to understand the exceptional feats performed by the athlete. This understanding is essential to alter the body functions to suit the needs of the sports. Basically there is no difference in the mechanism of activities of an athlete and a normal human being. Only the degree of activity changes. The heart rate at steady state indicates the requirement of blood in the body. A situation, where two persons performing the same exercise produce different steady state heart rate, is a clear indication of different degree of adaptation to exercise. The person with lower heart rate is better adapted exercise. The heart rate should show decrease with training, if the training is appropriate. This is applicable for any kind of endurance, strength & speed training.

BASAL HEART RATE

Basal heart rate is the heart measured after 8 hrs of complete physical and mental rest. Normally this heart rate is taken before a person gets up from his bed after overnight sleep. Basal heart rate is the indicator of recovery in a healthy person. Increase in basal heart rate shows insufficient recovery. It is possible that basal pulse rate may increase during training days of the week; however, it should come down to normal level after the week and recovery. Again, in the next week, with the same load, if the basal heart rate does not increase then it may be considered as a sign of adaptation with the load. Decrease in basal heart rate is clear evidence of adaptation to endurance training. However, a quick reduction in basal heart rate indicates overtraining. So, the basal heart rate value should be interpreted with care.

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MAXIMUM OXYGEN CONSUMPTION (VO₂ max)

Maximum oxygen consumption or VO₂ max indicates a person's maximum limit of the oxygen transport system. Although, after crossing the anaerobic threshold work load, anaerobic component may become dominant, a man is still capable of increasing aerobic energy production which is more cost efficient than anaerobic one. Higher VO₂ max bears less significance for the sports requiring higher degree of anaerobic work.

ANAEROBIC THRESHOLD (AT)

Anaerobic threshold point is the exercise load after which anaerobic metabolism takes dominance. Once the threshold point is exceeded the exercise can not be continued for a longer duration because of the accumulation of lactic acid in the muscle and other consequences. AT running speed is the optimum speed in middle- and long-distance performance. It is the factor which may determine the result in competition. An example will make it clear.

Athlete A has VO₂ max 70 ml./kg./min. at 170 beats/min. and AT speed 20 km./hr.

Athlete B has VO₂ max 70 ml./kg./min. at 170 beats/min. and AT speed 22 km./hr.

BURN OUT ATHLETE

The term "Burning out" is a recent introduction in the field of sports; to achieve better result in competitive sports many athletes push themselves to extent where 'training' becomes 'overtraining'. The changes in the body due to overtraining are sometimes taken as positive changes due to training. If such a condition is prolonged then the human body is forced to produce the performance by damaging its cells and tissues. Ultimately the athlete may become forced to discontinue his training due to injury or illness. Under these circumstances, athlete is called as "Burn out athlete".

SYMPTOMS OF SYMPATHETIC TYPE OF OVERTRAINING

1. Increased heart rate at rest and during exercise.
2. Show recovery after exercise.
3. Poor appetite and weight loss.
4. Mental instability and irritability increased.
5. Increased systolic and diastolic blood pressure in resting state.
6. Menstrual irregularities, oligomenorrhea or amenorrhea in females.
7. Disturbed sleep pattern (difficulties in falling asleep and early wakening)

SYMPTOMS OF PARASYMPATHETIC TYPE OF OVERTRAINING

1. Low or normal resting pulse rate.
2. Relatively low exercise pulse rate.
3. Fast recovery of heart rate after exercise.
4. Hypoglycemia during exercise.
5. Good appetite.
6. Normal sleep, lethargy and depression.
7. Low resting blood pressure.
8. Low plasma lactates during sub maximal and maximal exercise. (Lactate paradox)

TYPES OF OVERTRAINING

Depending on the affected organ & systems and pathogenesis in the body overtraining could be classified in three categories:

1. MECHANICAL OVERTRAINING: -

It involves the locomotors system, bone, joint and cartilage. These tissues get relatively low blood supply due to poor vascularity and as a consequence they show a low metabolic rate and slow recovery. Overloading by quick increases in load, high volume and inappropriate training material (shoes, equipments) may lead to pathogenesis of the connective tissue systems. This leads to frequent injuries of the affected parts.

2. METABOLIC OVERTRAINING OR OVER REACHING

High intensity and high-volume training leads to exhaustion of glycogen stores. This leads to very low ATP formation and finally breakdown of ADP to AMP and IMP. IMP forms uric and ammonia by further process and this creates a misbalance in acid-base regulation & overload the kidney.

3. OVERTRAINING SYNDROME OF STALENESS: -

It is featured by premature fatigue during training or exercise, decline in performance, mood changes, emotional instability, and decreased motivation. This situation may affect the immune system also and the athlete becomes vulnerable to infective diseases.

PREVENTION OF OVERTRAINING

1. Develop a well-balanced training program, with individual adjustment.
2. Have field or laboratory performance tests at regular intervals.
3. Emphasize proper diet (>55% carbohydrate).
4. Have the athlete keep training log in which resting heart rate and body weight is registered.

DIET AND NUTRITION

Exercise and good diet are both important for health. There is an important development in the knowledge of sports nutrition. A healthy diet includes three main nutrients, namely carbohydrate, proteins and fats. Diet provides the energy we need from the correct proportions of the nutrients. It should have wide variety of different foods and drinks to ensure all the vitamins and minerals.

NORMAL PEOPLE NUTRITION PROPORTION: -

Fat 30.35 %
 Protein 10.15 %
 Carbohydrates +55.00 %

HIGHLY ACTIVE PEOPLE NUTRITION PROPORTION: -

Very active people need more energy for example, endurance athletes need about 5000 cal and elite cyclists need 10000 cal. This extra energy should be obtained by increasing carbohydrate than by eating more fat or protein. So, athletes need larger proportion of carbohydrates.

Carbohydrates 60-75 %
 Protein 10-15 %
 Fat 20-30 %

CARBOHYDRATES AND FAT

Our diet provides energy from carbohydrates and fat. Carbohydrates are stores in the form of Glycogen in the liver and muscles. Liver glycogen is essentially used to maintain blood glucose level in blood Fat is stored in the fat tissues and muscle cells. These are carried by blood to the muscles for use. The body fat content of an average male adult is about 15 % and of female adult is 25%; Elite endurance athletes have less body fat.

ADINOSIN TRI PHOSPHATE (ATP)

During exercise the working muscles convert stored energy into kinetic energy and heat. Carbohydrate and fatty acids burn up in the presence of oxygen to make a chemical called ATP. ATP is the substance that actually makes muscle work. Because oxygen is needed this process is called "aerobic metabolism".

FACTORS INFLUENCING FUEL CHOICES

The exercise intensity and the working muscles which determine Fuel choices. The use of oxygen by the body is a key factor in determining fuel use and performance efficiency. Everybody had his own maximum oxygen uptake. Two people are running at the same speed using the same amount of oxygen. The one whose % of VO₂ max is higher will be feeling greater stress. An extra energy needed may not be completely covered by aerobic metabolism. Extra energy is provided an

aerobically which allows for a more rapid breakdown of carbohydrates without needing oxygen. Lactic acid is one of the causes of fatigue; therefore, anaerobic system is useful for a short-time.

ENERGY INTAKE BEFORE EXERCISE

It is clear that glycogen is essential for both to prolong aerobic metabolism and to fuel anaerobic metabolism. So, increase in glycogen stores in muscles can increase sports performance both in terms of the intensity and the duration of exercise. Without glycogen the muscle will be forced to rely on fat as a fuel and it will not be possible to sustain intensive exercise at optimum speed. The individuals who consume carbohydrate rich diets are better able to endure exercise. Carbohydrate loading can be achieved by gradually reducing the amount of training while increasing carbohydrate intake during 3-4 days prior to competition.

ENERGY INTAKE IMMEDIATELY (Before and During Exercise)

There is lot of debate and confusion regarding the diet to be taken immediately before and during exercise. However, following suggestions should help athletes:

1. Athletes should not eat within 3-4 hours of the start of a race.
2. Carbohydrates in either solid or liquid form can be beneficial.
3. Heavy meals should be avoided.
4. Glucose solution taken half an hour before exercise has been found to reduce performance.
5. Glucose solution taken immediately before exercise helps performances.
6. Fructose (fruit juices) does not raise insulin level and does not limit fatty acid availability but it restores glycogen at less than half the speed of sucrose, glucose or starch.
7. Endurance athletes can drink glucose or fructose solution throughout prolonged exercise.
8. Carbohydrate in the form of confectionery may be beneficial in long distance events throughout the race.

ENERGY INTAKE AFTER EXERCISE

Endurance athletes, sprinters, and game players all need replacement is essential for recovery. A practical rule for both men and women athletes are to eat 8-9 Gms Of carbohydrate per kg, Body weight per day. Glycogen is restored to the muscles at a rate of about 5% per hour. This takes at least about 20 hours to fully replenish stocks. During the first two hours after exercise glycogen is restored at a faster rate at 7%. So it is better for athletes to eat or drink carbohydrate as soon as after exercise. Larger carbohydrate meals don't appear to be more effective. Simple or complex carbohydrates in solid or liquid forms will be effective.

CONCLUSION

Physiology deals with the mechanism of human body functions. Research showed that optimal diet can improve sports performance but it must be remembered that muscle glycogen will alone not guarantee successful performance of an athlete. At least one must not lose competition because of insufficient glycogen stores.

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