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COMPREHENSIVE MEDICAL-PEDAGOGICAL CONTROL IN HEALTH AND ADAPTIVE PHYSICAL EDUCATION

Methodological recommendations

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The guidelines present methods of medical and pedagogical control in physical culture and sports.

This publication is intended for undergraduates of the specialty 1-08 80 04 Physical culture and sports.

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CONTENT

INTRODUCTION

Physical exercise is a very powerful means of changing the physical and mental state of a person. Properly organized classes strengthen health, improve physical development, increase physical fitness and performance, improve the functional systems of the human body. At the same time, it is necessary to understand that uncontrolled and unsystematic use of physical culture means is ineffective, and in some cases can cause irreparable harm to health.

Under the influence of physical activity, changes occur in the organs and systems of the human body. In order for physical exercises and sports not to have a negative impact on human health, it is necessary to regularly monitor the state of the body. This is a task not only for doctors and teachers, but also for the practitioners themselves.

To exclude all conditions under which there may be a negative impact of physical exercises, sports, the measures of control and self-control of the practitioners themselves are called upon.

The mass development of physical culture and sports, especially among children and adolescents, requires increased medical control over the health of athletes and athletes. A correct assessment of the initial functional state of the organism of an athlete or an athlete and changes under the influence of training of a number of indicators characterizing the activity of the cardiovascular and respiratory systems will prevent the harmful effects of excessive physical exertion on the body of the student.

Regular physical training not only improves health and functional state, but also increases efficiency and emotional tone. However, it should be remembered that independent physical education classes cannot be carried out without medical supervision and self-control. Self-control contributes to the correct use of means and methods of performing physical exercises, health promotion, achievement of high results and sports longevity. A properly organized set of physical activities, regular monitoring of a medical pecialist and constant self-control is a single system aimed at improving health.

CONTENT OF EDUCATIONAL MATERIAL

MODULE 1. MEDICAL AND PEDAGOGICAL OBSERVATIONS

Topic 1. The content, purpose and objectives of medical and pedagogical observations (VPN)

Methods of medical and pedagogical observation: continuous observation, with additional physical activity, determining the total effect of the load, with repeated (control) loads. The choice of the IPN method and research methods depending on the specificity of the sport. Assessment of the results of medical and pedagogical observations. Medical assessment of the level of functional readiness.

Topic 2. Medical supervision of schoolchildren and young athletes

Age groups and their morphological and functional characteristics. Passport and biological age. Acceleration. Retardation. Medical features of puberty. Features of medical control over children, adolescents, boys and girls involved in physical culture and sports in educational institutions and sports organizations. Medical groups for physical education. Start dates for different sports. Medical evaluation of early specialization. Sports selection and orientation. Medical supervision at the stages of training athletes.

Topic 3. Features of medical supervision of female athletes

Morphological and functional characteristics of the female body. Ovarian menstrual cycle (OMC): emergence, formation, stabilization. Well-being and performance in different phases of the ovarian-menstrual cycle. The influence of physical education and sports on the menstrual cycle, pregnancy, childbirth, the postpartum period. Gender control.

Topic 4. Features of medical control over middle-aged and older persons

Brief morphological and functional features of middle-aged and older persons. The concept of gerontology and geriatrics. The essence of the aging process. A set of medical examinations for admission to physical education. Absolute and relative contraindications to physical education. The principles of dividing into groups for physical education.

Topic 5. Medical supervision in sports for disabled people

Brief history of sports for disabled people. Sports and physical work with disabled people in the Republic of Belarus. Sports and medical classification of disabled people. Morphofunctional changes in the body of people with disabilities of various groups. Features of the educational process and medical control over various groups of disabled people. Testing of disabled athletes.

Topic 6. Self-control

Self-control. The tasks and content of self-control. Subjective and objective indicators. The simplest functional tests for self-control

Topic 7. General characteristics of the morbidity of athletes. A brief analysis of the morbidity of athletes. The influence of the specificity of the sport on the development of pathological processes. Brief description of chronic foci of infection and their manifestations. Influence of chronic intoxication on the athlete's body and sports performance. Sports traumatology.

Topic 8. Functional tests for assessing the health and performance of athletes. Characteristics of laboratory tests: Martine-Kushelevsky, S.P. Letunova, Harvard step test, samples PWC 170. Medical control in mass physical culture and sports.

AS A RESULT OF STUDYING THE ACADEMIC DISCIPLINE, the student must know:

– the content of pedagogical control during physical culture and sports;

– purpose, place, value of pedagogical control in physical culture and sports;

– special knowledge and skills that ensure correct observation, analysis and assessment of the actions of those involved;

– identifying shortcomings in their own actions, determining the degree of suitability and effectiveness of tools, methods and organizational forms of work in specific conditions and learning situations;

– elimination of noticed deficiencies or their prevention in subsequent classes. – the content of medical and pedagogical control;

– features of equipping places of employment with adaptive physical training.

be able to:

– to carry out medical and pedagogical control over the attendance of classes;

– control over training loads;

– control over the state of those involved;

– control over exercise technique;

– accounting of sports results;

– control over behavior during the competition own:

– timing of the activities of those involved in the class;

– determination of physical activity during the lesson;

– conducting control tests;

– conducting medical and pedagogical observations of the educational process.

– determination of the general (pedagogical) and motor (motor) density of the lesson.

1. IMPACT OF PHYSICAL EXERCISES ON THE HUMAN BODY

It is known that movement is the main stimulator of the vital activity of the human body. With a lack of movement, as a rule, a weakening of physiological functions is observed, the tone and vital activity of the body decreases. Training activates physiological processes and helps to ensure the restoration of impaired functions in humans. Therefore, physical exercises are a means of nonspecific prevention of a number of functional disorders and diseases, and therapeutic exercises should be considered as a method of rehabilitation therapy.

Physical exercises affect all muscle groups, joints, ligaments, which become strong, increase muscle volume, elasticity, strength and speed of contraction. Increased muscular activity forces the heart, lungs and other organs and systems of our body to work with an additional load, thereby increasing the functionality of a person, his resistance to adverse environmental influences. Regular physical exercises primarily affect the musculoskeletal system, muscles.

During physical exertion, blood flow increases: blood brings oxygen and nutrients to the muscles, which break down during life, releasing energy. When moving in the muscles, reserve capillaries additionally open, the amount of circulating blood increases significantly, which causes an improvement in metabolism.

Physical activity has a versatile effect on the human body, increases its resistance to adverse environmental influences. So, for example, in physically trained people, compared to untrained people, there is a better tolerance of oxygen starvation. In the response of the human body to physical activity, the first place is occupied by the influence of the cerebral cortex on the regulation of the functions of the main systems: there is a change in the cardiorespiratory system, gas exchange, metabolism, etc.

Exercises enhance the functional restructuring of all parts of the musculoskeletal system, cardiovascular and other systems, improve the processes of tissue metabolism. Under the influence of moderate physical exertion, the working capacity of the heart, the hemoglobin content and the number of red blood cells increase, and the phagocytic function of the blood increases. The combined activity of muscles and internal organs is regulated by the nervous system, the function of which is also improved with the systematic performance of physical exercises.

Physical exercises help accelerate regenerative processes, saturate the blood with oxygen, plastic («building») materials, which speeds up recovery. Physical exercises increase the general tone, stimulate the body's defenses.

However, you can not use physical exercises during the period of exacerbation of the disease, at high temperature and other conditions.

When applying physical exercises, in addition to normalizing the reactions of the cardiovascular, respiratory and other systems, the adaptability of the

recovering person to climatic factors is restored, the person's resistance to various diseases, stresses, etc. increases.

This happens faster if gymnastic exercises, sports games, hardening procedures, etc. are used. In many diseases, correctly dosed physical activity slows down the development of the disease process and contributes to a faster recovery of impaired functions.

Thus, under the influence of physical exercises, the structure and activity of all human organs and systems are improved, working capacity is increased, and health is strengthened.

2. FATIGUE AND OVERFATIGUE IN ATHLETES

2.1. Signs of fatigue, fatigue and overwork, their causes

Fatigue is a physiological state of the body that occurs as a result of activity and is manifested by a temporary decrease in performance. Often, the term «fatigue» is used as a synonym for fatigue, although these are not equivalent concepts: fatigue is a subjective experience. Fatigue can appear both during mental and physical work.

Mental fatigue is characterized by a decrease in the productivity of intellectual work, a weakening of attention, speed of thinking, etc. Physical fatigue is manifested by a violation of muscle functions: a decrease in strength, speed of contractions, accuracy, consistency and rhythm of movements.

Efficiency can be reduced not only as a result of the work done, but also due to illness or unusual working conditions (intense noise, etc.).

Insufficient rest time or excessive workload for a long time often leads to overwork. With overwork, headache, absent-mindedness, decreased memory, attention, and sleep are disturbed.

Overwork is a pathological condition that develops in a person as a result of chronic physical or psychological overstrain, the clinical picture of which is determined The basis of the disease is an overstrain of excitatory or inhibitory processes, a violation of their ratio in the cerebral cortex.

This allows us to consider the pathogenesis of overwork similar to the pathogenesis of neuroses. Prevention of overwork is based on the elimination of its causes.

Therefore, intensive loads should be used only with sufficient preliminary preparation. In a state of increased stress, intensive classes should be alternated with physical activity, especially on the days after exams or tests.

Under the action of a strong stimulus (stressor), an adaptation syndrome, or stress, develops in the body, during which the activity of the anterior pituitary gland and adrenal cortex increases. These changes in the endocrine system

largely determine the development of adaptive reactions in the body to intense physical or psychological activity.

However, chronic overstrain can lead to depletion of the adrenal cortex and thus to a violation in the body of previously developed adaptive reactions.

In a state of overwork, a person's basal metabolism increases and carbohydrate metabolism is often disturbed. Violation of carbohydrate metabolism is manifested in the deterioration of absorption and utilization of glucose. The amount of sugar in the blood at rest decreases.

The course of oxidative processes in the body is also disturbed. This may be indicated by a sharp decrease in the content of ascorbic acid in the tissues.

As already noted, it is generally accepted that there are two types of fatigue: one occurs during mental activity, the other – during muscular work. However, today, when there is a convergence of mental and physical labor in production, it has become almost difficult to single out mental or muscular fatigue in its pure form.

In any work activity, there are components inherent in both mental and physical labor. The magnitude of the impact on the body of physical activity can be determined by visual signs of fatigue.

2.2. Prevention of fatigue, fatigue and overwork

Prevention of fatigue, fatigue and overwork is based on the elimination of its causes. Therefore, intense exercise should only be used with sufficient prior preparation.

In a state of increased stress, intensive classes should be alternated with physical activity, especially on the days after exams or tests. All violations of the mode of life, work, rest, sleep and nutrition, as well as physical and mental trauma, intoxication of the body from foci of chronic infection must be eliminated. Reinforced training after any illness or in a state of convalescence after past illnesses should be prohibited.

When performing certain physical exercises in the process of work, three main results are achieved: acceleration of the process of working out; increasing the effectiveness of short-term rest in the process of work. Prevention of overwork is based on the elimination of its causes.

Therefore, intensive loads should be used only with sufficient preliminary preparation. In a state of increased stress, intensive classes should be alternated with physical activity, especially on the days after exams or tests. All violations of the mode of life, work, rest, sleep and nutrition, as well as physical and mental trauma, intoxication of the body from foci of chronic infection must be eliminated.

Reinforced training after any illness or in a state of convalescence after past illnesses should be prohibited.

The problem of restoring the normal functioning of the body and its performance after the work done (the fight against fatigue and the fastest elimination of its consequences) is of great importance in sports. The fact is that as the level of preparedness grows, the athlete needs an increasing strength of the stimulus (great physical activity) to ensure continuous functional improvement of the body and achieve a new, higher level of its activity.

Increasing the load provides a structural and functional improvement of blood circulation and strengthening of the trophic functions of the nervous system, the creation of a sufficient supply of energy, an increase in the capillarization of the skeletal and cardiac muscles.

All this leads to an increase in the body's potential, an increase in its functional reserve, adequate adaptation to physical stress, and acceleration of recovery.

The faster the recovery, the more opportunities the body has to perform subsequent work, and, consequently, the higher its functionality and performance. From this it is clear that recovery is an integral part of the training process, no less important than the direct training effects on the athlete.

With repeated large physical stresses, two opposite states can develop in the body: a) an increase in fitness and an increase in working capacity, if the recovery processes provide replenishment and accumulation of energy resources; b) chronic exhaustion and overwork, if recovery does not systematically occur.

3. SELF-CONTROL

3.1. Objective and subjective methods of self-control

Of great practical importance for those involved in physical culture and sports is self-control. It disciplines, instills introspection skills, makes the work of a doctor, coach and teacher more efficient, and has a positive effect on the growth of sports achievements.

Self-control is understood as monitoring one's health, physical development, functional state, tolerance of training and competitive loads.

It includes the observation and analysis of the states of the body, carried out using objective and subjective methods.

Objective methods include techniques that can be measured and quantified: anthropometric indicators (body length and weight, chest circumference, etc.), sports results, strength indicators of individual muscle groups.

Subjective methods can be used to assess well-being, mood, feeling of fatigue and tiredness, desire or unwillingness to exercise, impaired appetite and sleep, fear of competition and other conditions.

Subjective indicators of self-control:

• **Mood**. A very significant indicator that reflects the mental state of those involved in physical exercises. Exercise should always be fun. The mood can be considered good when a person is self-confident, calm, cheerful; satisfactory – with an unstable emotional state and unsatisfactory, when a person is upset, confused, depressed.

• **Well-being**. It is one of the important indicators for assessing the physical condition, the effect of physical exercises on the body. Those involved in poor health, as a rule, happen when they have diseases or when the functional capabilities of the body do not correspond to the level of physical activity performed. The state of health can be good (feeling of strength and vivacity, desire to exercise), satisfactory (lethargy, loss of strength), unsatisfactory (noticeable weakness, fatigue, headaches, increased heart rate and blood pressure at rest, etc.).

• **Fatigue.** Fatigue is a physiological state of the body, manifested in a decrease in performance as a result of the work done. It is a means of training and improving performance. Normally, fatigue should pass within 2-3 hours after class.

• **Dream.** The most effective means of restoring the health of the body after exercise is sleep. Sleep is critical to the recovery of the nervous system. Sleep is deep, strong, coming immediately - causes a feeling of cheerfulness, a surge of strength. When characterizing sleep, the duration and depth of sleep, its disturbances (difficulty falling asleep, restless sleep, insomnia, lack of sleep, etc.) are noted.

• **Appetite.** The more a person moves, does physical exercises, the better he should eat, as the body's need for energy substances increases. Appetite, as you know, is unstable, it is easily disturbed in case of ailments and illnesses, with overwork. With a large intense load, appetite can drop sharply.

• **Efficiency.** Rated as high, normal and low. With the correct organization of the training process in dynamics, the working capacity should increase.

• **Load tolerance.** It is an important indicator that assesses the adequacy of physical activity to the functional capabilities of the student.

Objective indicators of self-control.

• **Pulse.** Currently, heart rate is considered one of the main and most accessible indicators characterizing the state of the cardiovascular system and its response to physical activity.

The pulse rate of a healthy untrained person at rest usually ranges from 75–80 beats / min for women, and 65-70 beats / min for men.

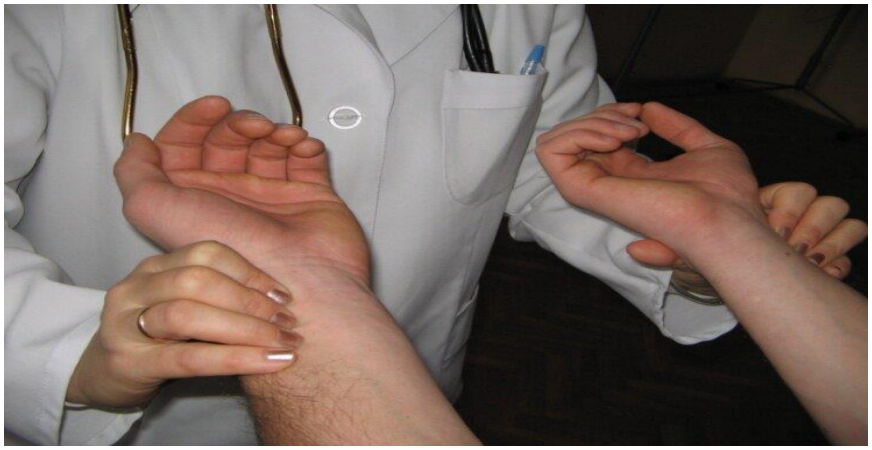
• In athletes, the pulse rate decreases to 50-60 beats / min, and this decrease is observed with increasing fitness.

Heart rate is determined by palpation on the carotid or radial arteries after 3 minutes of rest for 10, 15 or 30 seconds, after which the obtained values are recalculated per minute.

• **Measurement of heart rate** is carried out immediately in the first 10 seconds after work. For control, it is important how the pulse reacts to the load and

whether it decreases quickly after the load. It is for this indicator that the student should follow, comparing the heart rate at rest and after exercise.

At low and medium loads, the restoration of heart rate after 10-15 minutes is considered normal.



Measurement the pulse rate

• If the student's heart rate at rest in the morning or before each lesson is constant, then we can talk about a good recovery of the body after the previous lesson. If the heart rate is higher, then the body has not recovered.

• **Respiratory rate (RR) and VC**. Breathing at rest should be rhythmic and deep. Normally, the respiratory rate in an adult is 14-18 times per minute. When loaded, it increases by 2–2.5 times.

An important indicator of respiratory function is the vital capacity (VC) – the volume of air obtained at maximum share functional disorders in the central nervous system.

The basis of the disease is an overstrain of excitatory or inhibitory processes, a violation of their ratio in the cerebral cortex. This allows us to consider the pathogenesis of overwork similar to the pathogenesis of neuroses. Prevention of overwork is based on the elimination of its causes.

Therefore, intensive loads should be used only with sufficient preliminary preparation. In a state of increased stress, intensive classes should be alternated with physical activity, especially on the days after exams or tests.

Under the action of a strong stimulus (stressor), an adaptation syndrome, or stress, develops in the body, during which the activity of the anterior pituitary gland and adrenal cortex increases. These changes in the endocrine system largely determine the development of adaptive reactions in the body to intense physical or psychological activity. However, chronic overstrain can lead to depletion of the adrenal cortex and thus to a violation in the body of previously developed adaptive reactions.

In a state of overwork, a person's basal metabolism increases and carbohydrate metabolism is often disturbed. Violation of carbohydrate metabolism is

manifested in the deterioration of absorption and utilization of glucose. The amount of sugar in the blood at rest decreases.

The course of oxidative processes in the body is also disturbed. This may be indicated by a sharp decrease in the content of ascorbic acid in the tissues.

As already noted, it is generally accepted that there are two types of fatigue: one occurs during mental activity, the other – during muscular work.

However, today, when there is a convergence of mental and physical labor in production, it has become almost difficult to single out mental or muscular fatigue in its pure form. In any work activity, there are components inherent in both mental and physical labor. The magnitude of the impact on the body of physical activity can be determined by visual signs of fatigue.

3.2. Keeping a self-control diary

The best form of self-control is keeping a diary. It is recommended to record the volume and intensity of training loads, the results of estimates and competitions, some objective and subjective indicators of the state of the body during physical exercises.

The diary consists of two parts. In one of them, the content and nature of the training work should be noted (volume and intensity, pulse mode during its execution, duration of recovery after exercise). In another, the magnitude of the load of the previous workout and the accompanying well-being during wakefulness and sleep, appetite, efficiency are noted.

Qualified athletes are recommended to take into account the mood (for example, unwillingness to train), the results of the reaction to some functional tests, the dynamics of the vital capacity of the lungs, general performance and other indicators.

Self-control is necessary for all students, postgraduates, interns, teachers and employees engaged in physical exercises, but it is especially important for people with disabilities. These self-monitoring data help the teacher, coach, instructor and the students themselves to control and regulate the correctness of the selection of means and methods of conducting physical culture and health and scientific training sessions, to manage these processes in a certain way.

The state of health is assessed as «good», «satisfactory» and «bad»; at the same time, the nature of unusual sensations is recorded. Sleep is assessed by its duration and depth, its disorders are noted (difficulty falling asleep, restless sleep, insomnia, lack of sleep, etc.).

* Appetite is characterized as good, satisfactory, reduced and poor. Pain sensations are recorded according to their location, nature (sharp, blunt, cutting) and strength of manifestation.

* Body weight is determined periodically (1-2 times a month) in the morning on an empty stomach, on the same scales, in the same clothes. In the first during the training period, body weight usually decreases, then stabilizes

and subsequently increases slightly due to the increase in muscle mass. In case of a sharp decrease in body weight, you should consult a doctor.

* Training loads are recorded briefly. Together with other indicators of self-control, they make it possible to explain various deviations in the state of the body.

* Violations of the regime. The diary notes the nature of the violation: non-compliance with the alternation of work and rest, violation of the diet, consumption of alcoholic beverages, smoking, etc. For example, the consumption of alcoholic beverages immediately negatively affects the state of the cardiovascular system, the emergency response increases sharply and leads to a decrease in sports results.

* Sports results show whether the means and methods of training sessions are used correctly or incorrectly. Their analysis can reveal additional reserves for the growth of physical fitness and sportsmanship.

Assessment of physical development with the help of anthropometric changes makes it possible to determine the level and features of physical development, the degree of its compliance with gender and age, to identify existing deviations, as well as to determine the dynamics of physical development under the influence of physical exercises and various sports.

Anthropometric measurements should be carried out periodically at the same time of day, according to the generally accepted methodology, using special standard, verifiable tools. During mass examinations, height, standing and sitting, body weight, chest circumference, vital capacity of the lungs (VEL), strength of the flexors of the hand and other indicators are measured, mainly the state of the nervous system. In the diary of self-control, well-being is noted as good, satisfactory, bad. Well-being as an indicator of physical condition should be assessed taking into account the mood of the athlete.

When conducting self-monitoring, the following general assessment of performance is given: good, normal, reduced.

During sleep, a person recovers his strength and especially the function of the central nervous system.

The slightest deviations in the state of health, not yet manifested by other symptoms, immediately affect sleep. Sleep is considered normal, coming quickly after a person has gone to bed, strong enough, flowing without dreams and giving a feeling of cheerfulness and rest in the morning. Poor sleep is characterized by a long period of falling asleep or waking up early in the middle of the night. After such a dream, there is no feeling of vivacity, freshness.

Physical work and a normal regime help to improve sleep.

The self-control diary records the duration of sleep, its quality, disturbances, falling asleep, waking up, insomnia, dreams, intermittent or restless sleep.

During intense physical work, sweating is quite normal.

Sweating depends on individual characteristics and the state of the body. It is considered normal when an athlete sweats profusely during the first training

sessions. With increasing fitness, sweating decreases. Sweating is usually marked as profuse, large, medium or low.

The desire to train and participate in competitions is characteristic of healthy and especially young people, to whom physical exercises, according to the figurative expression of I.P. Pavlov, bring «muscular joy».

If an athlete does not feel the desire to train and participate in competitions, then this is an obvious sign of fatigue or the initial phase of overtraining. The desire to play sports is marked with the words «big», «there is», «no».

In the column of the self-control diary «The content of the training and how it is transferred», the essence of the lesson is stated in a very short form, since these data in combination with other indicators greatly facilitate the explanation of certain deviations.

This column marks the duration of the main parts of the training session.

At the same time, it is indicated how the athlete underwent training: **well, satisfactorily, hard.**

Without information about the violation of the general regime, it is sometimes impossible to explain the changes in indicators in other columns of the diary.

Athletes are quite well aware of the need to comply with the general regime: if an athlete really seriously decided to play sports and achieve high results, then compliance with the regime should be strictly mandatory.

4. DETERMINATION AND ASSESSMENT OF PHYSICAL DEVELOPMENT AND FUNCTIONAL STATE

4.1. Definition and assessment of physical development

The physical development of a person is understood as a complex of morphological and functional properties of an organism that determine the reserve of its physical strength.

The *main signs* of physical development studied during the examination include***: height (standing and sitting), body weight, chest circumference (in a calm state, with maximum inhalation and exhalation), lung capacity, circumference of the shoulder, hip, shin, strength of the muscles of the hand and fingers, as well as the strength of the muscles of the back.***

The assessment of physical development is carried out taking into account age, gender and sports specialization, according to the most common methods of correlation, standards and indices in sports medicine.

The *index method* is currently used only for the orientational assessment of anthropometric data and is an arithmetic ratio of two or three signs of physical development.

However, this method is not reliable enough, since the age, profession and other data of the person being examined are not taken into account.

1. *Erisman vital index-the ratio* of the vital capacity of the lungs in ml to body weight in kg. In men, the index value is 65–70 ml/kg, in women – 55–60 ml/kg.

2. *The weight-growth vital index* of the Quetelet is the ratio of the weight of the subject in gr to the height in cm. In men, the index value is 350-400 g/cm, in women – 325–375 g/cm

3. *The strength index determines* the development of strength of individual muscle groups relative to body weight. The index is calculated by dividing the magnitude of the strength index by weight and is expressed in %. The average value of the index for the brush in men is in the range of 70–75%, and in women – 50–60%.

The method of standards.

Standards are the average values of signs of physical development obtained by statistical processing of a large number of measurements of a homogeneous group of persons to which the subject belongs. For this purpose, «normative» evaluation tables are compiled. For each attribute, the table shows the average arif-metrical value of the attribute (M) and the mean square deviation from M (a).

4.1.1. Methods for assessing physical development

Subtract the average value from the numerical value to be evaluated for the attribute. The resulting difference shows the deviation of the attribute from the average value. It can have a positive value if the trait under study is greater than M, or a negative value when the trait is less than M.

For further evaluation of the obtained deviation, its value should be divided by the value of the corresponding mean square deviation (a), i.e. determine by how many sigma (a) the studied feature differs from the average value.

The quotient, and it can be with a plus sign if the attribute is greater than M, and with a minus sign if the attribute is less than M, should be written next to the numerical value of the attribute. It is necessary to calculate deviations in sigma with an accuracy of up to tenths.

If the difference between the value of the studied feature and its average value according to the standard *is less than 0.1* a, *then instead of M,* you need to write *"M (approximately M).* If the value of the attribute coincides with the average value, then M is left unchanged.

Deviations in sigma are used to assess physical development.

Assessment of physical development

Physical development is considered average if its value differs from the average value of M by no more than ± 0.5 A (M ± 0.5 a). Above and below the average, if the difference exceeds 0.5 A, but not more than 1a (from M + 0.5 A

to M ± 1a). If the difference exceeds ± 1 A, but not more than 2a (o tM ± 1adoM ± 2a), then physical development is assessed as high or low.

Physical development can be *very high or very low* if the indicators are greater *than ± 2a.*

For clarity, they build special graphs, the so-called anthropometric profiles. The anthropometric profile is a graphical representation of the results of the assessment of physical development indicators according to standards.

The advantage of such a graph for evaluating anthropometric data is its clarity. The profile clearly shows which signs of physical development are within the average data, which are higher and lower.

Correlation method. Since individual signs of physical development are closely related, a change in the magnitude of one of them leads to changes in the magnitude of the others.

The relationship (correlation) between the indicators may be different. It is expressed quantitatively by the correlation coefficient g. the closer the relationship between the values of the studied signs of physical development, the greater the value of the correlation coefficient. Its limit value is ± 1. The correlation coefficient is calculated by variational and statistical processing of materials**.**

4.2. THE STUDY OF the FUNCTIONAL STATE OF THE BODY SYSTEMS

4.2.1. Study of the functional state of the respiratory system

The respiratory system, as well as the circulatory system, is the leading one in maintaining the optimal oxygen regime of the body. Therefore, in the conditions of sports activity, extremely high requirements are imposed on the external ventilation apparatus, the implementation of which ensures the optimal functioning of the entire cardio-respiratory system.

This applies to cyclic sports in which the breathing system is limiting, especially when overcoming distances related to the zones of submaximal and high power.

Investigating the state of the respiratory system, the following tasks are solved:

* investigation of the functional state of the external breathing system and identify cation of its deviations from the norm;

* study of the effect of physical activity on the functional state of the respiratory system.

In the study of the functional state of the external respiration system, the strength of the respiratory muscles, vital energy are determined- lung bone (VEL), maximum ventilation of the lungs (MVL), a test with voluntary breath retention on inhalation and exhalation.

The measurement of these values at rest becomes of great importance for assessing the function of external respiration if the actual values are compared with the proper ones.

The volume of air obtained with the maximum exhalation made after the maximum inhalation is called the vital capacity of the lungs (VEL).

The composition of the VEL includes the following volumes: PRE – respiratory volume, RO vd – reserve volume of inspiration, RO vd – reserve volume of exhalation.

ZHEL is the main indicator of the functionality of the external respiratory system.

It depends on the following factors: the strength of the respiratory muscles, the mobility of the joints of the chest, the elasticity of the lungs. To a large extent, the gender, age and weight of the subject affect the personality of the patient.

The greatest values of the GEL are observed in persons who train pre-proper endurance.

For a more complete description of the actual value of the value, it must be expressed as a percentage of the proper (for this person) value.

ZHEL and other respiratory volumes can be accurately determined using spirography.

Research methodology

To work, a spirograph «Metatest-1», a disinfected nasal clip and a mouthpiece are required.

To determine the heat, the subject must take the deepest breath, and then a deep exhalation. At the end of recording, press the «stop» button. According to the spirogram.

4.2.2. Investigation of the functional state of the circulatory system

Research methodology

As a test to assess the adaptation of blood circulation to high-speed work and endurance work, the subject performs a three-stage combined SP test *Letunova*. When performing the test, the cuff of the tonometer is not removed.

During the test, the subject consistently performs 3 types of load with interruptions:

1. 20 squats in 30 seconds;
2. 3-minute rest;
3. 15-second running on the spot at the maximum pace;
4. 4-minute rest;
5. 3-minute running on the spot at a pace of 180 steps / min.

After the end of each load, heart rate and blood pressure are recorded throughout the rest period.

The *pulse* is counted at 10-second intervals.

Evaluation of research results

The results of the Letunov test are evaluated by identifying the types of circulatory response to physical activity. At the same time, to identify the mechanisms by which adaptation to loading occurs, changes in pulse and blood pres-

sure are compared. To assess changes in heart rate, the percentage of heart rate increase is determined.

At the same time, the heart rate recorded at rest is taken as 100%, and the difference in the pulse rate before and after the load is x.

Example.

The pulse at rest for 10 seconds was 12 beats, after physical exertion it was 20 beats for the first 10 seconds of the recovery period. The percentage of increase in heart rate (x) is calculated as follows:

12-100%;

(20-12) -x%

X=((20-12)*00%)/12=66%

The normal reaction of the heart rate to physical activity (20 squats) is considered to increase the pulse by 60–80%.

After a 3-minute run on the spot at a pace of 180 steps / min, the increase in heart rate should not exceed 100%. Exceeding this figure indicates an irrational reaction of the heart to physical activity.

When studying the reaction of blood pressure to Letunov's functional test, changes in systolic blood pressure, diastolic blood pressure and pulse blood pressure are analyzed. At the same time, more attention should be paid to changes in pulse blood pressure.

The percentage of increase in pulse blood pressure is calculated in the same way as the percentage of heart rate increase. Pulse pressure at rest is taken as 100%, and its difference immediately after the load and at rest is x.

It should be noted that after performing the first load, the pulse pressure should not increase by more than 60–80%, and with a 3-minute run – by 100–120% compared to the initial value.

In well – trained athletes , in most cases , it is noted:

* the *normotonic type* of reaction to the test, which is expressed in the fact that under the influence of each load, there is a pronounced increase in the pulse rate to varying degrees. After 20 squats, the heart rate reaches about 100 beats / min, and after the second and third loads-125-140 beats / min.

With the normotonic type of reaction to all types of loads, systolic blood pressure increases and diastolic blood pressure decreases. So, for example, after the second and third loads, the maximum blood pressure increases to 160–180 mm. Hg.

With this type of reaction, the percentage of heart rate increase should be less than the percentage of increase in pulse blood pressure, or correspond to it.

An important criterion for a normotonic reaction is also the rapid recovery of heart rate and blood pressure to the initial level. So, after the first load, full recovery can be observed in the second minute of rest, after the second load - in the third minute, after the third load - in the fourth minute. The slowdown in the

recovery of the above-mentioned indicators is associated with the lack of fitness of the athlete.

Other types of reactions to the Letunov sample are designated as *atypical.*

* *Hypertonic type of reaction*. This type is characterized by a sharp increase in maximum blood pressure to 180-220 mm hg; diastolic blood pressure either does not change or increases. With this type of reaction, there is a higher pulse response with a delayed recovery of heart rate to the initial level. The percentage increase in heart rate and pulse blood pressure significantly exceed the limit values.

The nature of the described changes may indicate a prehypertonic state. It is also associated with the phenomena of overwork or overtraining.

At the same time, a hypertonic type of reaction can also be observed in healthy well-trained athletes who have increased maximum pressure. This is due to the peculiarities of the sound method of determining blood pressure under load.

At rest in healthy people, systolic blood pressure, measured by the Korotkov method, is very close to the true systolic pressure developed by the left ventricle.

The difference between the actual and measured systolic blood pressure is designated as a hemodynamic shock, which is proportional to the kinetic energy developed by the heart when blood is released into the vessels.

During physical exertion, the kinetic energy of the cardiac output always increases, the hemodynamic shock increases, as a result of which the systolic blood pressure, measured by sound, may be greatly increased.

* *Hypotonic type* of reaction is characterized by a sharp increase in heart rate (up to 190 beats / min) on the 2nd and 3rd load with a slight increase in systolic blood pressure. At the same time, the percentage of increase in heart rate significantly exceeds the percentage of increase in pulse blood pressure. The recovery time of heart rate and blood pressure increases.

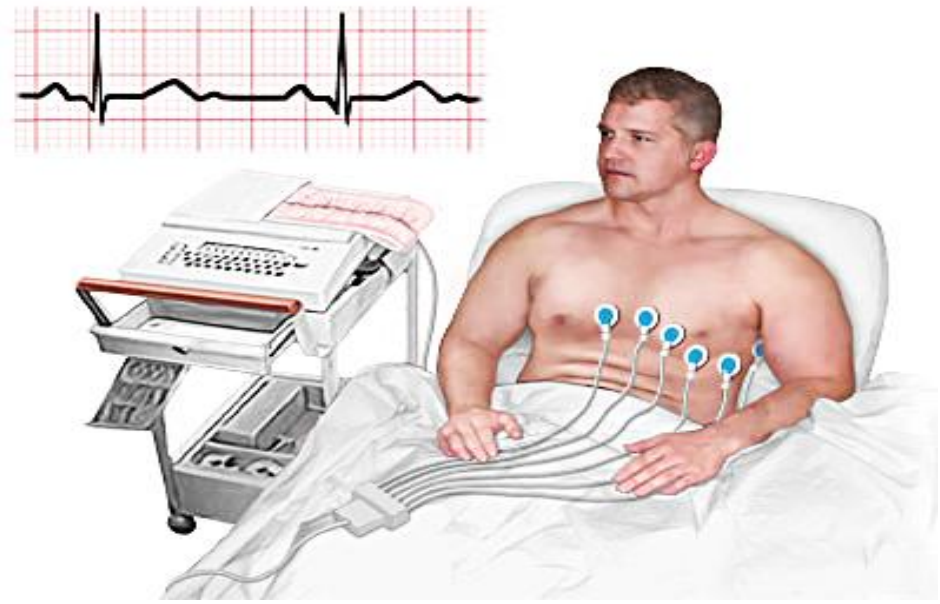
This type of reaction is considered unfavorable, because the increase in minute blood volume occurs mainly due to an increase in heart rate (the increase in systolic volume is small).

* *The dystonic type* of reaction is characterized by an increase in the maximum blood pressure after the 2nd and 3rd loads to 180-200 mmHg, simultaneously with which the "phenomenon of infinite tone" is noted – the minimum blood pressure decreases and after the second or third loads becomes zero.

It should be noted that the «infinite tone phenomenon» is considered a normal phenomenon. As a negative sign, it is considered only if the sound is observed within a few minutes after physical exertion.

* The «*infinite tone phenomenon»* is crucial in assessing this type of reaction, and therefore it makes no sense to calculate the percentage of increase in heart rate and pulse pressure.

* The *reaction with a stepwise rise* in maximum blood pressure is characterized by the fact that at the 2nd and 3rd minutes of the recovery period, systolic blood pressure is higher than at the first minute. Such a reaction indicates the inertia of the systems regulating blood circulation, and is assessed ***as unsatisfactory***.



Electrocardiography studies the physiology of the heart
Electrocardiography

Echocardiography studies the operation of valves and the size of of the heart
Echocardiography

4.2.3. Investigation of the functional state of the nervous and neuromuscular systems

When examining athletes, much attention is paid to the study of the functional state of the nervous system, which significantly determines the individual characteristics of mastering motor skills, the increase in fitness, speed of movement and the duration of maintaining athletic shape.

The peculiarities of the nervous system largely determine the nature and degree of reaction of various vegetative functions of the body to physical activity, their relationship, the rate of recovery, etc.

This gives grounds to assess the state of the nervous system not only by special neurological research methods, but also by studying all the reactions of the body as a whole, i.e. to interpret the results of studies of the state of various body functions from the standpoint of their interdependence and dependence on the state of the central nervous system.

Among the special methods of studying the nervous system, there are methods aimed at studying the functional state of the highest parts of the brain – the cerebral cortex, and methods that make it possible to study the state of the autonomic nervous system.

In addition, the condition of the peripheral nervous system is determined, which is of the most important practical importance for athletes.

Methods of conducting tests used in the study of the functional state of the nervous and neuromuscular systems

Methods of control of coordination abilities in sports training.

The control of coordination abilities is carried out in close connection with the assessment of other physical qualities and technical readiness of athletes. It is aimed at a comprehensive assessment of various manifestations of coordination, as well as a relatively isolated determination of the ability to assess and regulate dynamic and spatio-temporal parameters of movements, the ability to maintain stability of posture (balance), a sense of rhythm, the ability to arbitrarily relax muscles, coordination of movements.

When assessing coordination abilities, they focus on two types of movements:

* *relatively stereotypical,* involving the performance of pre-known exercises. In this case, the conformity of the technique demonstrated by the athlete to its rational structure, the stability of skills in the presence of various confounding factors, the variability of skills, etc. are evaluated

* *non-stereotypical,* associated with the effectiveness of performing movements in complex and variable situations. At the same time, the accuracy of motor reactions, the rationality of individual movements and their combinations, etc. are evaluated.

A comprehensive integral assessment of coordination abilities can be given according to the time required for the assimilation of complex motor actions, according to the time from the moment of changing the training or competitive situation to the beginning of a productive motor action, as well as according to the level of efficiency and rationality of the composition of motor actions when solving tasks that are difficult in coordination (for example, in sports games or martial arts).

For a comprehensive assessment of coordination abilities, it is often planned to perform a dosed group of various exercises in a strict sequence.

The total time spent by athletes on performing all motor actions serves as a measure of coordination abilities, since it reflects the speed, expediency and sequence of these actions, a sense of rhythm, the ability to navigate in difficult situations, the ability to control dynamic and kinematic characteristics of movements, maintain balance stability, etc.

In the integral assessment of specific coordination abilities, the implementation of this principle provides for the development of a program of specific motor actions of increased coordination complexity.

With regard to the assessment of the coordination abilities of athletes specializing in various sports, such programs can be compiled on the basis of sets of exercises used to develop coordination.

They should be based on the most difficult exercises in coordination, used in the process of training athletes.

It is quite natural that in the sport of higher achievements the main role is assigned to specific movements, during which it is possible to assess the sense of pace, the timing of motor actions, the accuracy of movements, the magnitude of the developed efforts, the spatial characteristics of various specific movements. At the same time, the tests should be strictly selective.

Control tests can be complicated by limiting or excluding visual or auditory control of motor actions.

Examination of the condition of the vestibular analyzer using the Yarotsky test

The condition of the vestibular analyzer, on which orientation with respect to the position and movement of the body in space, as well as the stability of the balance of the body, largely depends, plays a particularly important role in some technically complex sports.

With regular sports training, the function of the vestibular apparatus improves. This is due to the concentration of excitation in certain areas of the central nervous system and the weakening of vegetative and somatic reflexes that appear when the vestibular apparatus is irritated.

If the vestibular apparatus is unstable, irritation of it during physical exertion can cause a number of undesirable motor and autonomic reflexes.

Yarotsky's test is based on determining the time during which the subject is able to maintain balance when the weight-tibular apparatus is irritated by continuous rotation of the head.

Research methodology.

The subject in a standing position is offered to perform continuous head spinning in one direction at a pace of two movements in one second. The duration of maintaining balance is determined by a stopwatch. To prevent a fall that can lead to injury, it is necessary to insure the subject by standing near him.

Evaluation of research results

The normal state of the vestibular apparatus corresponds to maintaining balance for 28 seconds. For athletes, this time can reach 1.5 minutes.

Examination of the state of the motor analyzer

By means of a motor analyzer, the body receives information about changes in the position of the limbs and the whole body in space, about the direction of movement of body parts, weight, pressure (muscle-joint feeling).

The musculoskeletal feeling consists of sensitivity, which determines the assessment of muscle effort, weight assessment, pressure proprioceptive sensitivity, which provides the perception of changes in the position of the limbs and the whole body in space.

Thanks to these types of sensitivity, coordinated movements are possible. Under the influence of sports training, the motor analyzer is being improved.

Research methodology

The dynamometer measures the maximum strength of the brush, the value of which is recorded. Further, under visual control, the subject compresses the dynamometer 3 times with a force equal to 50% of the maximum result.

Then the subject, without looking at the device, must reproduce this effort. After that, under visual control, the dynamometer is compressed with a force equal to 3/4 of the maximum result. Again, an attempt is made to make this effort without looking at the readings of the device.

Evaluation of research results

The degree of deviation of the performed effort from the control is estimated. This degree of deviation is expressed as a percentage in relation to the control force.

Kinesthetic sensitivity is *considered normal if* the deviation is no more than 20% of the control force. For example, half of the maximum force is 20 kg. Therefore, the results of the control measurement, which will fit in the range of 20 ± 4 kg, will be normal.

Investigation of the coordination function of the nervous system using the Romberg test

Coordination of movements is the friendly work of individual muscle groups. In athletes, good coordination indicates the coordinated activity of the

vestibular apparatus, the apparatus of the musculoskeletal sense and the cerebellum.

Movement disorders and coordination disorders are one of the most clear signs of fatigue. Considering this fact, in order to determine the degree of fatigue, it is recommended to conduct coordination tests before and after training.

Coordination function and its disorders (ataxia) are determined using various tests. *There are dynamic and static ataxia.*

Static ataxia is detected using a Romberg test (simple and complicated).

- *A simple sample of Romberg*. The subject is standing (heels and socks together) stretches out his hands in front of him without tension, spreads his fingers and closes his eyes. Closing the eyes is necessary to exclude correction by the visual analyzer.
- *A complicated Romberg test*. Starting position: support on one leg, the foot of the other foot is applied with the sole to the kneecap of the supporting leg, the arms are stretched forward, the fingers are spread apart, the eyes are closed.

Evaluation of static coordination in athletes is based on the data of the complicated Romberg test:

– «good» – firm stability for more than 15 seconds, there is no trembling of fingers and eyelids;

– «satisfactory» – the pose is held for 15 seconds, but there is a slight tremor of the fingers and eyelids;

– «unsatisfactory» – the pose is held for less than 15 seconds.

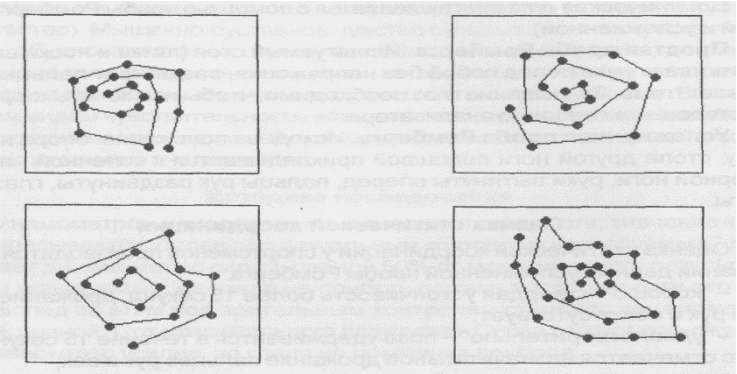
Dynamic ataxia is detected using various tests. The most commonly used are the f*inger – nasal test* and *adiadocho-kinesis.* The phenomenon of adiadochokinesis consists in the rapid change of one movement to another, the opposite of the first.

Investigation of the functional state of the motor sphere of the nervous system

The maximum frequency of movements of the upper limb is determined, which depends on the functional state of the afferent and efferent systems of the motor sphere and characterizes its lability.

Research methodology. The subject is asked to put the maximum number of dots in four squares (20x20 cm) for 40 seconds (Fig. 1). Sitting at the table, the subject begins to put dots in one of the four squares with the maximum frequency on command. After every 10 seconds, on command, without a pause, he moves his hand to the next square, continuing to perform movements with the maximum available frequency.

Fig. 1. Registration of the number of points when determining the maximum frequency of movements of the upper limb.



Methodical instructions

– it is recommended to put points by making concentric movements with your hand;

– after 40 seconds, the command «stop» is given;

– when counting points, it is recommended to lead a pencil from one point to another without taking it off the paper.

Evaluation of research results

When evaluating the results of the test, it is necessary to take into account sports specialization. Athletes who train the quality of speed and agility have a higher maximum frequency than athletes who work mainly on endurance.

The functional state of the motor sphere is estimated by the maximum frequency of points exposed in the first 10 seconds and its change during the remaining three 10-second periods.

1. The *normal* maximum frequency of arm movements in athletes is considered to be equal to 70 points in 10 seconds.

2. A *gradual* decrease in the frequency of movements indicates insufficient functional stability.

3. A *stepwise* increase in frequency to a normal level and above indicates insufficient lability of the motor sphere.

Investigation of the functional state of the autonomic nervous system

The study of the autonomic nervous system allows us to get an idea of the interaction and balance of its two departments – sympathetic and parasympathetic. With a sharp predominance of excitability of one of the departments, the tone of the autonomic nervous system as a whole is disturbed.

To study the state of the autonomous nervous system, tests are carried out that reveal the state of autonomic reflexes (oculocardiac, cutaneous vascular, etc.), as well as orthostatic and clino-orthostatic tests.

At the same time, it should be taken into account that athletes with a high level of fitness, at rest, there are some signs of predominance of the tone of the parasympathetic nervous system (low blood pressure, slowing breathing and heart rate). With vegetative tests, the change in heart rate in them is less pronounced than in an untrained person.

In a state of good fitness, an optimal relationship of adrenergic and cholinergic influences is noted.

Ocular-cardiac reflex (Aschner's test) characterizes the excitability of the parasympathetic part of the autonomic nervous system

Research methodology

In the supine position, the heart rate is determined by the examinee, then within 10 seconds, gradually increasing pressure is applied to the eyeballs with the eyelids

closed and the heart rate is calculated again

 .

The evaluation of the results of the study is carried out according to the pulse data:

1. Decrease in heart rate by 5-12 beats / min – the reflex is positive, the response is normal;

2. The heart rate does not change after the test - the reflex is negative, the excitability is reduced;

3. A decrease in heart rate by more than 12 beats /min indicates an increase in the excitability of the vagus nerve;

4. An increase in heart rate by more than 24 beats / min – the ocular-cardiac reflex is considered perverted

Clino-orthostatic test

Research methodology

The heart rate is calculated for 1 minute in the standing position, in the lying position for the first 15 seconds and again in the standing position for the first 15 seconds.

Evaluation of research results

When the subject moves from a vertical position to a horizontal, a decrease in heart rate by 4–12 beats indicates a normal tone of the parasympathetic part of the autonomic nervous system. A decrease in the pulse by more than 12 beats indicates an increased tone of the vagus nerve.

When moving from a horizontal position to a vertical one, the pulse normally increases by 6-18 beats. An increase in heart rate by more than 18 beats indicates an increase in the tone of the sympathetic part of the autonomic nervous system.

The conclusion about the state of the nervous and neuromuscular system is made on the basis of an analysis of the assessments of all the samples carried out and is formulated as follows: «The functional state of the nervous and neuromuscular system is *satisfactory (unsatisfactory»).*

4.3. MEDICAL AND PEDAGOGICAL OBSERVATIONS

1. The purpose and objectives of medical and pedagogical observations (VPN).

2. Functional tests used in medical and pedagogical observations.

The VPN for athletes consists in the joint control of the doctor and the coach over the course of training work in order to study the direct impact of physical exertion on the athlete's body.

During the VPN, the functional capabilities of the body, the degree of tension during a specific physical activity, the characteristics of reactions during competitions, training and during recovery are studied.

Observations of athletes are effective only if they are preceded by an in-depth examination of the functional state various systems of the body in compliance with the necessary conditions and the application of a complex of clinical and functional methods. It should be noted that these observations can be carried out before, during and after training.

With VPN , the following tasks are solved:

– the idea of the health status and fitness of the athlete is being clarified;

– the influence of training and competitive loads on the athlete's body is being studied;

– the compliance of physical activity with the level of fitness of the athlete is determined;

– the optimal rest time is set between individual exercises and between training sessions;

– medical, pedagogical and psychological means and methods aimed at improving the recovery processes after physical exertion are evaluated and selected;

– conditions and methods of conducting training sessions are being studied.

Currently, in order to determine the effect of physical exertion on the body, urgent, delayed and cumulative training effects are being studied.

An urgent training effect is the changes that occur in the body during exercise and in the next period of rest.

The *delayed* training effect is the changes that occur in the late phases of recovery: after training, in the following days.

The *cumulative* training effect is the summation (accumulation) of urgent and delayed effects of a large number of workouts-observed over a long period.

Depending on the types of training effects, operational, ongoing and stage-by-stage examinations are distinguished. Operative examinations are examinations, the purpose of which is to study the urgent training effect.

Studies are conducted after one day of rest, in the morning, 2 hours after breakfast. It is necessary to exclude charging. Based on the results of the examinations, a further training process is planned. The Harvard Step Test is used as an additional load. The results obtained using the method of additional loads characterize the degree of impact of training or competitive loads on the body and its recovery.

The essence of the method is to compare the body's reactions to a certain load before the start of training and in the recovery period after the end of training. At the same time, the severity of changes in the working capacity and reactivity of the body in connection with the completed training load is determined.

At the beginning, the subject's blood pressure, pulse in 10 seconds and respiratory rate in 15 seconds are measured in a sitting position. Then, without removing the cuff of the tonometer, the subject performs the Harvard step test, after which, in the same sequence as before the test, recovery indicators are measured for 5 minutes. After that, the athlete performs the load on the bicycle ergometer (in the zone of submaximal power). Then, again in the same se-

quence, the VPN is carried out with the application of an additional load (Harvard step test).

Evaluation of research results

Evaluation of the results of the study is carried out by comparing the data of changes in the body's response to additional stress before and after training.

According to the nature of the detected differences in reactions to the additional load, there are three options:

1. There is the same response to the load before and after training.

2. At the same time:

– less pronounced reactions of heart rate and systolic blood pressure in response to additional load indicate insufficient load in the workout;

– more pronounced shifts in heart rate and systolic blood pressure indicate a good functional condition of the athlete. A similar reaction of heart rate and maximum blood pressure can also be observed in an insufficiently trained athlete after a small load (training).

3. There is a qualitative difference in adaptive reactions. Heart rate and respiration after training react to a greater extent than systolic blood pressure, while heart rate recovery lasts more than 5 minutes. Such a reaction can be observed in insufficiently trained athletes or when tired after a very intense load in trained athletes.

4. This variant is characterized by significant changes in the body's reactions to additional stress after training: the recovery period is lengthened, the heart rate and respiratory rate are greatly increased, atypical circulatory reactions appear. Before training, the normotonic type of reaction is determined. These changes are noted in poorly trained athletes in a state of *overwork or overtraining*.

Operative examinations can be carried out:

– during training;

– with the use of an additional load before training;

– 30 minutes after training;

– morning and evening on the day of training.

When conducting operational examinations during training, it is necessary to take into account that:

– firstly, the adaptation of the body to physical activity is assessed by the submitted, registered directly during the exercise;

– secondly, the rapid examination conducted during exercise may to some extent interfere with the training process: to increase leisure time, tear athlete from performing up-rajania, etc.;

– thirdly, the assessment of the data obtained during the examination after a workout, estimated not organism adaptation to physical load, and the restoration of its functional systems.

When applying an additional load, the reaction of the body before training is compared with the indicators recorded 20-30 minutes after its completion.

Current surveys evaluate the delayed training effect.

Examinations are carried out:

a) before training or every day in the morning during training camp;

b) morning and evening for several days in a row;

c) at the beginning and at the end of the microcycle;

d) 18–20 hours after training.

Stage-by-stage examinations make a comparative assessment of changes in the functional state of the body's systems, physical qualities with the amount of work, the means and methods of training used.

Examinations are carried out at intervals once every 2–3 months during training camps.

Current surveys evaluate the delayed training effect.

Stage-by-stage examinations make a comparative assessment of changes in the functional state of the body's systems, physical qualities with the amount of work, the means and methods of training used.

Studies are conducted after one day of rest, in the morning, 2 hours after breakfast. It is necessary to exclude charging. Based on the results of the examinations, a further training process is planned.

4.4. TESTING METHODS

The most important section of the complex control is functional diagnostics, in particular, the determination of physical performance and other characteristics of the functional state of the body of the sports shift.

An important role in functional diagnostics belongs to the information obtained with the help of various samples (a synonym for the term «functional test» is the term «test»). With the help of testing, the functional state of the organism as a whole is determined, its readiness for competitive activity, the level of general physical performance, etc.

In addition to the term «general physical performance», there is the term «special physical performance», which characterizes the athlete's ability to perform work specific to this sport. It is obvious that the levels of general and special performance can vary significantly in the same athlete.

Overall physical performance is largely determined by the cardiorespiratory functional system, since the long-term work of the muscles is limited by the delivery of oxygen to them.

It should be noted that most functional tests characterize the activity of not one single system, but the organism as a whole. However, this does not exclude the possibility of using functional tests to assess the preferential response of any particular system in response to exposure.

The main tasks of testing in sports medicine are to study the adaptation of the body (according to the study of the most informative systems) to certain influences, the study of recovery processes after the cessation of exposure.

The body's response to the impact is assessed by the results of the change of indicators characterizing the operation of one or more of its systems.

At the same time, for a more objective assessment of the results of the study, *two rules must be observed:*

1. The input effect on the body should be expressed in quantitative physical quantities (in watts, etc.), since the effect on the body, expressed in the frequency of steps, running on the spot, the number of squats does not provide objective information about the intensity of the work performed.

2. When analyzing the test results, it is necessary to avoid a qualitative (descriptive) assessment of the results of a functional test (for example, the heart rate has slowly recovered). The output information (test results) should be expressed in quantitative physiological quantities.

Stage-by-stage examinations make a comparative assessment of changes in the functional state of the body's systems, physical qualities with the amount of work, the means and methods of training used.

The Harvard Step Test is used as an additional load.

The results obtained using the method of additional loads characterize the degree of impact of training or competitive loads on the body and its recovery.

The essence of the method is to compare the body's reactions to a certain load before the start of training and in the recovery period after the end of training.

At the same time, the severity of changes in the working capacity and reactivity of the body in connection with the completed training load is determined.

At the beginning, the subject's blood pressure, pulse in 10 seconds and respiratory rate in 15 seconds are measured in a sitting position. Then, without removing the cuff of the tonometer, the subject performs the Harvard step test, after which, in the same sequence as before the test, recovery indicators are measured for 5 minutes. After that, the athlete performs the load on the bicycle ergometer (in the zone of submaximal power).

Then, again in the same sequence, the VPN is carried out with the application of an additional load (*Harvard step test).*

Evaluation of research results

Evaluation of the results of the study is carried out by comparing the data of changes in the body's response to additional stress before and after training.

According to the nature of the detected differences in reactions to the additional load, there are three options:

1. There is the same response to the load before and after training. At the same time:

– less pronounced reactions of heart rate and systolic blood pressure in response to additional load indicate insufficient load in the workout;

– more pronounced shifts in heart rate and systolic blood pressure indicate a good functional condition of the athlete. A similar reaction of heart rate and maximum blood pressure can also be observed in an insufficiently trained athlete after a small load (training).

2. There is a qualitative difference in adaptive reactions. Heart rate and respiration after training react to a greater extent than systolic blood pressure, while heart rate recovery lasts more than 5 minutes. Such a reaction can be observed in insufficiently trained athletes or when tired after a very intense load in trained athletes.

3. This variant is characterized by significant changes in the body's reactions to additional stress after training: the recovery period is lengthened, the heart rate and respiratory rate are greatly increased, atypical circulatory reactions appear. Before training, the normotonic type of reaction is determined. These changes are noted in poorly trained athletes in a state of overwork or overtraining.

Samples *with a change in the position of the body in space.*

The body's reactions to changes in the position of the body in space are called postural. The reaction of the body to the transition from the horizontal position of the body to the vertical (head up) is designated as orthostasis.

The method of detecting the body's reaction to postural exposure has received the title of an orthostatic test.

There are two types of *orthostatic test: active and passive.*

An active orthostatic test consists in the independent transition of the subject from a horizontal position to a vertical one.

In a passive orthostatic test, a special turntable is used, the plane of which can be changed by the experimenter at any angle to the horizontal plane. The subject does not perform muscle work at the same time.

Samples with straining (dosed). Metered strain is performed using a pressure gauge, into which the subject exhales. The readings of this pressure gauge correspond to the value of the internal pressure. An increase in intra-thoracic and intra-abdominal pressure during this test reduces the venous return of blood to the heart in the vessels of the small circulatory circle.

All this taken together leads to a decrease in systolic blood volume. In response to this, heart rate and resistance to blood flow in peripheral vessels increase compensatorily.

Samples with a change in the gas composition of the inhaled air (hypoxemic samples). In most cases of sports and medical research, the change in the gas composition of the inhaled air is to reduce the oxygen tension in it. This sample is used to study resistance to hypoxia, which can be observed during competitions and training camps in the highlands and midlands.

Samples with *the introduction of drugs* in sports medicine are used to differentiate the norm from pathology.

According to the principle of *pharmacological testing,* these samples are divided into load and shutdown tests.

In stress tests, the applied pharmacological substance has a stimulating effect on the studied physiological or pathophysiological mechanism.

Shutdown tests are based on blocking (inhibiting) effects of pharmacological devices.

In addition to the above-mentioned effects on the athlete's body, such as the influence of high and low temperatures, changes in barometric pressure, etc. can also be used. It should be noted that these samples, due to their methodological complexity, have not been widely distributed.

Determination of physical performance using the Harvard Step Test index

The subject performs physical activity for 5 minutes in the form of climbing a step with a height of 50 cm(m) or 43 cm(w). The pace of movements is set by a metronome, the frequency of which is set to 120 beats / min.

Methodical instructions

– Before conducting the Harvard step test, the subject must make several trial ascents of the step.

– If the subject lags behind the rhythm for 20 seconds due to fatigue, then the study is stopped and its duration is recorded. The resulting time is included in the calculation formula.

– Before starting the test, blood pressure and heart rate are measured at rest.

– After performing physical activity, the subject counts his pulse in 30 seconds at 2, 3, 4 minutes. Additionally, after performing the GST, another researcher measures heart rate and blood pressure for 5 minutes (pulse – 10 seconds, blood pressure - 50 seconds).

The test results are expressed in the form of the Harvard Step Test Index (IGST). This value is calculated by the formula:

IGST = 100 * t (sec) / 2*(f1+f2+f3)

where, t is the actual time of the exercise test in seconds, f1,f2,f3 is the sum of the pulse for the first 30 seconds of each minute (starting from the second) of the recovery period.

Evaluation of results

The conclusion about physical performance according to IGST is given only when comparing this index with the nature of the pulse response and blood pressure:

1. Physical performance is considered good if high IGST numbers are accompanied by a normotonic reaction.

2. Satisfactory physical performance is considered when high IGST numbers are accompanied by a hypotonic reaction.

3. Physical performance is considered unsatisfactory in hypertensive, dystonic or stepwise reactions, regardless of the assessment of IGST.

Physical performance according to IGST is assessed according to various standards for athletes, depending on the type of sport

ACUTE pathological conditions

Among the acute pathological conditions encountered in sports practice (OPS) are distinguished: fainting, hypoglycemic state, heat and sunstroke, drowning, freezing.

Fainting states (OS) include cases with short-term and partial loss of consciousness. Prolonged loss or confusion of consciousness is referred to by the term «coma».

In athletes, OS occurs with gravitational shock, which occurs when an abrupt stop occurs after intense running, walking, skating, cycling, etc.

The mechanism of changes in this case is as follows

* decrease in venous return to the heart —> decrease in cardiac output —> oxygen starvation of the brain.

* The main reason is the shutdown of the «muscle pump».

OS also occurs during orthostatic collapse in the case of prolonged stationary stay in an upright position. In this case, a certain part of the blood is deposited in the veins of the lower extremities. With a reduced tone of venous vessels, the return of venous blood to the heart decreases.

In addition, OS can occur during straining (in t / a), short-term cardiac arrest, as well as due to a knockdown or knockout (in boxing).

Hypoglycemic condition is associated with a decrease in blood glucose – hypoglycemia. Develops in competitions in long-distance running, multi-hour bicycle races, during marathon swims, at long distances for skiers.

It is characterized by the presence of acute hunger, cold sweat, confusion, pale skin, dilated pupils, ridiculous actions at a distance.

Heat stroke occurs due to violations of heat transfer. It is observed when performing strenuous training and competitive loads in conditions of high temperature and humidity in clothes that prevent normal heat transfer, limiting the drinking regime during prolonged physical exertion.

Before the onset of heat stroke, there is a sharp increase in sweating, an increase in pulse and respiratory rate, dryness of the mucous membranes of the mouth. If the load continues, overheating of the body and heat stroke are observed – sharp shortness of breath, headache and dizziness, confusion, hallucinations, complete loss of consciousness may occur.

Sunstroke occurs under the direct action of sunlight (infrared part of the spectrum). At the same time, there is a sharp redness of the face, headache and dizziness, confusion or loss of consciousness.

In water sports, during mass swimming classes in health camps, sometimes there are cases of drowning. There are four main types of death in water:

1. primary, true or «wet drowning»;
2. asphyxic or «dry drowning»;
3. secondary drowning;
4. death in the water.

In these cases, with respiratory arrest, a sharp decrease or cessation of cardiac activity, artificial respiration, as well as indirect heart massage, should be performed without wasting time. The system of resuscitation measures corresponds to the rule A - B - C, where A is the respiratory tract, B is respiration, C is blood circulation.

This system consists of:

– cleaning and restoration of airway patency (point A);

– artificial respiration «from mouth to mouth» or «from mouth to nose» (point B);

– indirect heart massage (point C).

LIST AND TOPICS OF PRACTICAL EXERCISES

1. Methods of medical and pedagogical observation: continuous observation. 2 hours

2. Methods of medical and pedagogical observations with additional physical activity. 2 hours

3. Methods of medical and pedagogical 2 hours

4. Methods of medical and pedagogical observations for determining the total effect of the load. 2 hours

5. Methods of medical and pedagogical observations with repeated (control) loads 2 hours

6. The choice research methods depending on the specifics of the sport 2 hours

7. Evaluation of the results of medical and pedagogical observations 2 hours.

8. Content of the self-control diary. 2 hours

9. The effectiveness of physical education. 2 hours

10. Methods and indicators of self-control, its standards. 2 hours

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Applications

Appendix 1

CONDUCTING ANTHROPOMETRIC RESEARCH

Measurement of height by the standard method with a height meter and weighing on medical scales according to the generally accepted method.

The index of physique strength (according to Pinya) expresses the difference between standing height and the sum of body weight and chest circumference on exhalation: where x is the index; P is height, cm; m is body weight, kg; O is the chest circumference in the exhalation phase, see.

The smaller the difference, the better the indicator (in the absence of obesity). A difference of less than 10 is estimated as a strong physique, from 10 to 20 – good, from 21 to 25 – average, from 26 to 35 – weak, more than 36 – very weak.

The vital index of the lungs (VEINS) is used to determine the functionality of the external respiration apparatus. It is calculated how much air from the vital capacity of the lungs falls on each kilogram of the body.

The circumference of the chest is measured using a centimeter tape. It is advisable to carry out measurements as follows: the measuring tape is applied directly at the corners of the shoulder blade from behind, in front – at the level of the mid-sternal point.

Based on the results of anthropometric data to assess the correspondence of body weight and height in dynamics at the beginning and at the end of the academic year, the Quetelet index was determined by the formula: body weight, g / body length, see.

The Quetelet index indicates the correspondence of body weight to its height. PHYSICAL DEVELOPMENT 5–7 POINTS IS RATED AS LOW; 8–12 POINTS B – BELOW AVERAGE; 13–17 POINTS – AVERAGE; 18–22 POINTS ABOVE AVERAGE.

Appendix 2

DETERMINATION OF PHYSICAL PERFORMANCE USING THE HARVARD STEP TEST INDEX

The subject performs physical activity for 5 minutes in the form of climbing a step with a height of 50 cm (m) or 43 cm (w). The pace of movements is set by a metronome, the frequency of which is set to 120 beats / min.

Methodical instructions

– Before conducting the Harvard step test, the subject must make several trial ascents of the step.

– If the subject lags behind the rhythm for 20 seconds due to fatigue, then the study is stopped and its duration is recorded. The resulting time is included in the calculation formula.

– Before starting the test, blood pressure and heart rate are measured at rest.

– After performing physical activity, the subject counts his pulse in 30 seconds at 2, 3, 4 minutes.

Additionally, after performing the GST, another researcher measures heart rate and blood pressure for 5 minutes (pulse – 10 seconds, blood pressure – 50 seconds). The test results are expressed in the form of the Harvard Step Test Index (IGST). This value is calculated by the formula:

IGST = 100 * t (sec) / 2*(f1+f2+f3) where, t is the actual time of the exercise test in seconds, f1,f2,f3 is the sum of the pulse for the first 30 seconds of each minute (starting from the second) of the recovery period.

Evaluation of results

The conclusion about physical performance according to IGST is given only when comparing this index with the nature of the pulse response and blood pressure:

1. Physical performance is considered good if high IGST numbers are accompanied by a normotonic reaction.

2. Satisfactory physical performance is considered when high IGST numbers are accompanied by a hypotonic reaction.

3. Physical performance is considered unsatisfactory in hypertensive, dystonic or stepwise reactions, regardless of the assessment of IGST.

Appendix 3

PHYSICAL PERFORMANCE ACCORDING TO IGST IS ASSESSED ACCORDING TO VARIOUS STANDARDS FOR ATHLETES, DEPENDING ON THE TYPE OF SPORT

Average IGST values depending on sports (data *on I.V. Aulik)*

IGST Sports Qualification IGST Sports Qualification

Cross-country runners 111
Swimmers 90
Cyclists 106
Volleyball players 90
Skiers 100
Sprinters 86
Marathon runners 98
Weightlifters 81
Boxers 94
Not engaged in sports 62

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