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REGULATION OF PULMONARY OXYGEN EXCHANGE USING THERAPEUTIC PHYSICAL EDUCATION

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ABSTRACT
The higher the maximum oxygen demand of an athlete, the greater the chance to catch a high speed in the distance, and the higher the sports result. For example, In men who do not play sports, the maximum oxygen requirement is 3-3.5l-min. In highly qualified long-distance athletes, this indicator is 5-6l-min.

Keywords: Pulmonary oxygen exchange, physiological capacity, physiological capacity , maximal capacity, submaximal capacity, high capacity, moderate capacity, physiological responses, physical load, cyclic exercise, lactate or phosphogenic, glycolytic, aerobic or oxygen.

Introduction

The indicator of how much time you can perform a certain exercise is also calculated from the main indicators. Depending on the physiological strength, physical exercises are divided into four.

1 Maximum power - exercise time up to 20 seconds.
2 Submaximal power - from 20 seconds to 3-5 minutes.
3 High power - from 3-5 minutes to 30-40 minutes.
4 Medium strength – Lasts more than 40 minutes.

When defining physiological strength, attention is paid to the extent to which physiological reactions change. The appearance and size of the physiological response to a certain physical load depends on the functional capabilities of the leading physiological systems of the body. That is, the same physical load affects different people differently.

and aerobic exercises depending on the source of energy. When performing various cyclical exercises, energy generation by anaerobic and aerobic means is in different proportions. Anaerobic and aerobic energy production consists of three systems.

1 . Lactate or phosphogen .
2 . Lactate or glycolytic.
3 . Aerobic or oxygenated.

The operating limits of these three systems overlap each other. Cyclic exercises are divided into anaerobic and aerobic exercises depending on the share of anaerobic and aerobic energy systems in performing these exercises.

Anaerobic exercises are divided into three groups .

1 Maximum anaerobic power exercises.

2 Pre-maximal anaerobic power exercises.

3 Submaximal anaerobic power exercises.

maximal anaerobic power work is mainly carried out anaerobically. 90-100% of the total energy expenditure is provided by the anaerobic pathway. This work mainly takes energy from the breakdown of phosphorous compounds (AUF, KF) and partly through lactate or glycolytic pathways. During maximum anaerobic work, mature athletes use 120 kcal/min of energy. (short- distance running, short-distance swimming, short-distance cycling).

Due to the fact that maximal anaerobic exercise does not last long, the activity of the blood circulation and respiratory systems does not increase to a high level. In order to achieve high results in such exercises, the muscle control center, muscle activity, size and power of the phosphogenic energy system should be high.

75-85% of the energy expended during maximal pre-anaerobic exercise is produced by the breakdown of phosphorus organic compounds and glucose to lactic acid. Mature athletes use up to 50-100 kcal per minute when performing such exercises. The duration of such exercises is from 20 seconds to 50 seconds (running up to 200 meters, swimming for 100 meters, skating for 500 meters are considered maximal pre-anaerobic exercises .). The oxygen delivery system is important in providing energy for these exercises. Especially if the exercise lasts longer . For example, when running 400 meters, the heart rate may rise to its maximum at the end of the distance. Oxygen consumption at the end of the distance is 70-80 % of the maximum oxygen consumption. the amount of lactic acid in the blood reaches up to 15 mmol/l in leading athletes. the amount of sugar in the blood increases slightly.

60-70% of energy production in muscles performing submaximal anaerobic work is anaerobic, i.e. lactic acid production . But the aerobic system also makes a significant contribution to energy production . Such works or exercises last 1-2 minutes. For example, running for 800 meters, swimming for 200 meters, skating for 1000 and 1500 meters. Athletes spend up to 40 kcal per minute on average when performing such exercises. Oxygen supply system indicators will be close to maximum. After exercise, the amount of lactic acid in the blood is 20-25 mmol/l. the amount of sugar in the blood increases significantly (150 mg %).

seen that these exercises require high performance of both anaerobic and aerobic systems

production in the muscles working during aerobic exercise is mainly or entirely due to the oxidation process, the body must constantly consume oxygen. Therefore, the power of this exercise is measured by the level of oxygen consumption during the performance of the work. If the consumption of oxygen at a distance is compared with the maximum consumption of oxygen of this athlete, the relative aerobic physiological power of the performed exercise is determined. According to this indicator, aerobic exercises are divided into 5 groups:

Maximum aerobic exercise.

Maximal pre-aerobic exercise.

Submaximal aerobic exercise.
Moderate aerobic exercise.
Small aerobic exercises.

During maximal aerobic exercise, the distance oxygen consumption of the athlete is 95-100% of the maximum personal oxygen consumption . 60-70% of energy production is with the participation of oxygen. It can be seen that 30-40% of the energy is provided by the anaerobic system. Exercises can last 3-10 minutes. Such exercises include running for 1500-3000 meters, swimming for 400-800 meters, skating for 3000-5000 meters, cycling for 4 kilometers. The main source of energy is muscle glycogen. It decomposes both aerobically and anaerobically. 1.5-2 minutes after the start of the exercises , the number of heartbeats, systolic and minute volume, lung ventilation, oxygen consumption rate of this athlete increases to the maximum level. As long as the exercise continues, the above indicators may remain the same or decrease slightly. At the end of the exercises, the amount of lactic acid in the blood can reach 15-25 mmol/l.

During maximal pre-aerobic exercise, the distance oxygen consumption of the athlete is 85-95% of the maximum personal oxygen consumption. 90% of the consumed energy is produced by oxidation. Carbohydrates are used as an oxidizing agent, the respiration coefficient is equal to 1.0 . Mainly glycogen in the muscles and partially sugar in the blood are broken down. Exercises can last up to 30 minutes. Such exercises include running for 5000-10000 meters, swimming for 1500 meters, skating for 10000 meters . During exercise, heart rate is 90-95% of its maximum, lung ventilation is 85-90 % . The amount of lactic acid in the blood is around 10 mmol/l in mature athletes . Body temperature rises to 39 ^{o}C

During submaximal aerobic exercise, the distance oxygen consumption of the athlete is 70-80% of the maximum personal oxygen consumption . More than 90% of the energy produced for exercise is produced by oxidation, that is, aerobically. Most of the oxidizing substances belong to carbohydrates, and a little to fats. The breath coefficient is approximately 0.85-0.90 . This group of exercises can include marathon running, 30 km running, and athletic 20 km walks. Exercises can last up to 120 min.

During moderate aerobic exercise, the distance oxygen consumption of the athlete is 55-65% of the maximum personal oxygen consumption, and all the energy used is generated aerobically. Fats in muscles are considered as the main source of energy . Breathing coefficient is close to 0.8 . Such exercises can include sports walking up to 50 km, skiing for a distance of 50 km and more. The indicators of the heart and respiratory systems do not exceed their maximum level of 60-75%

During low-intensity aerobic exercise, the distance oxygen consumption of the athlete is 50% of the maximum personal oxygen consumption or less. All energy consumed is produced aerobically. Fats are the main oxidizing substance. We can show simple walking exercises for such exercises .

endurance is understood as the ability of people to cope with long-term mental and physical activity in everyday life . Therefore, according to the type and description of physical work, the following special types of endurance are distinguished:

1. Static and dynamic endurance.

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2) Local and global resilience.
3) Endurance - performing repeated exercises with great muscle strength. 4) Anaerobic and aerobic endurance.
In exercise physiology, the concept of endurance includes exercises with continuous oxygen consumption that perform global work for at least 2-3 minutes and more. Exercises that require the quality of endurance include all running exercises longer than 1500 meters, athletic walking, cycling on the highway and include others.
The higher the intensity of the work, the greater the rate of oxygen consumption during aerobic exercise. Therefore, athletes must have high aerobic capacity when performing exercises that require great endurance.
High maximum oxygen consumption . The maximum oxygen demand rate should be high, and athletes who can maintain it for a long time will have high physical endurance. The maximum oxygen demand rate determines the ability of a person to perform aerobic work. and can do it for a long time. For example, for two athletes to run at the same speed, both of them used the same 4 liters of oxygen per minute. The maximum oxygen demand of the first athlete is 5 liters per minute while running, and the oxygen demand is 80% of his maximum oxygen consumption. . The oxygen demand of the second athlete is equal to 4.4 l, min, and the oxygen demand at the distance is 90% of the maximum personal oxygen demand. Therefore, the first athlete performs the given physiological load more easily than the second athlete.
Thus, the higher the maximum oxygen demand of an athlete, the greater the chance to catch a high speed in the distance, and the higher the sports result. For example, In men who do not play sports, the maximum oxygen requirement is 3-3.5l-min. In highly qualified long-distance athletes, this indicator is 5-6l-min.
indicator of the maximum consumption of oxygen consumed by the whole organism is directly proportional to the body weight. It is called the absolute maximum oxygen consumption . The absolute index of maximal oxygen consumption is higher in swimmers, rowers, and cyclists. Oxygen consumption per 1 kg of body weight is called the relative indicator of maximum oxygen consumption . This indicator is inversely proportional to body weight in highly trained athletes, that is, the higher the body weight, the lower the relative maximal oxygen demand . Because of this, stayers have a relatively low body weight . Therefore , when evaluating the aerobic capacity of an athlete in running and snow walking sports, it is necessary to evaluate the maximum oxygen consumption according to the relative indicator of oxygen consumption.
Maximum oxygen demand depends on the maximum capacity of two functional systems
1).Oxygen transport system
2).Oxygen utilization system
3).Oxygen transport system includes external breath, 2)oxygen disposal system includes blood, cardiovascular systems. The functional properties of these systems ultimately determine the ability of the body to transport oxygen
3) The external respiratory system is considered the first part of the oxygen transport system and ensures the diffusion of oxygen into the blood through the alveolar membranes during lung ventilation. . But if the body size is taken into account, this difference may disappear, because the living capacity of the lungs increases in accordance with the body size. The maximum

oxygen consumption of the body depends on the body size and lung volume indicators won't be. For example, an athlete with a lower lung capacity may have a higher maximal oxygen consumption or vice versa. But in both athletes and people who have not yet exercised, high lung ventilation cannot be achieved with a small tidal volume and a vital capacity of the lungs during maximal aerobic work. For oxygen consumption of 4 liters per minute and more, the living capacity of the lungs should not be less than 4.5 liters. is of great importance. For example, when running for 10,000 meters in sprinters, lung ventilation is maintained at the level of 120-145 l/min until the end of the work. An unfit person can maintain this condition for a very short time. At the same pulmonary ventilation index, the number of breath movements is less in athletes than in non-executives . In athletes, the increase in lung ventilation is mainly due to the increase in the depth of breathing movements. It is determined by the equivalent of lung ventilation. This means that 1 liter of oxygen consumption is determined by how much air passes through the lungs . To maintain the same level of oxygen consumption, less air passes through the lungs of trained athletes than those who do not. Therefore, performing high-intensity aerobic exercise or pulmonary ventilation is reduced .

The diffusion of oxygen from the alveoli of the lungs is higher in athletes than in non-executives . For example, the parameters of the diffusion capacity of marathon runners at rest are equal to those of untrained people during maximal work. Thus, the external respiratory system changes as follows during endurance training: the volume and capacity of the lungs increase; increases the power and efficiency of the external respiratory system; the ability to diffuse gases from the alveoli of the lungs increases. blood system indicators change during endurance training. An increase in endurance increases the volume of flowing blood. The increase in volume is mainly due to blood plasma . The increase in mine plasma is explained by the increase in proteins in the flowing blood . During endurance training, the synthesis of albumin and globulins in the liver increases, and they pass into the blood, increasing its oncotic pressure. As a result, the tissue absorbs water from the fluid. Thus, the volume of flowing blood increases. An increase in the volume of flowing blood increases the return of blood to the heart and causes an increase in the systolic volume . In addition, the passage of blood through the skin facilitates thermoregulation. The amount of hemoglobin in the blood determines its oxygen capacity, which in turn has a positive effect on the ability to transport oxygen. The amount of blood flowing in athletes with high endurance is on average 700-900 g , in athletes with high endurance it is 1000-1200 g. Therefore, the resistance of erythrocytes and hemoglobin increases more and more during training . The amount of lactic acid in the blood of athletes who run long distances is less than those who do not train . During physical work, the concentration of lactic acid depends on three main factors : Satisfying the oxygen demand of working muscles; Aerobic and anaerobic energy production capabilities of working muscles; As a result of continuous endurance exercise, the amount of lactic acid in the blood decreases when performing the same work. The concentration of lactic acid in the blood of athletes is lower when the same work is done by both active and inactive people . This depends on several factors. Due to the high aerobic capacity of the muscles of fit athletes, less lactic acid is produced. Ladi. High-endurance athletes use lactic acid as a source of energy for slow fibers and heart muscles. Due to the amount of blood flowing in athletes, lactic acid is diluted more. Thus, physical endurance training not only improves aerobic capacity, but also strengthens the mechanisms of maintaining the level of lactic acid in the blood. The concentration of lactic acid in the blood, the partial pressure of carbon dioxide gas and the buffer system of the blood determine the pH of the blood. At rest, the pH of the blood of athletes and non-athletes is almost the same. High-endurance athletes have a lower blood pH than non-trained athletes when they work out with a higher load. However, during maximal aerobic exercise, athletes' pH drops more than those who do not exercise. At rest, the buffer system of the blood is no different from that of athletes and ordinary people. When performing work, its decrease is slow in athletes. In order to supply enough oxygen to the working tissues, the activity of the heart, which ensures the movement of blood in the blood vessels together with the external respiratory system, is of great importance. Naturally, when endurance is trained, a number of functional changes occur in the body's cardiovascular system . The high aerobic capacity of highly trained athletes is explained by the large systolic volume of the heart. Athletes have a lower heart rate than non-executives . Endurance athletes have a heart rate 10-20 times lower than that of non-athletes and those involved in high-intensity sports. A decrease in heart rate (bradycardia) is a specific manifestation of endurance training . For example, it was observed that the number of heartbeats in mature athletes was 30 per minute and even 21 in a quiet state. Maximal oxygen demand and sports performance of long-distance runners depend on the number of heart beats, with a relatively small number of heart beats, maximal oxygen demand and sports performance are high. In fit athletes, the decrease in the number of heartbeats is compensated by the increase in its systolic volume. Systolic volume gradually increases during exercise. As a result, the size of the heart chambers increases, and the contractility of the myocardium increases. During the maximum aerobic loads, the maximum indicators of heart activity are significantly different in endurance athletes than in non-exercised ones. For example, the minute volume of the heart is twice as big in athletes, it was found that the minute volume of the heart is 38 liters, maximum 42.3 liters per minute. The increase in the minute volume of the heart in athletes is mainly carried out by an increase in the systolic volume. An increase in systolic volume is considered a high index of endurance . If the maximum systolic volume is equal to 120-130 ml in untrained people , this indicator is equal to 190-210 ml in mature athletes. The capacity of the chambers of the heart and ventricles is greater in mature athletes. The total volume of the heart is 1000 cm in athletes, 800 cm in untrained people and athletes in vigorous sports. Aerobic capacity of endurance athletes is determined not only by the cardiac output, but also by the arterial-venous difference in oxygen. The greater the difference in oxygen content between arterial blood and the blood in the right ventricle, the more efficiently the oxygen transport system works. Such a difference depends on how much oxygen the blood flowing through the capillaries delivers to the tissue, or how much oxygen is retained. Therefore, during endurance training, the arterial-venous blood oxygen difference increases, that is, oxygen remains in the tissues. This leads to an increase in the number of capillaries in the working muscles. During exercise, the diffusion capacity of capillary walls increases. In addition, the ability of trained muscles to extract oxygen from the blood increases by approximately 1.5 times. Human muscle fibers are divided into 2 types.

1) Slow and 2) Fast fibers

1) Fast fibers, in turn, are divided into fast oxidative-glycolytic (II-A) and fast glycologic (II-B) types.

Slow-twitch fibers are mainly adapted to work aerobically, and are involved in long, less powerful contractions than fast-twitch fibers. The muscles of high-endurance athletes have a relatively large number of slow-twitch fibers . In exercisers, slow fibers make up about 80% of the muscle, and on average 1.5 times more than in non-exercisers. Observations show that the number of slow-twitch fibers is key. A person with such an innate muscle apparatus has a greater chance of achieving superior results from endurance exercise. Nevertheless, specific changes occur in the muscles during endurance training . For example, fast glycolytic fibers decrease or completely disappear in training muscles, and fast oxidative-glycolytic fibers make up the main part of the muscle. This increases the aerobic capacity of the muscle.

We can see the increase in endurance from the thickening of muscle fibers, that is, from hypertrophy. In the sarcoplasmic type of endurance training, an increase in the sarcoplasmic space is observed. In a trained muscle, the number and total size of mitochondria also increases. During endurance training, the number of capillaries around the muscle fibers increases. This increases the diffusion surface and increases the aerobic capacity of the cocktail. In endurance training, oxygen utilization by the muscles, or aerobic capacity, increases without increasing the capacity of the oxygen transport system. They are as follows:

and activity of special oxidizing enzymes increases.

2) The amount of myoglobin increases (by 2 times).

3) The amount of glycogen and lipids in the muscles increases.

4) Oxidizing ability of muscles, carbohydrates and especially fats increases.

A fit person takes most of the energy expended during work mainly in the account of oxidizing proteins. This can be seen in the lower respiratory quotient in those who exercise compared to those who do not . More fat participation in oxidation reduces carbohydrate oxidation. As a result, the reduction of muscle glycogen is delayed and the amount of sugar in the blood is reduced. It, in turn, has a positive effect on the activity of the central nervous system. Slowing down the oxidation of carbohydrates reduces the formation of lactic acid. Thus, endurance training increases the maximum aerobic capacity of the body and increases the efficiency of aerobic work.

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