LVIV NATIONAL MEDICAL UNIVERSITY N.A. DANYLO HALYTSKY

Department of Physical Training and Sports Medicine

Approved at the methodical meeting of
the department of Physical training and sports medicine
Head of the department
k.b.s., associate prof. Kunynets O.B. _____ **2023**
Protocol № 18 from 16.05

GUIDELINES

in the discipline

PHYSICAL REHABILITATION AND SPORTS MEDICINE

for 4th year students

training of specialists of the second (master's) level higher education in the field of knowledge 22 "Health" specialty 222 "Medicine" for independent work in preparation for practical classes

Topic 2 *"Research and evaluation of the functional state of the body through functional tests."*

LVIV-2023

Methodical guidelines are made in accordance with the requirements of the curriculum in the discipline "Physical Rehabilitation and Sports Medicine", compiled to train specialists of the second (master's) level of higher education in the field of knowledge 22 "Health" specialty 222 "Medicine".

According to the curriculum, the study of physical rehabilitation and sports medicine at the medical faculty is carried out in the 4th year of study. The program is designed for 75 hours, of which 30 classroom hours (practical classes), 8 hours - lectures and 37 hours of independent work of students (IWS).

Methodical recommendations prepared by assistant of the department of physical education and sports medicine Marusiak S.V., Candidate of Medical Sciences, associate professor of the department of physical education and sports medicine Leontieva Z.R.

According to the general wording of the head of the Department of Physical Education and Sports Medicine, Candidate of Biological Sciences, Associate Professor O.B. Kunynets.

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Methodical recommendations were discussed and approved at the methodical meeting of the Department of Physical Education and Sports Medicine

Protocol № 18 from 16 of May 2023

1. **Relevance of the topic:** The most important and responsible task of medical control is the correct assessment of the functional state and functional abilities of a person. To assess the functional state of the body in medicine there is a special section - functional diagnosis. The essence of functional diagnostics is also in the analysis of mechanisms that cause changes in the functioning of organs and systems under the influence of various factors. Carrying out functional tests is crucial in admission to competitions, trainings after the transferred diseases, injuries, after long breaks in employment, for fatigue, on the recommendations of coaches or at the request of athletes. Therefore, determining the functional state of the cardiovascular, respiratory and autonomic nervous systems is relevant and necessary in the daily work of a sports doctor.
2. **Duration of the lesson (or topic):** 2 (hours).
3. **Learning aim:**

   Specific goals:

   To know:
   - theoretical bases of carrying out functional tests and their value in functional diagnostics of cardiovascular, respiratory and autonomic nervous systems;
   - classification of functional tests;
   - functional indicators of fitness.

   Be able:
   - master the method of conducting functional tests: with breathing stop during inhalation (Stange) and exhalation (Genchi); with a change in body position in space (ortho- and clinistically); with physical activity (20 squats in 30 seconds and Letunov's test);
   - analyze the data obtained during functional tests;
   - mastering the skills of working with special medical documentation during functional tests (form № 061 / o or №162 / o).

   Learn practical skills:
   - independently perform functional tests: with respiratory arrest during inhalation (Stange) and exhalation (Genchi); with a change in body position in space (ortho- and clinistically); with physical activity (20 squats in 30 seconds and Letunov's test);
   - to provide recommendations on the choice of the type of physical exercises and recreational and health or training motor modes depending on the functional abilities of the subject.
4. **Basic knowledge, skills, abilities necessary for studying the topic (interdisciplinary integration).**

   Normal physiology- have basic registration skills physiological indicators.

   Pathological physiology- to determine the mechanisms of development of pre-pathological and pathological changes in the body.

   Propaedeutics of internal diseases- conduct functional tests with respiratory arrest, with a change in body position in space, with exercise. Interpret the received clinical data.

   Physical Education- have the technique of health and sports training. Carry out self-control during physical training.
5. **Student advice.**

   5.1. The list of the basic terms, parameters, characteristics which the student should master at preparation for the class.

Functional test- precisely dosed effect on the body of various factors, which allows you to study the response of physiological systems to a particular effect and allows you to get an idea of the state organism in terms of active life.

Functional condition- the level of adaptation of basic physiological systems to change the state of the internal and / or external environment.

Functional diagnostics- determination and assessment of the functional state of organs and systems of the body as a whole.

5.2. Theoretical questions for the lesson:

1. Organization and purpose of functional diagnostics.
2. General concepts of functional tests and their significance in clinical medicine. Determination of functional tests.
3. The main tasks to be solved during functional tests.
4. Classification of functional tests depending on the influencing factor.
5. Classification of functional tests with physical activity.
6. General requirements and scheme of functional tests.
7. Methods of conducting functional tests with respiratory arrest during inhalation (Stange) and exhalation (Genchi) and evaluation of the results.
8. Methods of conducting functional tests with changes in body position in space (ortho- and clinostatic) and evaluation of the results.
9. Methods of conducting a functional test with physical activity for recovery for low-trained individuals (20 squats in 30 seconds. (Martine-Kushelevsky).
10. Evaluation of the results of functional tests with physical activity for recovery.
11. Types of response of the cardiovascular system to exercise.
12. Characteristics of the normal type of response to exercise (normotonic).
13. Characteristics of pathological types of reaction to physical activity (hypotonic, hypertonic, hyperreactive, dystonic and stepped).

5.3. Practical work (tasks) performed in class:

1. Conducting and evaluating functional tests with respiratory arrest during inhalation (Stange) and exhalation (Genchi);
2. Conducting and evaluating functional tests with changes in body position in space (ortho- and clinostatic);
3. Conducting and evaluating tests with physical activity for recovery (20 squats in 30 seconds (Martine-Kushelevsky) or combined Letunov test);
4. Filling in special medical documentation during functional testing (form № 061 / o or №162 / o);

5.4. Topic content:

The main tasks of functional research:

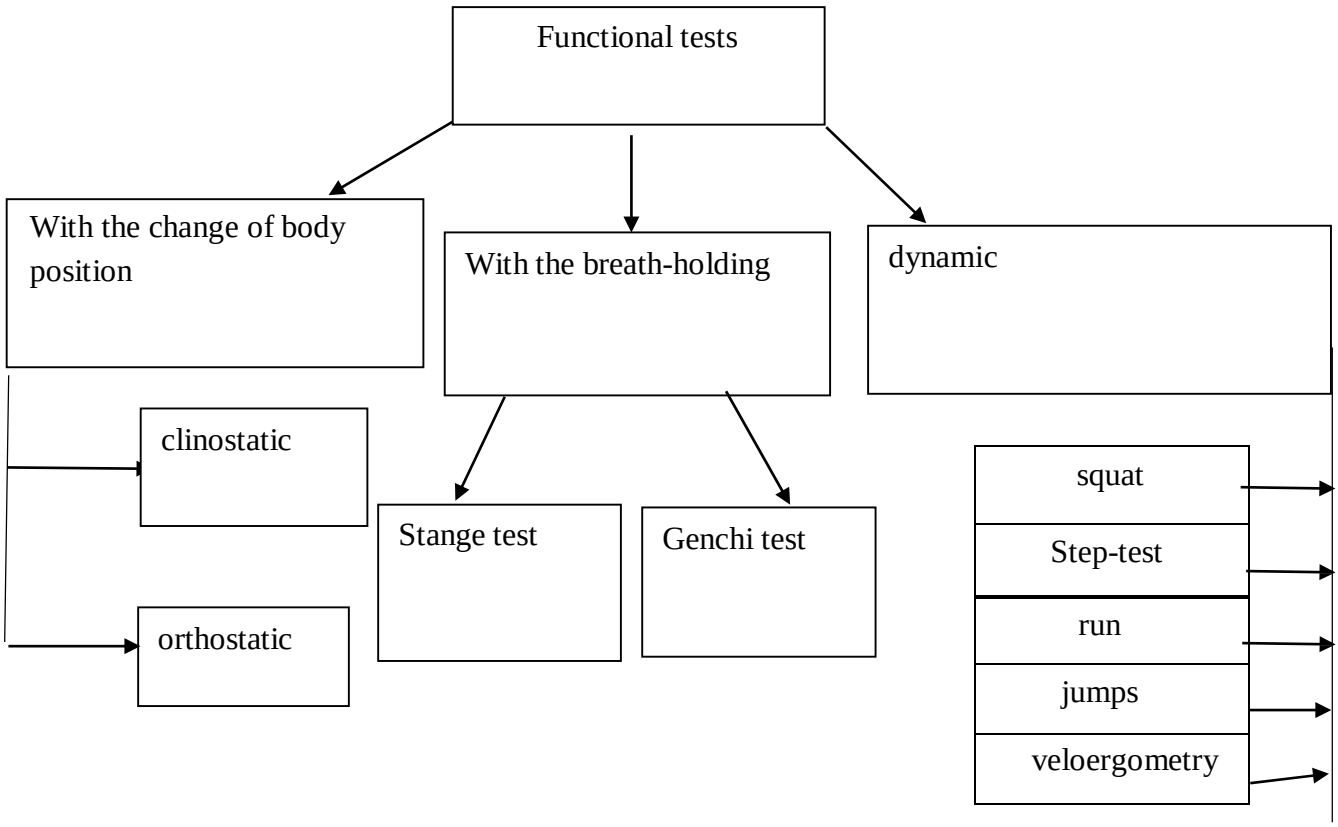
1. Determining and assessing the degree and nature of the response of organs and systems to the influencing factor.

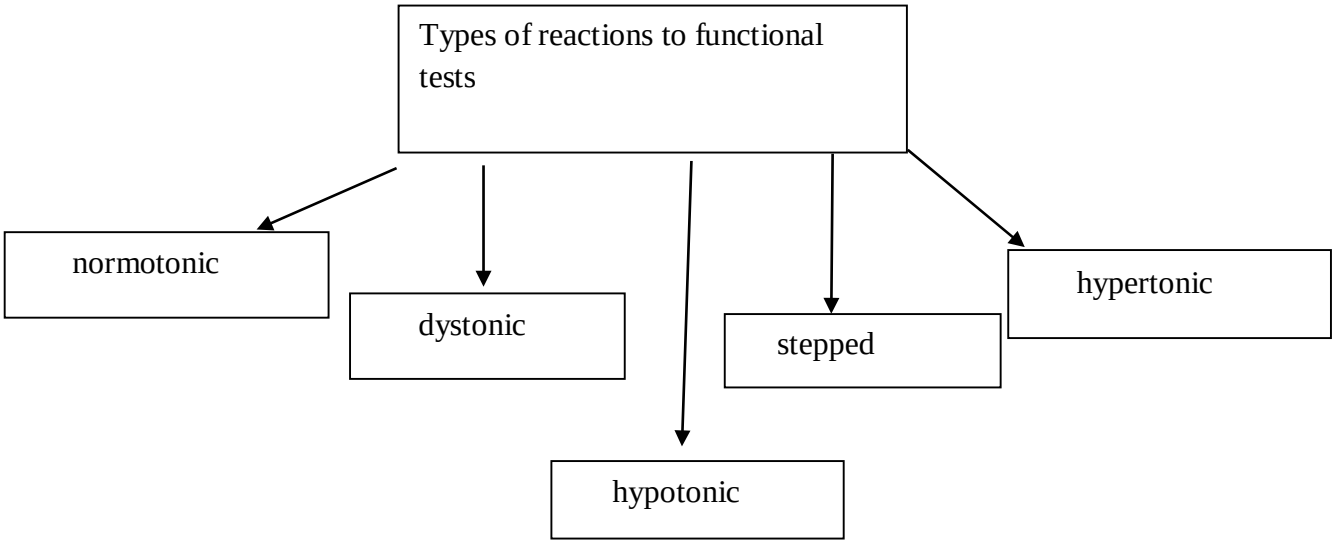
2. Identification of mechanisms of adaptation of the organism to changing conditions.

3. Detection of latent violations of the function, scope and extent of these violations.

Functional samples are used to assess mainly the response of a particular system in response to exposure. However, most of them characterize the activity of not one individual system, but the body as a whole.

Classification of functional tests:





General requirements are to the functional tests:

It should be noted that whatever the functional tests, they must meet certain requirements, namely - to be the same type, standard and dosed. Because only under such conditions it is possible to compare the data obtained from different individuals, or from one

person in different periods of time, ie in the dynamics. In addition, functional tests should be completely safe and at the same time sufficiently informative, as well as simple and accessible, without requiring special skills to perform them. Exercise tests should ensure that as many muscles as possible are involved and that the intensity of the load can be measured and varied as necessary.

Functional tests apply:

- ✓ For determination of physiology reaction on physical activities
- ✓ For the correction of training process
- ✓ With the aim of drafting on the individual program of physical rehabilitation of patients, and her correction
- ✓ Determinations of level of physical capacity of healthy and sick
- ✓ For the estimation of efficiency of training process
- ✓ For research of influence on the organism of pharmacological preparations.

Features of registration of some indicators

It is also necessary to pay attention to features of registration of some indicators, mainly it concerns pulse rate, when carrying out functional tests. In order to study the reaction of this indicator, it is calculated not for one minute, but for shorter time intervals, usually 10, 15 or 30 seconds.

Methods of conducting and evaluation of functional tests

Breath holding tests

Breath holding test during inhalation (Stange test). The test is performed in a sitting position. The subject should take a deep (but not maximum) breath and hold his breath as long as possible (squeezing his nose with his fingers). The duration of the break in breathing is counted with a stopwatch. At the moment of exhalation the stopwatch is stopped. In healthy but untrained individuals, the time of respiratory break ranges from 40-60 seconds for men and 30-40 seconds for women. For athletes, this time increases to 60-120 seconds for men and up to 40-95 seconds for women.

Breath holding test during exhalation (Genchi test). After making normal (not excessive) exhalations, the subject holds his breath. The duration of the break in breathing is marked by a stopwatch. The stopwatch is stopped at the moment of inhalation. Respiratory delay time in healthy untrained individuals ranges from 25-40 seconds for men and 15-30 seconds for women. Athletes have significantly higher rates (up to 50-60 seconds for men and 30-50 seconds for women).

Samples with changes body position in space

Orthostatic test. After lying down for at least 3-5 minutes the subject counts the pulse rate for 15 seconds and the result is multiplied by 4. Thereby determine the initial heart rate for 1 min. Immediately after the transition to a vertical position, and then after 3 minutes. standing (ie when the heart rate stabilizes) his blood pressure is measured again and determine the heart rate (according to the pulse for 15 sec., multiplied by 4).

The normal response to the test is to increase the heart rate by 10-16 beats per 1 minute immediately after lifting. After stabilization of this indicator in 3 min. standing heart rate decreases slightly, but by 6-10 beats per 1 min. higher than in the horizontal position. A

stronger reaction indicates increased reactivity of the sympathetic part of the autonomic nervous system, which is characteristic of insufficiently trained individuals. Weaker reaction is observed in the case of reduced reactivity of the sympathetic part and increased tone of the parasympathetic part of the autonomic nervous system.

Clinostatic test. This test is performed in reverse order: heart rate is determined after 3-5 minutes calm standing, then after a slow transition to a supine position, and finally after 3 minutes. being in a horizontal position. Pulse is also counted for 15 second time intervals, multiplying the result by 4.

For a normal reaction is characterized by a decrease in heart rate by 8-14 beats per 1 min. immediately after the transition to a horizontal position and some increase after 3 minutes stabilization, but the heart rate at the same time for 6-8 beats per 1 min. lower than in the vertical position. A greater decrease in heart rate indicates increased reactivity of the parasympathetic part of the autonomic nervous system, less - a reduced reactivity.

Exercise tests

Rufie test: conducting a test, in investigated, that are in position, lying on a back during 5 min, determine a pulse for 15 second (P1). Then during 45 seconds the investigated executes 30 squats for 45 second. After it he lie down and for him again count up a pulse for the first 15 seconds, and then for the last 15 seconds from the first minute of period of renewal.

$$\textbf{Rufie test} = \frac{4(P1+P2+P3)-200}{10}$$

Combined Letunov test. The test consists of 3 consecutive different loads, which alternate with rest intervals. The first load - 20 squats (used as a warm-up), the second - running on the spot for 15 seconds. with the maximum intensity (speed load) and the third - running on the spot for 3 minutes. at a pace of 180 steps in 1 minute. (endurance load). The duration of rest after the first load, during which heart rate and blood pressure are measured, is 2 minutes, after the second - 4 minutes. and after the third - 5 minutes. Thus, this functional test allows to estimate adaptation of an organism to physical activities of various character and various intensity.

There are 5 main types of reactions of the cardiovascular system: normotonic, hypotonic, hypertonic, dystonic and stepped

1. The normotonic type of reaction is characterized by:

- acceleration of pulse rate by 60-80% (on average by 6-7 beats per 10 sec.);
- moderate increase in systolic blood pressure to 15-30% (15-30 mm Hg);
- moderate decrease in diastolic blood pressure by 10-15% (5-10 mm Hg), due to a decrease in total peripheral resistance due to dilation of peripheral vascular vessels to provide working muscles with the required amount of blood;
- the normal period of the recovery process: for men it is up to 2.5 minutes, for women - up to 3 minutes.

This type of reaction is considered favorable, as it indicates an adequate mechanism of adaptation of the body to exercise.

2. Hypotonic (asthenic) type of reaction is characterized by:

- significant acceleration of the pulse - more than 120-150%;
- systolic blood pressure is slightly increased, or does not change, or even decreases;
- diastolic blood pressure often does not change, or even increases;

- significantly slowed down recovery period - more than 5-10 minutes.

This type of reaction is considered unfavorable because the mechanism of adaptation to the load is unsatisfactory.

3. The hypertensive type of reaction is characterized by:

- significant heart rate acceleration - more than 100%;
- significant increase in systolic blood pressure - up to 180-200 mm Hg. and above;
- a certain increase in diastolic blood pressure - up to 90 mm Hg., or a tendency to increase;
- the recovery period is significantly slowed down (more than 3 minutes).

The type of reaction is considered unfavorable due to the fact that the mechanism of adaptation to the load is unsatisfactory. This type occurs with a predisposition to hypertensive conditions (including latent forms of hypertension), vegetative-vascular dystonia of the hypertensive type.

4. The dystonic type of reaction is characterized by:

- significant heart rate acceleration - more than 100%;
- significant increase in systolic blood pressure (sometimes above 200 mm Hg);
- reduction of diastolic blood pressure to zero ("phenomenon of infinite tone"), which lasts for more than 2 minutes (the duration of this phenomenon up to 2 minutes is considered a variant of the physiological response);
- slowing down the recovery period.

The type of reaction is considered unfavorable and indicates excessive lability of the circulatory system, due to a sharp violation of the nervous regulation of the peripheral (microcirculatory) vascular bed. Observed in disorders of the autonomic nervous system, neuroses.

5. For the step type of reaction is characterized by:

- a sharp increase in heart rate - more than 100%;
- stepwise increase in systolic blood pressure, ie systolic blood pressure measured immediately after exercise - in the first minute - lower than in 2 or 3 minutes of the recovery period;
- delayed recovery period

The type of reaction is considered unfavorable because the mechanism of adaptation to the load is unsatisfactory. It indicates a weakened circulatory system, unable to adequately and quickly provide the redistribution of blood flow needed to perform muscular work. It is often observed in the elderly, especially diseases of the cardiovascular system.

5.5. Materials for self-control:

1) Questions for self-control:

1. What are the features of the examination of an athlete or sportsman?
2. What is the essence of functional diagnostics?
3. What is a functional state?
4. What is the scheme of functional research?
5. What are the main tasks of functional research?
6. What "tool" is in the hands of a doctor to study the functional state?
7. What is the difference between the concepts of functional state and functionality?
8. What is the classification of functional tests?
9. What samples can be used to study the functional state of the cardiovascular system?
10. What samples can be used to study the functional state of the respiratory system?

***2)* Situational (clinical) tasks for self-control:**

- Typical, standard, classic, have an unambiguous answer, students know the algorithms for their solution - **II level;**

- Atypical, non-standard, reflecting complicated professional situations - **III level.**

II level:

1. After the test with dosed exercise 20 squats for 30 seconds. in the subject L., 30 years increased heart rate from 14 beats. for 10 sec. up to 28 beats. for 10 sec., blood pressure changed from 130/80 to 180/90 mm Hg. The recovery period was 4 minutes

Task:

1. Determine the type of reaction of the cardiovascular system to the load;

2. Describe the recovery period;

3. Assess the quality of the response of the cardiovascular system to the load;

4. Assess the mechanism of adaptation of the cardiovascular system to the load;

5. Give an opinion on the possibility of admitting the patient to physical activity and recommendations on the necessary motor mode and level of physical activity.

2. After the test with dosed exercise 20 squats for 30 seconds. in the examined V., 33 years the pulse from 12 beats increased. for 10 sec. up to 26 beats for 10 sec., blood pressure changed from 120/80 to 145/0 mm Hg. Recovery time was 300 seconds.

Task:

1. Determine the type of reaction of the cardiovascular system to the load;

2. Describe the recovery period;

3. Assess the quality of the response of the cardiovascular system to the load;

4. Assess the mechanism of adaptation of the cardiovascular system to the load;

5. Give an opinion on the possibility of admitting the patient to physical activity and recommendations on the necessary motor mode and level of physical activity.

3. After the test with dosed exercise 20 squats for 30 seconds. the subject V., 13 years old, who had recently suffered from SARS, had an increased heart rate of 12 beats. for 10 sec. up to 26 beats for 10 sec., blood pressure changed from 120/80 to 145/0 mm Hg. Recovery time was 300 seconds.

Task:

1. Determine the type of reaction of the cardiovascular system to the load;

2. Describe the recovery period;

3. Assess the quality of the response of the cardiovascular system to the load;

4. Assess the mechanism of adaptation of the cardiovascular system to the load;

5. Give an opinion on the possibility of admitting the patient to physical activity and recommendations on the necessary motor mode and level of physical activity

III level

1. A girl A, 13 years old after the orthostatic test, the following results were obtained: an increase in heart rate immediately after getting up by 18 beats / min. and an increase in heart rate by 12 beats / min. after 3 minutes standing position relative to the initial heart rate.

Question:

1. Evaluate the results obtained?

2. What system do we test with an orthostatic test?

3. What diseases can these disorders lead to in the future?

4. Give advice to this girl regarding the level of physical activity and the necessary type of physical activity to prevent possible diseases.

3) Tests for self-control

1. During the combined functional test Letunov apply the following physical activities:
A. Running on the spot for 3 minutes. at a pace of 180 steps in 1 minute, 20 squats in 30 seconds, running on the spot for 15 seconds. with a high rise of the thighs
B. Running on the spot for 15 seconds. with a high rise of the thighs, 20 squats in 30 seconds, running on the spot for 3 minutes. at a pace of 180 steps in 1 minute.
C. 20 squats for 30 sec., Running on the spot at maximum speed with a high rise of the thighs for 15 sec., Running on the spot for 3 minutes. at a pace of 180 steps in 1 minute.
D. 20 squats in 30 seconds, 60 jumps in 30 seconds, running on the spot for 3 minutes. at a pace of 150 steps in 1 minute.
E. 60 jumps in 30 seconds, running on the spot for 3 minutes. at a pace of 120 steps in 1 minute.
2. Functional systolic murmur after exercise test:
A. Intensifies;
B. Does not change;
C. Increases or weakens;
D. Weakens or disappears;
E. Changes the timbre.
3. The main tasks to be solved during most functional tests:
A. Assessment of the nature of the response of organs and systems to a functional test;
B. Research of mechanisms of adaptation of an organism to the changed conditions;
C. Detection of latent dysfunction of organs and systems;
D. All answers are correct;
E. There are incorrect answers.
4. After trying 20 squats for 30 seconds. the subject's heart rate increased from 12 beats. for 10 sec. up to 20 beats. for 10 sec., blood pressure changed from 120/80 to 140/60 mm Hg. Determine the type of reaction of the cardiovascular system:
A. Normotonic;
B. Hypotonic;
C. Hypertensive;
D. Dystonic;
E. Stepped.

5. The main manifestation of the economization of physiological functions at rest in trained individuals is:
A. Acceleration and deepening of respiration;
B. Reduction of the diastole phase;
C. Sinus bradycardia;
D. Sinus tachycardia;
E. Increased cardiac output.
6. The main signs of long-term adaptation of the cardiovascular system to optimal physical activity (especially for the development of endurance) are:
A. Sinus bradycardia, physiological hypotension, severe myocardial hypertrophy;
B. Sinus bradycardia, moderate hypertension, hypertrophy mainly of the left myocardium;
C. Sinus bradycardia, physiological hypotension, moderate myocardial hypertrophy with the corresponding development of coronary bleeding;
D. Sinus bradycardia, hypotension, hypertrophy mainly of the right myocardium;
E. Sinus tachycardia, physiological hypertension, moderate myocardial hypertrophy with the corresponding development of coronary bleeding.
7. Organic systolic murmur after exercise test:
A. Weakens;
B. Intensifies;
C. Does not change;
D. Changes the timbre;
E. Disappears.
8. What parameters determine the type of reaction of the cardiovascular system to standard exercise:
A. Changes in heart rate;
B. Changes in systolic and diastolic blood pressure;
C. Pulse excitability, the nature of changes in systolic, diastolic and pulse blood pressure;
D. Changes in heart rate and respiration;
E. Changes in heart rate and pulse blood pressure.
9. The normotonic type of reaction of the cardiovascular system to exercise is characterized by:
A. Increase in heart rate to 60-80%, moderate increase in systolic blood pressure, some (up to 10%) decrease in diastolic blood pressure, increase in pulse blood pressure to 60-80%;
B. Increase in heart rate to 60-80%, moderate decrease in systolic, diastolic and pulse blood pressure;
C. Increase in heart rate to 60-80%, a significant increase in systolic, diastolic and pulse blood pressure;
D. Increase in heart rate over 100%, slight increase in systolic, diastolic, decrease in heart rate;
E. Increase in heart rate over 100%, significant increase in systolic blood pressure, significant decrease in diastolic blood pressure.
10. After trying 20 squats for 30 seconds. the subject's heart rate increased from 12 beats. for 10 sec. up to 25 beats for 10 sec., blood pressure changed from 120/80 to 180/95 mm Hg. Determine the type of reaction of the cardiovascular system:
A. Normotonic;
B. Hypertensive;
C. Hypotonic;
D. Dystonic;
E. Stepped.

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Informational resources

zakon.rada.gov.ua/go/1556-18
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Methodical

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