Original Article

Analysis of the response and recovery levels of cardiovascular and vegetative nervous systems in people with coronary heart disease

NATALIA ZHARSKA[1], VIRA BUDZYN[2], OLHA MATVIYAS[3], NATALIIA BAZYLIAK[4], OLHA RYMAR[5], GALINA HAVELKO[6]
[1,2,3,4,5,6,] Lviv State University of Physical Culture named after Ivan Boberskij, UKRAINE

Abstract.
Problem statement. An important criterion for the effectiveness of the physical rehabilitation program is the body's tolerance to physical activity, which can be assessed on the basis of the responses of the cardiovascular and vegetative nervous systems. The use of graduated physical exercise in complex therapy allows to partially normalize metabolism and vegetative regulation (to reduce sympathetic and increase parasympathetic activity). **Approach.** Research methods: theoretical analysis of scientific and methodological library and e-resources, pedagogical monitoring, medical and biological research methods (study of medical histories, examination, survey, determination of heart rate, tonometry), functional research methods (Robinson index, Kerdo index), methods of mathematical statistics. **Purpose.** The purpose of the study was to determine the levels of response and recovery of the cardiovascular and vegetative nervous systems in the process of physical rehabilitation of people with coronary heart disease (stable angina, II functional class) in the post-hospital period. **Objectives** of the study: to develop a program of differentiated use of physical rehabilitation measures for the second adult age people with coronary heart disease (stable angina, II functional class) in the post-hospital period and to determine the levels of response and recovery of cardiovascular and vegetative nervous systems in the process of using of physical rehabilitation means for people suffering from a coronary heart disease (stable angina, II functional class) in the post-hospital period. **Results.** Based on the calculation of Robinson indices and Kerdo indices, current and operational criteria for assessing the effectiveness of the process of physical rehabilitation for people with coronary heart disease (stable angina, II functional class) were developed for further differentiated use of means and methods of physical rehabilitation. **Conclusion.** The established type of reaction and recovery of the cardiovascular and autonomic nervous systems can be used as current and operational criteria for the effectiveness of physical rehabilitation in people with coronary heart disease (stable angina, II functional class) and further differentiated use of means and methods of physical rehabilitation.
Keywords: physical rehabilitation, criteria, Robinson index, Kerdo index, graduated physical exercises.

Introduction.

Diseases of the cardiovascular system occupy a prominent place among the factors of morbidity and mortality in Ukraine. Such diseases, first of all, include a chronic coronary heart disease, which significantly limits the working capacity of the population and ultimately leads to the development of myocardial infarction (Apanasenko, 2004, Belovol, Knyazkova, 2015, Vazquez, Abanto, Aregliano, 2015, Sapa, Noudga, 2016, Kryzhanivsky, 2000, Vatutin, Glass, Lavrova, 2017, Gidzinska, Moroz, Lasitsa, Dzizinska, 2015).

An important criterion for the effectiveness of the physical rehabilitation program is the body's tolerance to physical activity, which can be assessed on the basis of the reaction of the cardiovascular and vegetative nervous systems (Bykovskaya, 2015, Nascimento, Brant, Moraes, Ribeiro, 2015, Zharska, 2012, Rudbury, Morad, Manzhulovsky,, Lomakovsky, 2015, Makarova, 2010, Shakhlina, 2012, Shved, Levitska, 2018). One of the important indices of the reserve of the cardiovascular system is the Robinson index, which characterizes the systolic work of the heart and the Kerdo index, which characterizes the influence of autonomic regulatory mechanisms on the cardiovascular system functioning. Determination of these indices during and at the end of exercise is informative about the functional ability of the myocardium during physical exercises and recovery of the cardiovascular system (Belovol, Knyazkova, 2015, Epifanov, 2016, Zharska, 2011, Gidzinska, Moroz, Lasitsa, Dzizinska, 2015, Kovalenko, Dolzhenko, Nesukai, Dyachenko, 2015). The use of graduated physical activity in complex therapy allows to partially normalize metabolism and autonomic regulation (reduce sympathetic and increase parasympathetic activity) (Arutyunov, 2013, Kovalenko, 2008, Vatutin, Glass, Lavrova, 2017, Gidzinska, Moroz, Lasitsa, Dzizinska, 2015).

The effectiveness of comprehensive treatment of people with coronary heart disease (CHD) is associated with the use of special physical rehabilitation programs, which are designed to activate the reserves of

Corresponding Author: NATALIA ZHARSKA, E-mail: zharskan@gmail.com

----

the cardiovascular system and the development of aerobic capacity (Gurevich, 2006, Arutyunov, 2013, Polyanska, 2007). They are performed depending on the clinical features of the disease, intracardiac hemodynamics and the presence of hypertrophy of the heart walls (Kryzhanivskij, 2000, Bagria, 2012). Cardiac patients do not have obvious pathological changes that limit motor function, but the state of the cardiovascular system significantly limits their ability to work (Arutyunov, 2012, Polyanska, 2007). Thus, the development of physical rehabilitation programs and the definition of criteria for their effectiveness for people with coronary heart disease in the post-hospital period are priority research areas.

Analysis of recent research and publications. The need for the use of physical rehabilitation in the comprehensive recovery of persons with diseases of the cardiovascular system has been proven by theory and practice (Belovol, Knyazkova, 2015, Bykovskaya, 2015, Zharska, 2011).

Today there is a large number of scientific papers on the use of physical means and methods in the rehabilitation of people with coronary heart disease (Bykovskaya, 2015, Nikolayeva, 1993, Rudbury, Morad, Manzhulovsky, Lomakovsky, 2015, Misyura, Shestakov, Zobenko, Karpukhin, 2013, Popov, 1999, Shakhlina, 2012, Shved, Levitska, 2018), but practically no criteria have been developed to assess the effectiveness of a scientifically sound system of integrated use of physical rehabilitation means in people of the second mature age with coronary heart disease (stable angina, II functional class). Existing scientific and applied approaches to this process are generalized, there are almost no recommendations to take into account the peculiarities of adaptive changes that occur under the influence of graduated exercises in patients with coronary heart disease, no individualized use of physical rehabilitation, etc. (Epifanov, 2016, Arutyunov, 2013, Rudbury, Morad, Manzhulovsky, Lomakovsky, 2015, Makarova, 2010).

At the same time, there are few studies on the detailed study of Robinson and Kerdo indices as criteria for assessing the effectiveness of the physical rehabilitation process in people with coronary heart disease (stable angina, II functional class) for further differentiated use of means and methods of physical rehabilitation.

The physical basis for the rehabilitation of people with coronary heart disease is the processes of adaptation and compensation of existing disorders. The development of compensatory and adaptive processes can be influenced by exercise, moderate physical activity, dosed walking to get the best results of rehabilitation in less time. An important criterion for the effectiveness of the physical rehabilitation program is the body's tolerance to physical activity, which can be assessed on the basis of the responses of the cardiovascular and vegetative nervous systems (Kovalenko, 2008, Romanchuk, 2003, Romanchuk, 2004, Makarova, 2010).

One of the important indices of the reserve of the cardiovascular system is the Robinson index, which characterizes the systolic work of the heart and the Kerdo index, which characterizes the influence of vegetative regulatory mechanisms on the functioning of the cardiovascular system (Arutyunov, 2013, Kovalenko, 2008, Romanchuk, 2003). Insufficient contractile reserve of the myocardium is the main reason for reduced physical performance of people with coronary heart disease. This leads to increased sympathetic tone, pulmonary ventilation and vasoconstriction. Determination of these indices during and at the end of physical activity is informative about the functional ability of the myocardium during physical activity and recovery of the cardiovascular system (Apanasenko, 2004, Arutyunov, 2013, Kovalenko, 2008).

The use of graduated physical exercise in complex therapy allows to partially normalize metabolism and vegetative regulation (to reduce sympathetic and increase parasympathetic activity). This is observed in the regression of clinical manifestations, such as fatigue, shortness of breath, muscle weakness, and sleep disturbances by increasing physical performance, tolerance to exercise and quality of patients' life (Arutyunov, 2013, Gurevich, 2006, Bagria, 2012). Therefore, determining the levels of response and recovery of the cardiovascular and vegetative nervous systems is necessary while developing criteria for the effectiveness of the physical rehabilitation process for people with coronary heart disease.

The purpose of the research is to establish the types of response and recovery of the cardiovascular and vegetative nervous systems in the process of physical rehabilitation for people with coronary heart disease

The object of the research: physical rehabilitation of people with coronary heart disease.

The subject of the research: means of physical rehabilitation for the recovery of people with coronary heart disease.

The objectives of the study:

1. To develop the program of differentiated use of means of physical rehabilitation for people of the second mature age with coronary heart disease (stable angina, II functional class) in the post-hospital period.

2. To determine the levels of response and recovery of cardiovascular and vegetative nervous systems in the process of physical rehabilitation of people with coronary heart disease (stable angina, II functional class) in the post-hospital period.

Materials and Methods.

The research methods:

1. Theoretical analysis of scientific and methodological library and e-resources on the impact of graduated exercises on the functional state of cardiovascular and vegetative nervous systems in people with coronary heart disease.

----

2. Paraclinical methods (tonometry, pulsometry)

3. Functional research methods (Robinson index, Kerdo index),

3. Method of mathematical statistics.

4. Percentile method.

Blood pressure measurement (BP, mm Hg) was performed according to the method of Korotkov mechanical apparatus for measuring blood pressure model BP AGI-20. Determination of heart rate (beats / min.) was performed by palpation on the radial artery for 15 sec. with the following recalculation to determine the number of beats per 1 minute.

To study the state of the reserves of the cardiovascular system we used the Robinson index, which was calculated by the formula:

IR = heart rate × SAP / 100.

The Kerdo index, which characterizes the influence of autonomic regulatory mechanisms on the functioning of the cardiovascular system, was calculated by the formula: IK = (1 - DAP / heart rate) × 100, norm: from -10 to + 10%.

That is, at values> 0.1 - the prevalence of sympathetic influence (sympathicotonia - SMT) is stated, at values in the range from – 0.1 to + 0.1 - vegetative influence is balanced (etonia), at values <- 0.1 - it is stated predominance of parasympathetic influence (PSMT).

To evaluate the digital parameters we used statistical programs Statistska 6.0.

The percentile method allows using the percentile scale to select people with medium, high and low scores. The evaluation was performed using tables of the centile type, where one centile is one hundredth of any basic unit of measure. The columns of these tables show the quantitative limits of the trait in a certain proportion or percentage (centile) of persons of a given age and sex. At the same time, the values inherent in half of the persons in the range from 25 to 75 centiles were taken as average or conditionally normal values (Table 1).

Table 1

Criteria for the distribution of Robinson and Kerdo indices for centile evaluation

Index	Percentage of the indicator				
	< 5 %	5-25 %	25 -75 %	75 – 95 %	> 95 %
Robinson index	High level	Above average level	Optimal level	Below average level	Low level
Kerdo index	Expressive PSMT	Moderate PSMT	Optimal level	Moderate SMT	Expressive SMT

Notes: PSMT - parasympathicotonia; SMT – sympathicotonia

Organization of the research. The study was conducted on the basis of cardio - pulmonology department of the Clinical Hospital of Lviv Railway in the village of Bryukhovychi, during which the responses of individuals to the proposed physical activity were determined on the basis of the analysis of the physiological curve, which helped to optimize the impact on each person's capabilities. The study involved 50 people aged 50-60 years with a coronary heart disease (stable angina, II functional class), among which men and women were 64% and 36%, respectively.

Results and Discussion.

Based on the theoretical analysis and the results obtained during the study, the physical rehabilitation program was developed for adults of the second mature age with coronary heart disease (stable angina II functional class), which provided differentiated use in addition to conventional means of physical rehabilitation, and means that help normalize thoracocervical muscle tone (special exercises for the back muscles, segmental-reflex massage combined with neck massage, physiotherapy procedures) and methods of dosed walking.

In order to develop criteria for the effectiveness of physical rehabilitation, it was necessary to establish the most common response options of the cardiovascular and autonomic nervous systems in persons with this pathology, which is necessary for proper construction of physical rehabilitation program and adequate selection of physical activity. To determine the levels of response of the cardiovascular and vegetative nervous systems based on heart rate and blood pressure measurements, the Robinson (RI) and Kerdo (KI) indices were calculated before, at the peak and after exercise (in the first, fifth and tenth minutes of recovery).

The data on the calculation of RI and KI in the whole group of examined people in the dynamics of the proposed physical rehabilitation program were analyzed. Percentile analysis of the obtained data provided an opportunity to characterize the features of changes in the cardiovascular and vegetative nervous systems during the course of physical rehabilitation in patients with coronary heart disease (stable angina, II functional class).

In the initial state of people with this pathology, according to the calculation of RI, it was found that most of the people (about 90%) have significant stress in the functioning of the cardiovascular system, and the relative economization of cardiac function (RI - from 95 to 111 standard units), which corresponds to a level below the average, as it was stated by G. L. Apanasenko (2004), occurs in a very small (about 10%) number of people (Fig. 1).

--- 767

At the same time, characterizing the changes in RI, which determine the peculiarities of the functioning of the cardiovascular system in this category of people, it should be noted that most often their RI ranges from 117.8 to 145.5 standard units.

That is, this level of RI can be interpreted as optimal one considering the existing pathology, the increase in RI above 145.5 standard units at rest should be considered as inadequate, and above 162.6 standard units - completely inadequate (or critical), which may be a relative contraindication to training and require additional examination.

At the peak of the load in individuals of this group, the RI often increases in the range from 177.9 to 239.7 standard units, which allows us to characterize this increase as optimal, while the increase above 239.7 standard units is inadequate, and an increase above 254.7 standard units - absolutely inadequate.
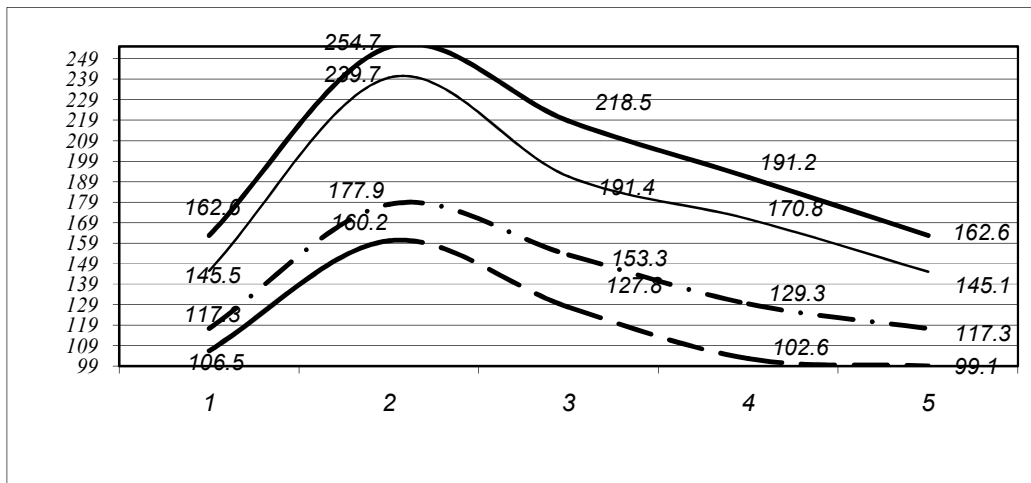
Notes: 1. At the beginning of the load, 2. At the peak of the load, 3. At 1 minute of recovery, 4. At 5 minutes of recovery, 5. At 10 minutes of recovery

———— *limit between> 95% and 75 -95%* ——– *·* —– *limit between 25 - 75% and 5 - 25%*
———— *limit between 75 -95% and 25 -75%* –– –– –– *limit between 5 - 25% and <5%*

Fig. 1. The limits of the distribution of response levels of the cardiovascular system of persons with coronary heart disease in the process of physical rehabilitation according to the Robinson index.

The position of the RI at the peak of the load in the range of 160.2 - 177.9 standard units may indicate, on the one hand, a moderate, adequate, or insufficient impact of physical activity, depending on the initial level of RI. Thus, if at the beginning of the process the RI was within the optimal range, then with such a change the impact should be considered insufficient. If at the beginning of the process the RI was within the levels below the optimal, then such a load can be characterized as moderate or adequate (Apanasenko, 2004, Kovalenko, 2008). It should be noted that the reduction of RI during physical rehabilitation under any circumstances will require its cessation.

At the end of the rehabilitation course, the reduction in RI is expected, which describes the recovery process after exercise. Characterizing the recovery process, it should be noted that the optimal level of RI for 1 min. recovery is the level of 153.3 - 191.4 standard units; accelerated recovery should be considered at RI values in the range of 127.8 - 153.3 standard units, fast - at RI values less than 127.8 standard units. At the same time, the position of the RI in the range of more than 191.4 standard units will indicate inadequate recovery, or excessive physical activity in the process of physical rehabilitation, which may be caused by improper selection and distribution of exercises within parts of the physical activity experience (Polyanska, 2007, Romanchuk, 2004).

It should be noted that at 5 minutes of recovery in most individuals, the RI reaches baseline values, and low-level limits even decrease below baseline (<102.6 standard units), although a certain number of individuals have fairly large values (more than 170,8 standard units). That is, when for 5 minutes of recovery the level of RI exceeds 170.8 standard units it should be assumed that physical activity was excessive, and the body's response to it was inadequate. Characterizing the distribution of RI for 10 minutes of recovery, it can be argued that by this time the RI in all individuals should be restored to the initial level, and in some cases even decrease compared to baseline, which should be a criterion for increasing the load in the next process of physical rehabilitation.

To characterize the autonomic activity in the process of physical rehabilitation, we developed a centile scale for assessing the Kerdo index, which characterizes the predominance (sympathicotonia,

----

----

parasympathicotonia) or balance (eitonia) of the vegetative nervous system impact on cardiovascular activity (Arutyunov, 2013, Kovalenko, 2008, Romanchuk, 2004).

At the initial state in most people with coronary heart disease (stable angina II functional class), taking into account the basic drug treatment, there is (Fig. 2) eytonic variant of regulation of the cardiovascular system with a certain tendency to parasympathicotonia (PSMT) - median limits of RI from - 0.12 to – 0.02 standard units, at the same time variants of sympathicotonic (SMT) influence are observed in less than in 5% of cases.

This option of regulation of the cardiovascular system, in our opinion, is due primarily to adequate drug treatment, which in coronary heart disease is aimed at reducing the activity of the sympathetic division of the vegetative nervous system.

At the peak of the load in the process of physical rehabilitation, you should pay attention to the areas of activity that indicate the adequacy or excess of the inclusion of SMT effects. During the recovery period, emphasis should be placed on the inclusion of PSMT effects, which will characterize the speed of recovery and the presence of SMT effects, which will indicate a significant increase in the tone of sympathicotonic effects, which is often associated with inadequate exercise (Bagria, 2012, Romanchuk, 2003).
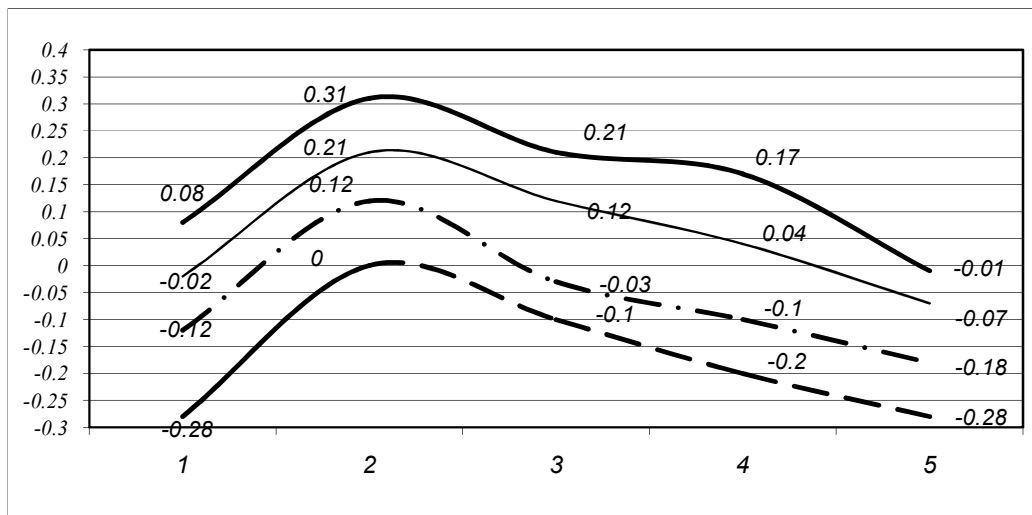
Notes: 1. At the beginning of the load, 2. At the peak of the load, 3. At 1 minute of recovery, 4. At 5 minutes of recovery, 5. At 10 minutes of recovery

————— *limit between> 95% and 75 -95%*   — · — *limit between 25 - 75% and 5 - 25%*
————— *limit between 75 -95% and 25 -75%*   — — — *limit between 5 - 25% and <5%*

Fig. 2. The limits of the distribution of levels of activity of the vegetative nervous system of people with coronary heart disease in the process of physical rehabilitation according to the Kerdo index.

The most characteristic changes in the KI in the process of physical rehabilitation in the observed group indicate a slight predominance of SMT-impact at the peak load, accompanied by an increase in KI in the range from 0.12 to 0.21 standard units. That is, the activity of the SMT department at this level is the most optimal in determining the activity of the vegetative nervous system. Increasing the KI to the level of 0.22 - 0.31 standard units will indicate a moderate inadequacy of the response of the SMT department, and an increase in KI above the values of 0.31 standard units about a significant inadequate increase in SMT impact.

At the end of 1 minute recovery in the vast majority of individuals KI is in the range of -0.03 - 0.12 standard units, which characterizes the eytonic variant of regulation with a certain tendency to SMT. However, in a significant number of people (about 25%) there is a moderate predominance of SMT-impact, and only about 5% of people turn on the mechanisms of restoration of cardiovascular regulation, which is characterized by a decrease in KI <- 0.1 standard units.

At 5 minutes recovery in the vast majority of individuals there is an eytonic variant of regulation with a certain tendency to PSMT. In 25% of patients, according to heart rate and blood pressure, there is a moderate predominance of PSMT -impact, which indicates the restoration of the initial level of regulation of the cardiovascular system. However, in more than 5% of cases there is an increase in SMT-impact, which indicates a steady increase in SMT tone and delayed mechanisms of restoration of the cardiovascular activity regulation (Apanasenko, 2004, Bagria, 2012, Polyanska, 2007). That is, an adequate option for the recovery process after the process of physical rehabilitation should be considered as such, when 1 minute recovery is marked by eitonia with a tendency to moderate SMT, and 5 minutes recovery – by eitonia with a tendency to moderate PSMT. Noteworthy are the options when at 1 minute KI > 0.21 standard units, and at 5 minutes KI > 0.17 standard units,

-- 769

----

which indicates a delay in the mechanisms of restoration of regulation of the cardiovascular system and can be interpreted as inadequate (Kovalenko, 2008, Bagria, 2012).

At 10 minutes after the end of the process of physical rehabilitation in most individuals there was a restoration of KI to baseline values with a tendency to increase PSMT effects.

Conclusions.

Informative indices of the physical activity impact, in the process of physical rehabilitation, on the body of people with coronary heart disease are the Robinson Index and Kerdo Index, which allow characterizing the response of the cardiovascular and vegetative nervous systems to the impact of exercise, as well as its adequacy.

People with coronary heart disease (stable angina, II functional class) are characterized by insufficient, moderate, optimal, inadequate and unacceptable response of the cardiovascular and vegetative nervous systems to exercise.

The established type of response and recovery of the cardiovascular and vegetative nervous systems can be used as current and operational criteria for the effectiveness of physical rehabilitation of people with coronary heart disease (stable angina, II functional class) and further differentiated use of means and methods of physical rehabilitation.

1. It was developed an improved program of physical rehabilitation for the people of second adult age with a coronary heart disease (stable angina, II functional class), which provided for the differentiated use of therapeutic gymnastics with an emphasis on special exercises for the muscles of the back, and lower extremities, in combination with segmental massage and massage of the neck area, upper and lower extremities, as well as graduated walking, and physiotherapy means.

2. It is established that the optimal level of response of the cardiovascular system at the peak load in this category of persons is that characterized by fluctuations in the Robinson index in the range of 177.9 - 239.7 standard units, an increase in this index shows redundancy, and a decrease about the lack of rehabilitation effects. The speed of recovery processes after the process of physical rehabilitation involves a complete recovery or reduction relative to baseline values for 10 minutes. It was found that the response of the vegetative nervous system is optimal at values of the Kerdo index at the peak load in the range of 0.12 - 0.21 standard units, higher values indicate inadequacy (hyperreactivity), smaller values indicate insufficient reactivity of the vegetative nervous system. At 10 minutes Kerdo's recovery index should be in the range - 0.18 - -0.07 standard units, which indicates the predominance of parasympathetic influences and complete recovery.

3. The established type of response and recovery of the cardiovascular and autonomic nervous systems can be used as current and operational criteria for the effectiveness of physical rehabilitation in people with coronary heart disease (stable angina, II functional class) and further differentiated use of means and methods of physical rehabilitation.

References:
Apanasenko, G. L. (2004) Diagnosis of individual health. *Hygiene and sanitation,* №2. 55 - 58.
Belovol, A. N., Knyazkova, I. I. (2015) Cardiovascular risk and hyperlipidemia. *Practical angiology,*- №4. 5-14.
Bykovskaya, T. Yu. (2015) *Fundamentals of rehabilitation: Participation in the treatment-diagnostic and rehabilitation process.* Phoenix, Rostov, Russia.
Vazquez, A. H., Abanto, H. E., Aregliano, S. B. (2015) Hypertension: disease or risk factor? *Emergency Medicine,* №7. 7-12.
Sapa, Yu., Noudga, N. (2016) Hypodynamia as a risk factor for cardiovascular disease in the practice of a family doctor. №2. 18-22.
Nascimento, B., Brant, L., Moraes, D., Ribeiro, A. (2015) Global health and cardiovascular diseases. *Ukrainian Journal of Cardiology*. №4. 123-133.
Epifanov, V. A. (2016) *Medical therapeutic culture and massage: a textbook for medical schools and colleges.*- "GEOTAR-Media"
Zharska, N. V. (2011) Peculiarities of methods of therapeutic physical culture in ischemic heart disease. *Bulletin of Chernihiv National University named after T.G. Shevchenko.* (86), T. 2. 185-187.
Zharska, N. V. (2012) Changes in the functional state of the cardiovascular system in persons with coronary heart disease. *Physical activity, health and sports.* № 3 (9). 47-52.
Arutyunov, G. P. (2013) Cardiac rehabilitation. - Moscow. MEDpress-inform.
Kovalenko, V. N. (2008) *Guide to Cardiology.* Institute of Cardiology of the Academy of Medical Sciences of Ukraine. МОРИОН.
Kryzhanivsky, V. O. (2000) *Diagnosis and treatment of myocardial infarction.* Phoenix, 2000.
Nikolayeva, L. F. (1993) *Rehabilitation of patients with cardiovascular diseases. Cardiovascular diseases. A guide for doctors*. M . Medicine, T.4.
Vatutin, N. T., Glass, E. V. Lavrova, D.D. (2017) Review of European guidelines for the prevention of cardiovascular disease in clinical practice. *Practical angiology.* (43) 4. 26-35.

Gidzinska, I. M., Moroz, G. Z., Lasitsa, T. S., Dzizinska, O. O. (2015) Prevention of cardiovascular diseases: historical aspect and current state of the problem. *Ukrainian Medical Bulletin. Therapia*. №6. 62-64.

Rudbury, P. H., Morad, A., Manzhulovsky, V. N., Lomakovsky, A. N. (2015) Risk factors and means of rehabilitation in patients with coronary heart disease. *Physical culture, sports and health of the nation.* Issue 19. Vinnytsia. 649-653.

Makarova, I. N. (2010) Rehabilitation in diseases of the cardiovascular system. GEOTAR-Media.

Recommendations for rehabilitation in heart disease. (2011) *American association for the rehabilitation of patients with cardiovascular and respiratory diseases.* Olymp..

Romanchuk, O. P., Panenko, A. V., Noskin, L. O. (2004) Individual sanotyping as a basis for targeted correctional and rehabilitation measures. *Odessa Medical Journal.* - №1. 65-68.

Romanchuk, O. P., Panenko, A. V. (2003) Prerequisites and possibilities of practical application of a comprehensive study of the functional state of the body of persons during sanatorium rehabilitation. *Med. rehabilitation, balneology, physiotherapy.* №1. 30-3

Misyura, O. F., Shestakov, V. N., Zobenko, I. A., Karpukhin, A. V. (2013) Sanatorium cardiological rehabilitation. Spetslit.

Kovalenko, V. N., Dolzhenko, M. N., Nesukai, E. G., Dyachenko, Ya. S. (2015) Comparative characteristics of prevention of cardiovascular diseases in Ukraine and Europe according to EUROASPIRE IV: hospital line. *Arterial hypertension.* №5. 57-61.

Popov, N. (1999) *Physical rehabilitation: [textbook for academies and institutes of physics. culture].* Rostov. Feniks.

Shakhlina, L. G. (2012) Physical rehabilitation. Modern aspects. *Pedagogy, psychology and medical-biological problems of physical education and sports*, № 9. 98-103.

Shved, M. I., Levitska, L. V. (2018) *Modern technologies of rehabilitation treatment of patients with acute coronary syndrome.* Kyiv. Medknyha Publishing House.