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1. Physical education of different population groups.
2. Improving the training of athletes of different qualification.
3. Biomedical Aspects of Physical Education and Sports.
4. Human health, physical rehabilitation and physical recreation.
5. Biomechanical and informational tools and technologies in physical education and sport.
6. Management, psychological-educational, sociological and philosophical aspects of physical education and sport.
7. Historical aspects of the development of physical culture and sports in Ukraine.

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Substantiation of methods of selection and orientation of children to practice gymnastics in the long-term preparation system

Abdulvahid Dlshad Nihad

Koya University, Kay-Sandzhak, Autonomous Republic of Kurdistan, Iraq

Purpose: *to determine the most effective methods of selection and orientation of children for gymnastics.*

Material & Methods: *the study included children 7–8 years of secondary school in Kharkov and Kurdistan in the amount of 112 students. Methods of pedagogical observations, sociological surveys, method of expert evaluations, medical and biological methods of assessing physical development, and methods of mathematical statistics are used.*

Results: *are based on studies found the most specific criteria for assessing the physical development of children 7–8 years of specific features of the chronological and biological age and criteria for evaluation of their physical readiness. Specific features of the physical development of children 7–8 years old, having characteristic signs of a tendency to exercise in gymnastics are determine.*

Conclusions: *the peculiarities of individual physical development of children of 7–8 years are established, taking into account the peculiarities of their biological age, it is possible to establish with the highest accuracy the most characteristic features of the somatotype of children, corresponding to the performance of exercises in gymnastics.*

Keywords: *physical development, biological age, somatotype, gymnastics.*

Introduction

Any kind of sport as a specific type of activity acts as a natural selection factor, which leaves the arena only the fittest to the corresponding extreme and special conditions of competitive activity in its respective movement direction. In this representation of gymnastics as a specific type of movement activity it has the features to be met by natural opportunity to engage in this sport. These features are factors of selection and orientation of children for gymnastics in the system of long-term preparation.

Sports selection solves the problem of identifying promising children, from which you can prepare outstanding athletes. The process of selection and orientation is closely related to the structure of the athlete's long-term development. In accordance with this, five stages of selection are highlighted, each of which raises questions: is the subject able to solve by its characteristics those tasks that are at a particular stage of long-term preparation [1].

In accordance with these requirements, basic selection criteria are established at each of its stages. In the first stage of selection play a large role anthropometric and morphological and functional characteristics involved. The accuracy of the chosen fitness criteria determines the permissible selection error and the orientation to the subsequent tasks. At present, the basis for such assessments is the long-term experience of working with the athletes of the trainer, doctor and other specialists, as well as comprehensive surveys, which provides more informed conclusions.

The sports selection conducted at the first stage reveals the makings and abilities in technical and tactical skill, the level of functional readiness, the level of development of movement qualities, mental characteristics, the level of tolerable age-related loads, their adequacy to the individual characteristics of the athlete. The obtained data are the basis for the orientation athletes training at a later stage of long-term improvement.

Sport selection and orientation are not a one-stage event of sports improvement in the continuous process of long-term athlete training. As in any process, its control requires observability of its dynamics and appropriate means of its correction. This requires the certification of individual training in accordance with established criteria for monitoring the measure of the success of its promotion. Such a problem at this stage is completely soluble due to the existing computer hardware and its use in the practice of the organization of the training process. At present, this problem is quite relevant in the construction of a scientifically based system of selection, orientation, management and control in the long-term staged athletes training.

Communication of the research with scientific programs, plans, subjects

The presented researches performed on the topic Consolidated Plan of research work in the field of physical culture and sports in 2011–2015 by theme 2.6 “Theoretical and methodological bases of perfection of training process and competitive activities in the structure of long-term preparation of sportsmen”, the state registration number 0111U001168.

The purpose of the research

To determine the most effective methods of selection and orientation of children for gymnastics.

Objectives of the study:

1. To determine the characteristic features of the motor activity of gymnastics as the main components of the professionogram of this sport.

2. To consider the individual features of physical development in accordance with the difference in biological age from its chronological age.

3. Identify the main components of the biomechanics of movement activity in gymnastics and morpho-functional tests of selection of children to engage in gymnastics.

Material and Methods of the research

In the studies involved children 7–8 years of secondary school in Kharkov and Kurdistan in the amount of 112 students. *Methods:* analysis and generalization of scientific and methodical literature, biomedical techniques, pedagogical experiment, static analysis.

Results of the research and their discussion

Implementation of selection and prediction in gymnastics, as in any other sport, is based on the identification of the most important indicators of physical development, physical fitness, physical condition and the nature of the individual's learning. All these characteristics have dynamics of their development in the age group, which must be taken into account in order to meet the optimal conditions for the construction of the training process. Gymnastics classes start with 7–8 years. Existing tests and methods for assessing the prospects for success in gymnastics are based on the average statistical criteria for their construction relative to each chronological age of the contingent.

Considering that it is necessary to monitor and evaluate the physical development of adequate his arsenal available to motor activity, individual biological age and features of its high-quality flow, body structure, the main factors of physical, trophic and mental development should be the need to process large amounts of information and determining the similarity of individuals to achieve the same end result. The task is to determine the shared significance of each of the indicators used to ensure the same final result. Such multicomponent problems have an extremely complex solution, which makes it very difficult to consider them. A second factor that creates a great difficulty in achieving the overall evaluation is the ambiguity of the concepts and definitions of the objects, events and processes. In all cases, the basis of comparison is the final equifinental result, which plays the role of a criterion for the similarity of mutually conditioned relations. In this case, there are two tasks: the establishment of more rigorous definitions of those factors that are the subject of comparison, and a compare of their significance in providing the same equifinal result, which allows us to identify significant signs for the implementation of the selection process and predict the success of certain sports. In this case, this kind is gymnastics.

One of the determining factors for selecting and predicting the success of a particular sport is the concept of physical development of a person. This concept is extremely multilateral. The doctrine of physical development is one of the most early-formed independent areas of physical anthropology. The doctrine of physical development is one of the most early-formed independent areas of physical anthropology. In modern anthropology, physical development is understood as a complex of morphofunctional properties of the organism that determines the reserve of its physical capabilities, the degree of capacity, as well as the process of morpho-functional, and especially somatic indices, that can be controlled to assess their development [2; 3].

The most effective method for accomplishing this task is a modified method of clinical anthropometry by M. Ya. Breitman [4; 5]. Its essence consists in comparing the absolute sizes of fifteen linear biokinematic links of the body, referred to the body length of the subject. This allows us to establish a qualitative structure of the somatotype constitution and make a comparison with the necessary accuracy and the definition of those structures of physique that are observed in athletes achieving the highest development of motor actions in gymnastics. The latter can be the basis for the selection of individuals that are structurally somatotype structures are the most promising to engage in gymnastics.

The concept of "physical development" is closely related to the age of the surveyed individuals. In the practice of the selection we find only the use of chronological age. However, in reality, the true biological age of an individual may differ significantly from the chronological. In this case, the used age estimates of physical development will deviate significantly from the actual relative to a particular individual [6; 7].

In ongoing research used method of estimating the biological age, developed in KhSAPC. This methodology is standardized and includes all the existing private methods for assessing the biological maturity of an individual on the specific indicators of the biological maturity of the system under consideration [8; 9]. Since the selection and prediction of the success of sports gymnastics in the studies used comparative characteristics of the structure of the somatotype, a methodology was used to assess the biological maturity or biological age, built on the basis of clinical anthropometry by M. Ya. Breitman, but using a three-dimensional evaluation of body shaping [10].

Biological age in this modified procedure is determined by the growth of the body weight of an individual relative to its chronological value of the surveyed contingent. In this case, a general indicator of biological development is established, which may seem lagging, normal or advanced. Regarding each specific value of body weight, the variability of its shape was determined with respect to distribution in three directions: height, width and thickness of the body.

After performing this operation, the qualitative structure of the body structure was analyzed using a modified technique M. Ya. Breitman. On the basis of the final analysis, those structural structures of somatotypes those were inherent in individuals who achieved the same high equifinal result in mastering the complexity of motor actions in gymnastics. On the basis of the filled material, a standard of morphofunctional components of the structure of the physique, predisposed to the effective perception and assimilation of the arsenal of exercises of gymnastics for children of 7-8 years of chronological age.

A comparison of the corresponding biological age for the observed contingent of 122 male children of the Kurdistan Republic in Iraq and Ukraine amounted to 7±1,19 years, for 8±1,12 years. The chronological age corresponds to the biological age, when the body weight of the subject completely coincides with the body weight of the population norm. The standards for the evaluation of the physical development of the pupils in terms of growth and weight readings taken from the official publication of the State Institution "Institute for Hygiene and Medical Ecology O. M. Marzeeva National Academy of Medical Sciences of Ukraine" [11].

It should be noted that when selecting the criteria for selection and prediction for the successful development of sports activities, it is not the absolute values of the monitored indicators that should be taken into account but their relative dimensionless quantities that preserve the constancy of the relations and reflect the qualitative structure of the interacting components of the morphofunctional structures of the whole organism. Absolute values have high informativity, which to a greater extent reflects the social conditioning of changes in the environment of the body. In contrast to the chronological age, which has a constant flow rate, the biological age can have different speed, which is associated with the conditions of the educational environment, and demonstrate acceleration and deceleration of the nature of its flow [12].

Structure anthropometric parameters used is shown in table 1.

The most characteristic structure of the somatotype, which determines predisposition to develop the arsenal of movement activity of appropriate complexity in gymnastics at the first stage of selection, is presented in table 2.

According to its requirements, gymnastics as a factor in the educational environment makes certain specific requirements for the correlation of physical qualities in the successful development of movement activity in sports exercises. The most important for this sport are such motor qualities as: movements coordination, joint mobility (flexibility), strength, special endurance. By special endurance in sports gymnastics includes the ability to preserve the work of a given intensity while accompanying a sufficiently strong static tension during the whole time of its performance, which ensures the preservation of the working gymnast posture of the. This side of the physical preparation of gymnasts is very poorly studied and survey experts in the field gymnastics was not marked by any respondent. In the scientific literature, it is pointed out that the most significant factor in the cost of energy consumption in all forms of movement activity are static stresses related to the preservation of the working posture, ensuring dynamic performance of the respective movement activity [13].

Almost all stages of long-term sports training and especially in the first stage of the particular importance played by control of the current physical condition. The most significant drawback of such control is the evaluation tests based on an average value of its exponent. Moreover, based on such criteria for evaluating the empirical formulas are used, no scientific rationale. A striking example of this phenomenon acts widely used sample Rufie and set on its base Rufie index to assess the level of efficiency of the individual. A similar conclusion is relative to many other tests [14; 15]. In the studies conducted, the level of working capacity and the measure of fatigue were evaluated on the basis of the methods developed in KhSAPC, which allow an individual assessment of the current state, based on taking into account the revealed physiological patterns of the course of these processes [13; 16]. In the structure of these methods, plyometric standard exercises are used in which the rate of quenching of kinetic energy is accurately measured according to the characteristics of the characteristic reflecting the manifestation of the spring function of the biokinematic link at the angle of its movement and the dynamics of the behavior of the mean arterial pressure (MAP). This characteristic is simultaneously recorded on the right and left hand, and is estimated based on the observed asymmetry of her testimony.

Conclusions

Based on the results of the research and achieve the objectives can be formed the following conclusions:

1. Features movement activity in gymnastics that constitute the main components of its professiogram, lies in the fact that the determining cause of fatigue are occurring energy that go into static forces preserving the working position, providing the kinematics of movements of the exercises.

2. Individual features of physical development, which determine the inherent predisposition to gymnastics, are associ-

Table 1
Structure of anthropometric indicators

1. Upper face 2. Bottom face 3. Neck	Head with neck	Entire body length of the median-vertical line
4. Acromioclavicular-teat distance 5. Teat -umbilical distance 6. Umbilical-inguinal distance	Torso	
7. Hip 8. Shin 9. Foot	Leg	
10. Half acromial distance 11. Half span distance 12. Length of the foot from the heel to the end of the thumb	Horizontal distances	
13. Shoulder Length 14. Length of forearm 15. Length of the brush	Arm	

Table 2

Characteristic somatotype structure, which determines the predisposition to develop the arsenal of movement activity of appropriate complexity in gymnastics at the first stage of selection (% of body length)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8,85	4,21	5,79	6,84	13,66	10	26,14	20,33	4,21	9,5	6,33	14,7	18	14,5	10,5
8,33	3	4,17	8,33	17,66	7	23,5	25,5	5,5	9	7	16	19	14,6	9,2
8	4	5,33	6,22	15,11	5,33	26,66	24	5,2	9,33	7,11	14,5	17	14	9,73

Note. *The first line corresponds to the somatotype structure standard, which represents the average population characteristic of the surveyed contingent. The second and third lines correspond to the category of the surveyed persons who most successfully master the arsenal of gymnastics exercises that are part of the program of the initial stage of long-term training related to the implementation of pre-selection and sports orientation.*

ated with the rate of growth of body weight and its shaping into the corresponding somatotype structure. From the side of morphofunctional indices, this manifests itself in a lower body length relative to its average statistical population index and established deviations in the qualitative structure of the structure of the biokinematic links of the body relative to its length.

3. Gymnastics on the structure of building competitive exercises is characterized by the presence in them of a significant proportion of static electricity spent on the preservation of the working posture of the exercises. This fact determines the test for the selection of persons wishing to engage in gymnastics. The essence of the test is the ability to maintain a static force.

Further research will be aimed at determining the fundamental factors of the psychological reliability of competitive activities, which is especially important in the final stages of long-term training of athletes.

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Information about the Authors

Abdulvahid Dlshad Nihad: *Koya University, Kay-Sandzhak, Autonomous Republic of Kurdistan, Iraq. URL: http://koyauniversity.org/*
ORCID.ORG/0000-0002-0011-5655
E-mail: dlshad_dubai@mail.ru

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Special aspects of coordination ability development of 7–8 year-old acrobatic rock'n'roll athletes

Nataliya Batieieva[1]
Petro Kyzim[2]

[1]*Kyiv National University of Culture and Arts, Kyiv, Ukraine*
[2]*Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine*

Purpose: *to determine the dynamics of development of coordination abilities of 7–8 years old acrobatic rock'n'roll athletes.*

Material & Methods: *following research methods were used: theoretical analysis and generalization of data from special scientific and methodological literature; pedagogical observation; pedagogical testing; methods of mathematical statistics.*

Results*: results of a pedagogical study of the development of the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes indicate a significant increase in the indicators of coordination abilities, which confirm that the use of special exercises is an effective approach in the training process.*

Conclusion: *comparison of the dynamics of statistical indicators of final testing of acrobatic rock'n'roll athletes showed an increase in all tested indicators.*

Keywords: *coordination ability; athletes; acrobatic rock'n'roll; testing.*

Introduction

Acrobatic rock'n'roll – is a complex coordinated sport that is a synthesis of dance and acrobatics. In the performance of competition program is very important manifestation of coordination abilities of athletes [1; 3]. Coordination abilities can be defined as a set of human properties, manifested in the process of solving motor tasks of different coordination complexity and determine the success of controlling motor actions and their regulation. In connection with the complex character of coordination abilities, naturally, there is no generalized indicator of the level of their development [5]. For this, a number of criteria are used, the most important of which are:

– during the development of the new movement, or some combination – than it is shorter, the higher the coordination abilities;

– time required to rebuild their motor activities in accordance with the changing situation. Under these conditions, the ability to choose the most optimal plan for a successful solution of the motor task is considered a good indicator of coordination capabilities;

– biomechanical complexity of the motor actions performed or their complexes (combinations).

It is established that coordination abilities ensure economical expenditure of energy resources of young athletes, which affect the amount of their use, since the muscular force, precisely dosed in time, space and as it is filled, and the optimal use of the corresponding phases of relaxation lead to rational expenditure of forces [2; 4; 5].

Literary sources do not fully cover the development of the coordination abilities of 7–8 year-old acrobatic rock'n'roll athletes. In the training process with acrobatic rock'n'roll is not at the proper level, attention is paid to their development.

Despite this, our study of the specifics of the development of the coordination abilities of 7–8 year-old acrobatic rock'n'roll athletes is topical [5; 7].

The purpose of the research

To determine the dynamics of development of coordination abilities of 7–8 years old acrobatic rock'n'roll athletes.

Objectives of the study:

1. To study the problems of developing the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes.

2. Determine the content and features of the formation of coordination abilities among 7–8 years old acrobatic rock'n'roll athletes.

Material and Methods of the research

The study was conducted from september 2016 to march 2017, the study used the following research methods: theoretical analysis and generalization of data from special scientific and methodological literature; pedagogical observation; pedagogical testing; methods of mathematical statistics. 16 acrobatic rock'n'roll athletes were tested at the beginning and at the end of the study.

Results of the research and their discussion

At the beginning of the school year, in mid-september, the first testing of the development of the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes was conducted,

Table 1

The results of the initial testing of the development of the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes (n=16)

№ с. u.	Indicators				
	Shuttle run (s)	Static equilibrium (s)	Throwing and catching the ball (number of times)	Reflection the ball from the floor (number of times)	Jumping rope (number of times)
1.	14,9	10,0	12	9	15
2.	15,7	9,3	14	9	14
3.	15,0	8,8	13	7	11
4.	15,6	9,5	9	8	16
5.	13,7	10,2	11	7	13
6.	16,4	8,9	10	10	12
7.	15,4	8,3	12	9	12
8.	14,6	9,4	11	9	11
9.	14,9	10,1	11	10	14
10.	14,7	9,4	13	9	15
11.	15,4	8,7	12	8	10
12.	15,7	9,6	10	7	15
13.	13,8	10,3	12	6	14
14.	16,5	9,0	9	11	11
15.	15,2	8,2	11	8	11
16.	14,5	9,6	12	10	12
$\bar{X}_1 \pm m$	15,12±0,19	9,33 ± 0,17	11,37 ± 0,35	9,18±0,35	12,87 ±0,53

which allowed to determine their initial level. Test results are presented in the table 1.

During pedagogical observation, the training process with acrobatic rock'n'roll was conducted in accordance with the curriculum.

In the study of the development of the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes, we used exercises in the training and educational process. The training process of rock'n'roll athletes was conducted according to the traditional method.

In mid-march, we conducted repeated testing on the same tests and in the same sequence. Test results are presented in the table 2.

To determine the changes in physical fitness indicators during the school year, we used Student's t-test to compare the indicators at the beginning and at the end of the study (table 3).

Comparison of the initial and final testing has shown growth in all tested parameters (figure 1–5). All changes in the indicators for all tests are statistically reliable (P<0,05).

Table 2

The results of the final testing of the development of the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes (n=16)

№ с. u.	Indicators				
	Shuttle run (s)	Static equilibrium (s)	Throwing and catching the ball (number of times)	Reflection the ball from the floor (number of times)	Jumping rope (number of times)
1.	14,8	10,5	14	11	17
2.	15,5	9,9	16	12	15
3.	14,7	11,0	15	9	12
4.	15,5	10,0	13	10	18
5.	13,4	10,9	12	8	15
6.	16,0	9,5	10	13	13
7.	15,2	9,4	14	11	15
8.	14,2	10,1	13	11	13
9.	13,3	12,2	16	14	19
10.	14,1	10,4	17	15	17
11.	14,3	12,1	17	11	13
12.	14,2	11,4	15	13	19
13.	12,4	12,9	14	10	18
14.	15,0	11,5	13	15	15
15.	14,5	10,6	16	14	16
16.	13,2	12,3	15	13	17
$\bar{X}_2 \pm m$	14,39 ± 0,22	10,9 ± 0,23	14,37± 0,38	11,87± 0,49	15,75 ± 0,51

Table 3

The dynamics of development of coordination abilities of 7–8 years old acrobatic rock'n'roll athletes (n=16)

№	Tests	At the beginning of the study $\bar{X}_1 \pm m$	At the end of the study $\bar{X}_2 \pm m$	Increase, %	t_p	t_{rp}	P
1.	Shuttle run, s	15,12±0,19	14,39 ± 0,22	4,8	2,51	2,12	<0,05
2.	Static equilibrium, s	9,33 ± 0,17	10,9 ± 0,23	14,4	5,48	2,12	<0,05
3.	Throwing and catching the ball (number of times)	11,3 ± 0,35	14,37± 0,38	21,3	5,81	2,12	<0,05
4.	Reflection the ball from the floor (number of times)	9,18±0,35	11,87± 0,49	22,6	4,46	2,12	<0,05
5.	Jumping rope (number of times)	12,87 ±0,53	15,75 ±0,51	18,3	3,91	2,12	<0,05

Considering the average changes, it can be noted that the increase in the indicators of development of coordination abilities among 7–8 years old acrobatic rock'n'roll athletes is uneven.

The smallest increase (4,8%) of the indicators was found in the shuttle race, characterizing the development of space-time parameters, where the following results were recorded: $\bar{X}_1 \pm m=15,12\pm0,19$; $\bar{X}_2 \pm m=14,39\pm0,22$.

In static equilibrium, characterizing the level of cessation of macroscopic mechanical systems and body movement, the increase was 14,4%, where the following results were recorde d: $\bar{X}_1 \pm m=9,33\pm0,17$; $\bar{X}_2 \pm m=10,9\pm0,23$.

In throwing and catching the ball, characterizing the level of orientation in space, the growth rate – 21,3%, the following results were recorded: $\bar{X}_1 \pm m=11,3\pm0,35$; $\bar{X}_2 \pm m=14,37\pm0,38$.

The highest growth rates (22,6%) were recorded in the "reflection the ball from the floor" test, which characterize the level of orientation in the space, where the following results were recorded: $\bar{X}_1 \pm m=9,18\pm0,35$; $\bar{X}_2 \pm m=11,87\pm0,49$.

The indicators of jumps rope (18,3%), which characterize the level of development of coordination of movements, have changed in the direction of improving the results: $\bar{X}_1 \pm m=12,87\pm0,53$; $\bar{X}_2 \pm m=15,75\pm0,51$.

Conclusions

1. Analysis of scientific and methodological literature indicates an insufficient level of research on the development of

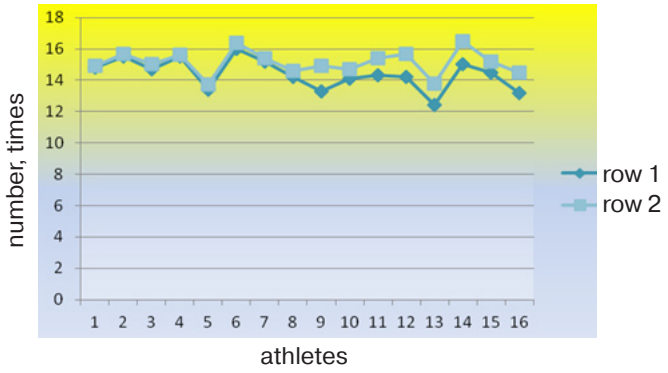

Fig. 1. Results of the test "shuttle run": *row 1 – indicators of initial testing of athletes; row 2 – indicators of final testing of athletes.*

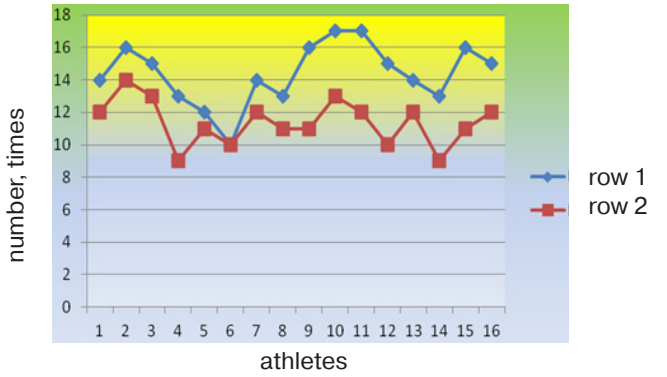

Fig. 3. Results of the test "throwing and catching the ball": *row 1 – indicators of initial testing of athletes; row 2 – indicators of final testing of athletes.*

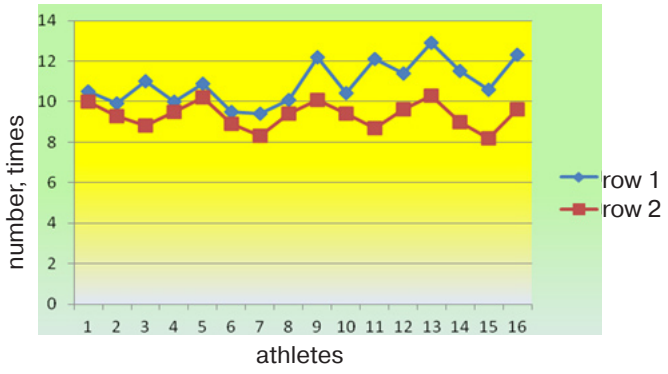

Fig. 2. Results of the test "static equilibrium": *row 1 – indicators of initial testing of athletes; row 2 – indicators of final testing of athletes.*

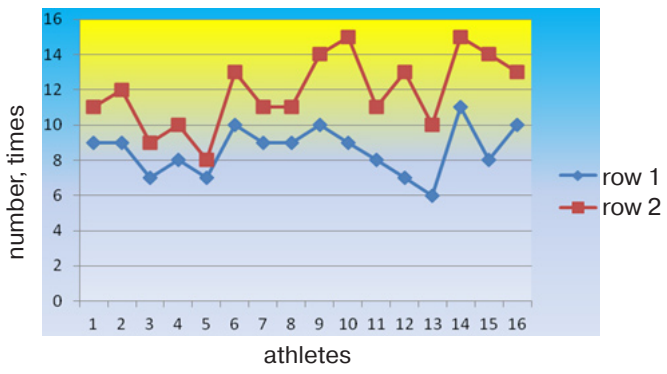

Fig. 4. Results of the test "reflection the ball from the floor": *row 1 – indicators of initial testing of athletes; row 2 – indicators of final testing of athletes.*

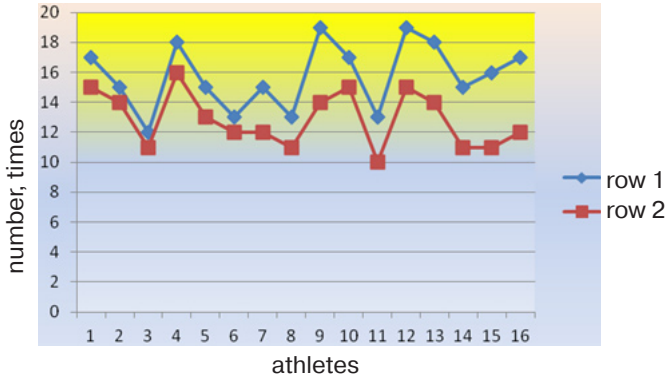

Fig. 5. Results of the test "jumps rope": *row 1 – indicators of initial testing of athletes; row 2 – indicators of final testing of athletes.*

the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes.

2. The developed content of the training process is aimed at developing the coordination abilities of acrobatic rock'n'roll athletes.

3. Considering the average changes, it can be noted that the increase in the indicators of development of coordination abilities among 7–8 years old acrobatic rock'n'roll athletes is uneven.

Revealed the smallest increase (4,8%) rates in the shuttle run: $\bar{X}_1 \pm m = 15,12 \pm 0,19$; $\bar{X}_2 \pm m = 14,39 \pm 0,22$.

In static equilibrium, the increase – 14,4%, the following results were determined: $\bar{X}_1 \pm m = 9,33 \pm 0,17$; $\bar{X}_2 \pm m = 10,9 \pm 0,23$.

In throwing and catching the ball, the growth rate was 21,3, the following results were noted: $\bar{X}_1 \pm m = 11,3 \pm 0,35$; $\bar{X}_2 \pm m = 14,37 \pm 0,38$.

The best possible growth rates (22,6%) were recorded in the test "reflection the ball from the floor", the following results were noted: $\bar{X}_1 \pm m = 9,18 \pm 0,35$; $\bar{X}_2 \pm m = 11,87 \pm 0,49$.

Jumping rope – the increase was 18,3%: $\bar{X}_1 \pm m = 12,87 \pm 0,53$; $\bar{X}_2 \pm m = 15,75 \pm 0,51$.

Prospects for further research will be directed to the search for new means and methods for developing the coordination abilities of 7–8 years old acrobatic rock'n'roll athletes.

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Information about the Authors

Nataliya Batieieva: *PhD (Physical Education and Sport), Associate Professor; Kiev National University of Culture and Arts: E. Konovaitsia, 36, Kiev, 01133, Ukraine.*
ORCID.ORG/0000-0001-8575-5506
E-mail: kyzim@mail.ru

Petro Kyzim: *Associat Professor; Kharkiv State Academy of Physical Culture: Klochkovskaya 99, Kharkov, 61058, Ukraine.*
ORCID.ORG/0000-0001-5094-3988
E-mail: kyzim@mail.ru

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Kinematic characteristics of the backstroke swimming technique of the qualified swimmers with the effects of cerebral palsy

Vasiliy Bosko

Sumy State Pedagogical University name is A. S. Makarenko, Sumy, Ukraine

Purpose: *to determine kinematic characteristics of backstroke swimming technique of athletes with spastic cerebral palsy (CP).*

Material & Methods: *12 swimmers with effects of cerebral palsy were involved in the experiment (level of sports qualification – master of sports and candidate of master of sports); Video shooting and computer video analysis of their technique of backstroke swimming; The obtained data were analyzed and generalized using the methods of mathematical statistics.*

Results: *kinematic characteristics of the technique of backstroke swimming of disabled athletes with spastic diplegia and a hemiparetic form of CP, such as the body position of swimmer in water (angle of attack, angle of rotation of the trunk around the longitudinal axis), position and work the hands and feet of the swimmer (the angles of flexion the main joints and their movement), integral characteristics (cycle time, step, rate and ratio of these characteristics at a constant swimmer speed).*

Conclusions: *determined biomechanical characteristics motions skilled swimmers with spastic CP forms, which indicate the specificity of their technique of backstroke swimming, so we recommend that you take into account the findings in the search for effective means and methods of sports training.*

Keywords: *kinematic characteristics, swimming technique, backstroke swimming, cerebral palsy.*

Introduction

Modern level of achievements in sport swimming is characterized by high technical skill. Several scientists [2; 3; 6] argue that the rationality and productivity of the technician's swimming skills depends on the biomechanical characteristics, namely the kinematics movements. Therefore, in sports practice, an important direction is to determine and analyse the athlete's kinematic characteristics in order to find effective means and methods for training him. Today there are a large number of both foreign [10; 11; 12; 23; 24], and domestic research [1; 4; 8; 9], devoted to the kinematics of movements of swimmers.

Preparation of athletes with disabilities has the specificity associated with the means at their physical and psychological characteristics [6; 16; 17]. Only some scientists in their studies [13; 14; 15; 20] highlight some aspects of the problem of the influence of kinematic characteristics on the technique of swimming such swimmers. Determination of the kinematic characteristics of the technique of sporting methods of swimming for such a special group of people as athletes with effects of CP was found in foreign publications [18; 19; 21; 22]. However, in the domestic literature available to us, scientific substantiation of such data in accordance with the methods of swimming, in particular backstroke swimming, is not represented.

In view of the foregoing, this problem becomes extremely relevant in the sports training of swimmers with effects of CP. All this was the impetus for our research in this area.

Communication of the research with scientific programs, plans, subjects

The research is carried out in accordance with the plan of research work of the Sumy State Pedagogical University named after A S Makarenko for 2011–2015 . Under the theme "Raising the level of health and physical fitness of the various groups of the population by means of physical culture" (state registration number 0111U005736); for 2016–2020 under the theme "Optimizing the training process of athletes in long-term training system" (state registration number 0116U000898).

The purpose of the research

To determine kinematic characteristics of backstroke swimming technique of athletes with spastic cerebral palsy (CP).

Material and Methods of the research

The study involved 12 athletes with effects of CP the level of sports qualification master of sports and candidate masters of sports, which belong to the class of S6–S8 in accordance with the classification code of the International Paralympic Committee. All athletes agreed to conduct the study. At the beginning of the study, we analyzed and summarized the data of the scientific and methodological literature, which allowed us to determine the state of the study of the problem. To quantify the performance of athletes, we used video in the frontal and sagittal planes with the help of two video cameras (GoPro HERO 3 + Silver Edition). The results were processed and analyzed by a computer program Kinovea®. Statistical processing of materials research was carried out using the

software package Microsoft Excel 2010 using common methods of mathematical statistics.

Results of the research and their discussion

The results of the video analysis obtained were summarized and presented in tables 1–4, where the following kinematic characteristics were determined: the position of the body of the swimmer in the water (angle of attack, angle of rotation of the trunk around the longitudinal axis), the position and work of the swimmer's arms and legs (angles of flexion of the main joints and their movement), integral characteristics (cycle time, step, rate and ratio of these characteristics at a constant swimmer speed). These indicators characterize the main features of the backstroke swimming technique of athletes with effects of CP, depending on its forms.

According to the data of table 1, in swimmers with SD, the angle of attack is more by 11% compared to the parameters of swimmers from the HF, it averages 11,3±0,82°. For swimmers from the HF this indicator ranges from 5° до 14°. In some swimmers with effects of CP, the angle of attack reaches a minimum – 5°, but the athlete's body is stored in a streamlined position, the body's midsection is increased because of the low immersion in the water limbs and the stable angle of the hip joints.

It is important to note that in swimmers with GF CP, the angle of attack increases in the repulsion phase of the affected arm when this phase coincides with the preparatory phase of the affected leg.

For the technique of swimming athletes with both SD and HF CP is characterized by a violation of the balance of the body in all planes, most pronounced in the horizontal and sagittal. Because of this, the body torsional oscillations around the longitudinal axis occur, at this moment the roll of the trunk in swimmers with SD 33,2±1,22° and 35,9±0,96° in swimmers with HF, which is a consequence of the lesion of one side of the body. Therefore, the greatest angle of rotation of the trunk around the longitudinal axis is observed in swimmers with HF at the beginning of the repulsion phase of the working movement by hand and is 40°. A swimmer with SD there is an increase of the angle when the athletes overcame a distance, using straight arms traffic.

Since during the movement of the hand the main moving planes of the swimmer are the hands and forearms [5], we measured the angle of attack of the hand and the angle of flexion of the elbow joint (table 2).

A characteristic feature of the work of the hands of athletes with spastic diplegia is the proximity of its characteristics to the work of the hands of healthy athletes, therefore the effectiveness of the hands of swimmers with SD is higher than HF. The angle of flexion of the elbow joint of swimmers with SD is greater on average by 19% of the corresponding indexes of the affected extremity of swimmers from the HF, and the exponent of the stroke – approximately 21%.

For swimmers from the hemiparetic form of CP such features is characterized: 1) length of the stroke of an affected limb is

Table 1

Kinematic characteristics of the body position in water during the backstroke swim of the swimmers with effects of CP (n=12)

Characteristic	CP form	Meanings		$\bar{X}$±Sx
		min	max	
Angle of attack (deg.)	SD	6	14	11,3±0,82
	HF	5	14	10,1±0,79
Angle of rotation of the trunk around the longitudinal axis (deg.)	SD	24	38	33,2±1,22
	HF	28	40	35,9±0,96

Note. *SD – spastic diplegia; HF – hemiparetic form.*

Table 2

Kinematic characteristics of the position and work of hands during the backstroke swim of the swimmers with effects of CP (n=12)

Characteristic	CP form		Meanings		$\bar{X}$±Sx
			min	max	
Elbow flexion angle (deg.)	SD	R	130	178	150,3±3,81
		L	134	176	152,1±3,96
	HF	affected limb	98	136	121,5±3,77
		healthy limb	125	154	141,2±3,03
Angle of attack brush (deg.)	SD	R	21	44	29,8±2,32
		L	20	42	29,2±2,24
	HF	affected limb	28	45	38,1±1,39
		healthy limb	24	44	33,5±1,68
Length of the stroke (m)	SD	R	1,46	1,92	1,76±0,32
		L	1,42	1,86	1,68±0,54
	HF	affected limb	1,01	1,49	1,38±0,84
		healthy limb	1,24	1,65	1,56±0,02

Note. *SD – spastic diplegia; HF – hemiparetic form; R – right hand; L – right hand.*

less than the length of the stroke of a healthy limb due to contracture of the joints; 2) angles in the joints of the affected limb are almost constant due to the impossibility of full extension of the arm, therefore the arm enters the water with the elbow rather than the brush, and outruns the brush in the working movement phase, the expressed position of the elbow below the wrist is observed, which adversely affects the efficiency of the swimming technique; 3 healthy limb performs an *S*-shaped stroke, so it is more effective, and the affected limb performs a more straightforward stroking, which is not rational; 4) there is a large load on the legs, if the hands are more affected, and vice versa.

Swimmers with effects of CP HF, limited use of the affected part of the body is observed, which leads to asymmetry in the technique of performing swimming movements with hands and kicking. For athletes with effects of CP is characterized by constant spasticity of the muscles of the affected side, therefore a number of motor limitations arise. The angles of flexion of the elbow and wrist joints affected limbs close to constant, so the angle of attack of the hand of the affected limb more than 12% of the angle of attack brush healthy limb swimmers with GF CP (table 2). Angles of flexion in the elbow joint of the affected limb through spasticity and contractures are constant almost throughout the entire movement. As a result, athletes can not perform a full stroke by hand. The repulsion phase, as a rule, is not completed, which leads to a shorter stroke. Therefore, these athletes have a small step, but they try to compensate for the swimming speed, increasing the pace of movements (table 1). For a healthy limb, characteristic movements with a large amplitude. Some swimmers have a prolonged delay of the injured arm at the thigh in the repulsion phase at the end of the working movement, there are difficulties holding the arm in a static position and carrying it over the water.

Since the main moving planes when moving the swimmer's legs, first of all, are the foot and the shin [5], we measured the angles in the ankle, knee and hip joints (table 3).

Video analysis of the position and work of the legs during the backstroke swim of the swimmers with the effects of CP showed that a healthy leg or less affected performs continuous movements that move forward, striking with the injured legs almost does not give the driving force to the swimmer, so there is a violation of the horizontal and lateral balance.

The features of the foot injury of swimmers with SD (angles of flexion of the hip and knee joints are actually permanent) lead to the lack of effective foot movements, so athletes keep the limbs in the most streamlined position. When characterizing the work of the feet during the backstroke swim of the swimmers with the effects of CP is appropriate to talk only about the effectiveness of the legs of swimmers from the HF.

The greatest angles of flexion of the hip and knee joints in athletes of the HF CP are observed during the performance of the working phase (table 3). Some athletes in the phase of the hand grip there is a pronounced hip flexion up to 133°, which results in an increase in the angle of attack to 10°. Some athletes also have a knee joint out of the water. This is the reason for the increase in the body's midsection, and accordingly the force of the drag.

The angle of flexion of the ankle through spasticity of muscles and contracture retains an almost constant value. The greatest angle of flexion of the ankle is observed in the limiting phase of the transition from the working to the preparatory phase and is on the average 129,2±3,47° for athletes with SD and 131,2±4,64° for the affected limb swimmers from the HF, respectively. At the same time, a healthy limb works more actively with a large amplitude, the bending angle on average is 140±3,27°. In some athletes with the effects of CP in the ankle, the fixed value of the flexion angle is 106°, which is a consequence of excessive spasticity of flexor muscles and low joint mobility.

For the swimming technique of athletes with both SD and HF CP, the following characteristics are typical: the stricken limb these athletes try to keep in a more streamlined position, almost without moving it; through the spasticity of the extensor muscles, the legs retain near-angled corners during movement; a healthy limb performs movements with large amplitude and powerful strokes.

To integral biokinematic characteristics of swimming, the backstroke swimmers with the effects of CP refer to the rate, step and speed of movement (table 4). It should be noted that the higher the athlete's class, the more individual are these indicators. Swimmers with SD step is not significantly higher than the corresponding figure at the swimmers with the HF (by 10,5%), but the rate is lower by 6,8%. Figure 1 shows the relationship between the step and the rate of athletes with HF and SD. Athletes with SD observed average step of 1,8 m, while the rate is 31 cycles min^{-1}. Athletes with HF have a step of 1,6 m, however, the rate of these athletes 33 cycles min^{-1}.

Table 3

Kinematic characteristics of the position and work of legs during the backstroke swim of the swimmers with effects of CP (n=12)

Characteristic	CP form		Meanings		$\bar{X}$±Sx
			min	max	
Angle of flexion of the hip joint (deg.)	HF	SD	165	176	171±1,15
		affected limb	152	170	161,8±1,37
		healthy limb	133	148	140,9±1,58
Angle of knee flexion (deg.)	HF	SD	154	170	164,1±1,48
		affected limb	148	168	160,1±1,58
		healthy limb	108	144	131,1±3,06
Angle of ankle flexion (deg.)	HF	SD	106	144	129,2±3,47
		affected limb	110	162	131,2±4,64
		healthy limb	124	158	140±3,27

Note. *SD – spastic diplegia; HF – hemiparetic form.*

Table 4

Integrated kinematic characteristics of backstroke swimming of the swimmers with effects of CP (n=12)

Characteristic	CP form	Meanings		$\bar{X}\pm Sx$
		min	max	
Step (m)	SD	1,5	2,2	1,80±0,07
	HF	1,2	2,1	1,61±0,08
Rare (cycles min^{-1})	SD	28	37	31,3±0,81
	HF	32	39	33,6±0,69
Cycle time (s)	SD	1,7	2,3	1,93±0,05
	HF	1,5	2,2	1,80±0,05
Relationship betweenthe step and rate	SD	0,041	0,076	0,058±0,003
	HF	0,027	0,064	0,049±0,002

Note. *SD – spastic diplegia; HF – hemiparetic form.*

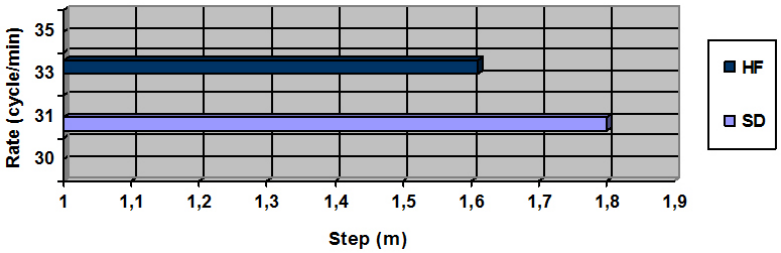

Fig. 1. Step and pace during the backstroke swim of the swimmers with effects of CP

That is, an inverse proportion is observed, and a smaller step is compensated for by a higher rate. This is because the upper limbs of athletes with a hemiparetic form are more affected. As a consequence, the ratio of the step to the rate for swimmers with SD and for swimmers with GF HF is, on average 0,058 and 0,049 respectively. At the same time, the cycle time of athletes with spastic diplegia is 6.7% higher than that of swimmers from the hemiparetic form of CP.

The results of the research show that swimmers with effects of CP have a number of physiological characteristics (impaired motor function, contracture, increased muscle tone, decreased muscle strength and performance, impaired coordination of movements, etc.) that actively influence the training process and determine the specifics techniques of various styles of swimming, including backstroke swimming.

Conclusions

1. Analysis of scientific and methodological literature testifies to the lack of scientifically grounded research on the kinematic characteristics of the technique of backstroke swimming of athletes with spastic forms of CP.

2. The kinematic characteristics of the technique of backstroke swimming of disabled athletes with spastic diplegia and hemiparetic form of CP are determined: the body position of the swimmer in the water (the angle of attack, the angle of rotation of the trunk around the longitudinal axis), the position and work of the swimmer's arms and legs (angles of flexion of the main joints and their displacement), integral characteristics (cycle time, step, rate and ratio of these characteristics at a constant swimmer speed).

3. It is established that for the technique of swimming of athletes both with SD and HF CP, the balance of the body in all planes and the asymmetry of the movements. The effectiveness of the hands of swimmers with SD is higher than that of swimmers with HF, but the low efficiency of leg movements. Swimmers with SD, the step is higher than the corresponding index of swimmers with HF (by 10,5%), but the rate is lower by 6,8%. An inverse proportion is observed, and a smaller step is compensated by a higher rate.

4. The received data testify that the technique of backstroke swimming of athletes with spastic forms of CP has its own specifics.

Prospects for further research in this direction

In further research, it is necessary to take into account the obtained kinematic characteristics as a theoretical foundation for the justification of new techniques backstroke swimming for teaching children with effects of CP.

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Information about the Authors

Vasiliy Bosko: *Sumy State Pedagogical University name is A. S. Makarenko: Romenskaya str. 87, Sumy, 40002, Ukraine.*
ORCID.ORG/0000-0002-8796-2362
E-mail: bosv@mail.ru

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Fitness industry: state and prospects of development in the countries of the world

Liubov Chekhovska

Lviv State University of Physical Culture, Lviv, Ukraine

Fitness industry is a sphere of successful and promising business in many countries around the world. That is why it is necessary and relevant to study the prospects for the development of the international fitness industry.

Purpose: *to study the state of functioning and prospects for the development of the fitness industry in the world.*

Material & Methods: *theoretical analysis and generalization of scientific literature, sources and information of the world internet, documentary method, system analysis method, comparison and compare method.*

Results: *the article presents an analysis of the fitness market in different countries in the world. The volume of the market is determined by the number of fitness clubs, the number of clients and profitability. Examines the key trends in the industry of sports services, its economic performance. The top 20 most popular fitness networks of the world are determined. Describes the fitness industry in the US and Russia.*

Conclusion: *fitness industry in various countries of the world develops and strengthens positions on the world arena, during 2012–2016. concluded the most successful transactions. The total revenue of the fitness industry in 2015 was 81 billion dollars. In 2016, most European operators of fitness clubs expected financial growth.*

Keywords: *fitness industry, fitness clubs, revenue, profit.*

Introduction

Today, the worldwide trend is the interest in a healthy lifestyle. That's why fitness is becoming more popular all over the world. At present, the fitness industry is a sphere of successful and promising business, after all, in terms of growth rates it is the second largest in the world after high technologies [14; 15]. Due to the consistently high rates of development, the fitness industry has a high investment attractiveness, the market volume of which is increasing every year.

Market transformations, the commercialization of the infrastructure of mass sports in the world receives new development impulses and often has not only positive but also negative consequences. .

Fitness acquired (A. I. Shamardin, 2005; A. A. Krasnova, 2005; Y. Belyak, 2015). In many countries, the reduction in health care costs and the solution of demographic problems is associated with movement activity in the mass sport system [15].

Questions related to the study of fitness, formed as a scientific problem relatively recently. Issues that reveal the problems of restoring the mental, spiritual and physical strength of a person (H. J. Gibson, J. F. Singleton, 2011; J. B. Bączek, 2011); physical training of those engaged in fitness (Z. E. Firileva, 2009), theoretical and methodical aspects of fitness (E. G. Saykina, 2008; V. I. Grigoriev, 2009, Y. Belyak, 2014) improving the management system of sports services structures (V. P. Mironenko, 2009); assortment policy in the field of sports and health services (E. S. Kabanovskaya, 2005); organizational and pedagogical factors of management of the sphere of fitness services (S. I. Smirnov, 2013); theoretical and methodological foundations of recreational activities of various groups of the population (A. V. Andreeva, 2014) development of marketing (M. Vasilenko, N. Karpenko, S. Kovalchuk, J. Levinson, E. Romat, J. Trout, etc.) and others.

The relationship of research with scientific programs, plans, themes

The work is carried out in accordance with the scientific theme of the Department of Fitness and Recreation LSUPC "Technology of attracting the population to improving physical activity" (Protocol No. 8 of 19.04.2016 Academic Council meeting LSUPK, state registration number 0117U003040).

The purpose of the research

To study the state of functioning and prospects for the development of the fitness industry in the world.

Material and Methods of the research

Research methods: theoretical analysis and generalization of scientific literature, sources and information of the world Internet, documentary method, system analysis method, comparison and contrast method.

Results of the research and their discussion

The international fitness industry is increasingly developing and strengthening in the world arena. It was the most stable during 2012–2016. Compared with other industries. For the

purpose of the study, we analyzed the accounting documents for 2014–2016. European Association of Physical Activity (Europe Active Association) and the International Association of Sports Clubs (IHRSA) [12; 14]. They combine fitness, wellness clubs in Europe and the world respectively, the most authoritative in the fitness industry, so the reliability of these reports is not in doubt.

It is established that it was in the fitness industry that the most successful deals were concluded in the last few years. So, in 2013, the global fitness industry as a whole was about 75,5 billion dollars in profits, totaled 150,000 fitness clubs, in which about 132 million people were trained [14]. Quantita-

Table 1
Characteristics of the fitness markets of different countries (by IHRSA, 2014)

Market	Income ($)	Number of clubs	Number of members
USA	21 828 000 000	30 500	50 249 000
UK	6 235 173 800	5 900	7 600 000
Germany	5 348 110 500	7 566	7 890 000
Italy	4 251 494 521	6 000	4 160 000
Spain	4 110 859 842	4 640	6 384 000
Russia	1 622 707 832	3 300	1 700 000

tive characteristics of the markets of the fitness industry of the largest countries are presented in the table 1.
So, America's fitness industry increased its profits to 21,8 billion dollars, having 30,500 clubs, which were visited by more than 50 million customers. Income in 2013 in the US grew by 8,1% compared with 2012. And the number of customers increased by 6.7%. Sales of additional services increased by 2,5% [14].

As for Europe, its fitness industry received profits of about 32 billion dollars in 2013, having 45,000 clubs with 41,9 million customers. So, in the UK and Germany, growth and stabilization of the fitness market took place. In the UK, the number of clubs has increased to 5900, with more than 7 million customers (see table 1). In this country there is a tendency to strengthen the position of the network of fitness clubs "low cost". In Germany, there were almost 7.9 million customers in more than 7,000 clubs (see table 1). The results of the analysis show that Spain, Italy and Portugal "experienced" the crisis, as they revealed a 20% decrease in the number of fitness clubs and the number of clients in accordance. Although, in our opinion, the financial performance of Italy and Spain is not critical, as the countries were able to profit in the fitness industry 4,25 billion and 4,21 billion dollars, respectively. In Greece and Ireland - the fitness market has decreased by 10% [14].

IHRSA reporting documents show the growth of the fitness industry in 15 countries in Latin America.

This is confirmed by the fact that the revenues of their fitness industry markets amounted to about 5.5 billion dollars in 2013, with 46,000 clubs. One of the leaders is Brazil – 2.4% billion in revenue, 23,398 clubs, 7 million customers. Mexico and Argentina took the second and third places respectively.

The profits of Asian countries in the fitness industry in 2013 amounted to about 11,5 billion dollars, with 18,000 clubs out of 14,6 million customers. Australia and New Zealand numbered about 3,000 clubs, together with 2,3 million customers, both markets had profits of about 2,1 billion dollars [14].

According to the report on the Australian market in 2013, revenues amounted to more than 1,8 billion dollars, moreover, 1,4 billion dollars in the structure of the country's gross domestic product (GDP) belongs to the fitness industry.

According to the EuropeActive report for 2015 [7; 11] established the largest leaders of the European market of fitness services in 2014 for profitability in the UK (5,6 billion euros) and Germany (4,8 billion euros) (Fig. 1).

In our opinion, this is due primarily to the high standard of living in these countries. It should also be noted that in the aggregate the share of the first 5 countries (UK, Germany, France, Italy and Spain) accounted for 64% of the total Euro-

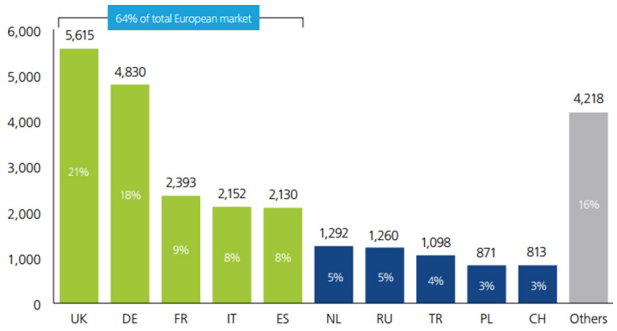


Fig. 1. Top-10 European fitness markets (million EUR, 2015) [11; 12]

pean fitness market (see Fig. 1).
It should be noted that in 2014 Germany was the largest fitness market in Europe, with 9,5 million consumers (the leading position belongs to the German network "McFIT" – 1,3 million customers), then – Great Britain (8,8 million customers), France (5,2 million), Italy (5,1 million) and Spain (4,9 million). The most popular fitness networks in the world are presented in table 2 [7].

Analysis of the reporting documents allowed to establish that the markets of Eastern Europe: Russia, Turkey and Poland were among the ten most promising objects of the fitness industry. It is worth noting that they have a favorable growth potential of the number of clients of fitness clubs than the mature markets of Western Europe. Also Turkey and Russia have

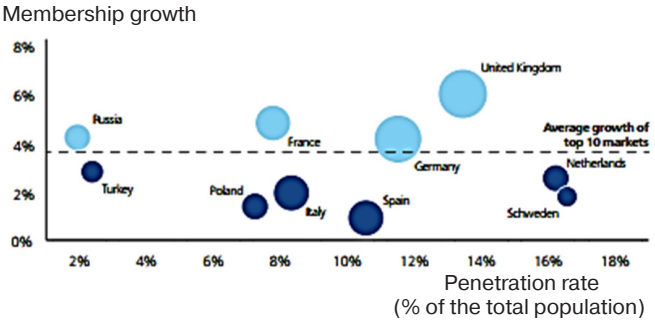


Fig. 2. The level of penetration and increase in the membership of the top 10 European fitness markets: *the total number of members (bubble size)*

Table 2

Top 20 most popular fitness networks in the world

Rank	Operator	Number of customers
1	McFIT	1204000
2	HealthCity/Basic-Fit	780000
3	Virgin Active	598000
4	Health&Fitness Nordic	565000
5	Fitness First	454000
6	David Loyd Leisure	450000
7	Fitness World	400000
8	Sport City/Fit For Free	350000
9	Pure Gym	300000
10	Nuffield Health	297000
11	Alex Fitness	290000
12	Kieser Training	269000
13	DW Sports	265000
14	Clever Fit	252000
15	Curves	242000
16	INJOY	239000
17	The Gym Group	225000
18	Holmes Plase Group	211000
19	Mrs.Sporty	209000
20	ACTIC	205000

a significant potential fitness market with a penetration rate of 2.4% and 1.9% respectively (Fig. 2).
As you can see, among 10 countries Sweden and the Netherlands are the most mature fitness markets with a penetration rate of 16,7% and 16,4% respectively [11].

According to the results of the analysis of the IHRSA report for 2016, the total world income of the fitness industry in 2015 was already 81 billion dollars, 187,000 clubs operated, which were visited by 151 million customers. In figure 3 represents countries that account for 71% of the total revenue of the fitness industry.

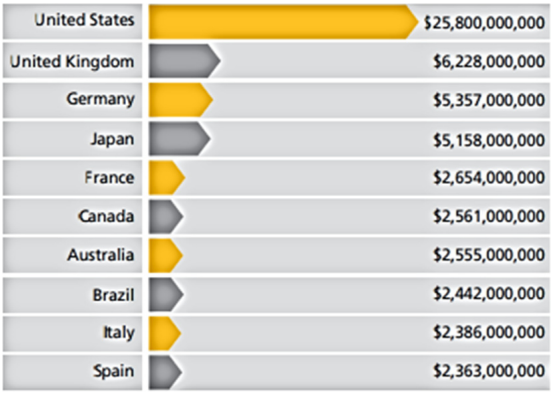


Fig. 3. Top-10 countries, accounting for 71% of total industry revenue (according to the report IHRSA, 2016) [14]

The real gross domestic product (GDP) per capita and the degree of urbanization explains the penetration of the fitness market in 2015. The ratio of the indices of these factors is shown in figure 4.

Also in figure 5 shows the countries in which the largest number of fitness clubs are concentrated (million).

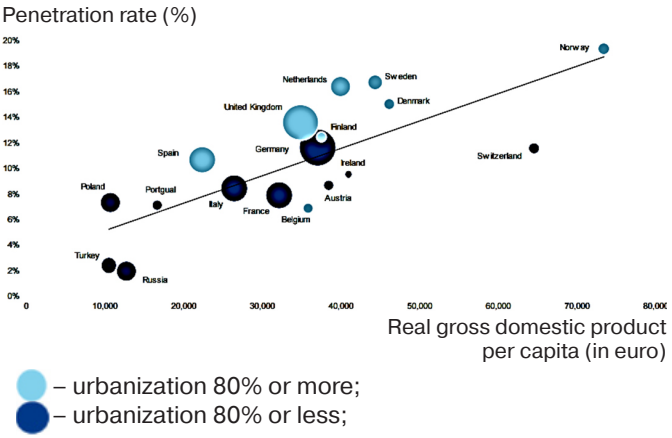


Fig. 4. The ratio of real gross domestic product (GDP) per capita and the level of urbanization [12]: *the total number of members (bubble size)*

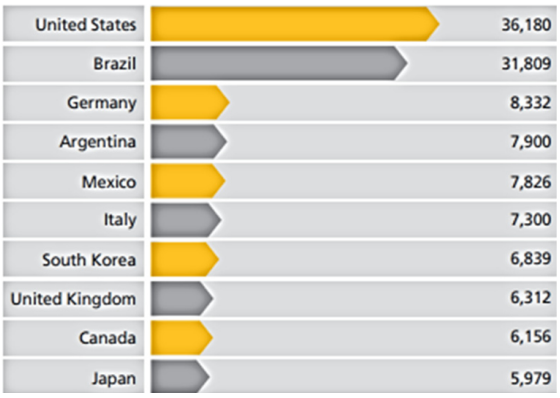


Fig. 5. Top-10 countries, accounting for 67% of the world's number of fitness clubs (according to the report IHRSA, 2016) [14]

So, the leader in this indicator is the United States. A more detailed analysis of the information reveals the dynamics of growth and profitability of the fitness industry in this country (tab. 3).

Table 3

The volume of the US fitness market (according to the report IHRSA, 2016) [11]

Year	Revenue ($, billions)	Number of clubs (million)	Number of members (millions)
2014	24,2	34,460	54,1
2015	25,8	36,180	55,3

In our opinion, such growth is connected both with the popularization and development of sports in educational institutions (schools, colleges, universities), and with the development of recreational and amateur sports.

Analysis of the reporting documents also allowed the establishment of 5 US states with the largest number of clubs. These include: California, Texas, Florida, New York, Pennsylvania. In states where there are a large number of clients of fitness clubs, include: Massachusetts, Colorado, New Jersey, Illinois, California. The most popular networks in the US: LA

Fitness, Life Time Fitness, Planet Fitness and CrossFit, and fitness clubs: «Equinox", "24 Hour Fitness", "Curves", "The Sports Club/LA", "Crunch", "Gold's Gym", "YMCA", "David Barton Gym", "Anytime Fitness".

In most eastern countries, fitness is in its infancy, which is due to national and cultural traditions. However, the popularity of fitness clubs is growing. So, the studies conducted in fitness clubs located in expensive hotels in the United Arab Emirates, showed that the number of Arab clients is up to 50%. The purpose of their visit is to promote health and reduce stress [13].

In China, despite the high sports activity, the popularity of fitness clubs is low, since 55% of consumers prefer state sports societies, 40% – state sports clubs in the community, and only 5% – to private clubs [2].

Analyzing the fitness industry in Russia, we note that to date it is in the formative stage and lags behind the western for

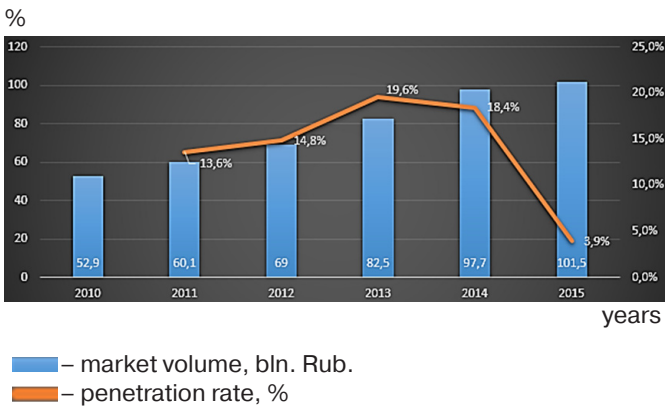


Fig. 6. Dynamics of indicators of the market of fitness services in Russia

20–30 years [3; 4]. Although the pace of its development has decreased, but the positive dynamics persisted (Fig. 6).
So, in 2015 in Russia nominal growth of the market made 14,1%, real – 3,9%. The volume of the market of fitness services along with the attendant (Crossfit, personal trainings, etc.) amounted to at least 101,5 billion rubles. [1; 8]. According to the estimation of the international sports organization IHRSA, in mid-2013 there were more than 3000 fitness clubs in Russia, with more than 1,7 million clients. However, the number of those who are engaged in fitness is about 2%. By placing the objects of the fitness industry, it is uneven, the leaders are Moscow and St. Petersburg [9]. Although in general there has been a positive trend in increasing the number of fitness clubs in Russia (Fig. 7).

In our opinion, several factors contribute to the growth rates:

– relatively weak initial state of penetration of fitness services into the domestic market (only 3% of the population of Russia and 12,5% of Moscow residents are engaged in fitness);

– weak development (passivity) of fitness services outside of Moscow and St. Petersburg, with a high potential for their development in the regions;

– growing popularity of fitness as a worldwide trend;

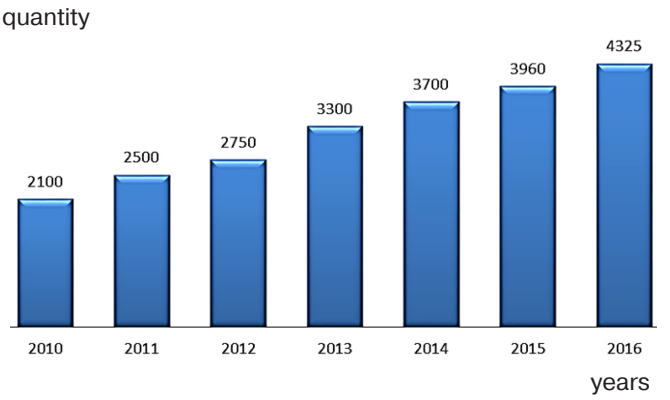


Fig. 7. The number of fitness clubs in Russia in 2010–2016 years

– state policy in the field of sports, contributes to an increase in the number of people who are engaged in sports, including - in fitness clubs in particular.

Consequently, the volume of the Russian fitness market was about 1% of the global market and exceeded 1 billion dollars. Basically, as already noted, it is concentrated in large cities

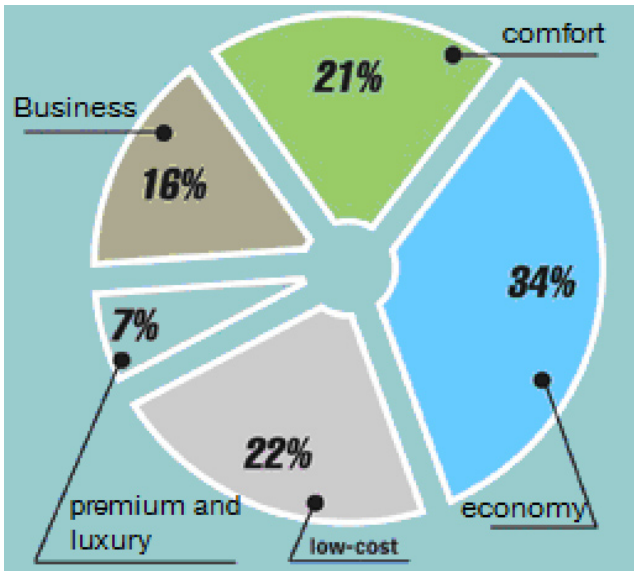


Fig. 8. Structure of the market of fitness services in Moscow and the Moscow region (% of market turnover)

(Moscow, St. Petersburg, etc.) (Fig. 8), and in the regions the niche of fitness services is practically not occupied.
If in the market of fitness services in Moscow large clubs tend to develop on their own, then in the regions mainly operate franchise clubs. The percentage of clubs that are franchised by network operators in the regions is more than 25%. The largest revenue network fitness clubs in Russia – World Class, which is also actively developing franchising: currently, half of the 72 clubs in the network are open for franchise.

The largest fitness companies in Russia are: the "Russian Fitness Group" (World Class and "Fizkult" brands) – 80 clubs, Alex Fitness – 60, Fitness House – 49, X-Fit – 33, Zebra – 30

Strata Partners (CityFitness and Orange Fitness brands) – 27, "Planet Fitness" – 22 clubs. The above listed networks unite about 300 clubs. At the same time, more than 500 clubs can be called full-fledged fitness centers, while the other 2800 are ordinary gyms.

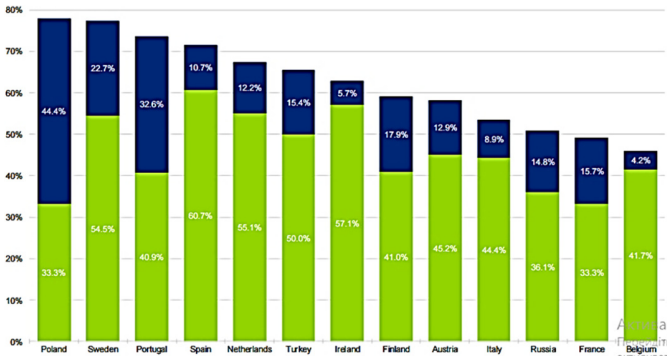
Table 4
Average annual cost for visiting the fitness club (2015 p.)

Country	Average annual cost of visiting, $
Japan	400–500
Italy	350–450
Russia	1600

It is interesting to note that the cost of visiting fitness clubs in Russia was significantly higher than in Europe (tab. 4) [5]. However, the main income in the developed fitness markets was due to turnover of visitors, while in Russia – at the expense of the cost of subscription [6; 9; 10].

Prospects for further development of the Russian fitness services market look favorable: even in the current economic situation, the market will continue its growth in the next 4–5 years, and if it improves – it will increase the growth rates of indicators close to 22–25% in nominal terms. With the further development of the Russian market for world trends, the number of network fitness clubs in the Russian regions will continue to increase in the coming years.

Most European operators of fitness clubs expected revenue growth in 2016. As the data (Fig. 9) show, Poland in this sense



Remark: increase 2,5-7,5% ; increase >7,5%

Fig. 9. The expected increase in the income of the fitness industry of countries in the 2016 (in %) [12]

was considered as the most "optimistic" country. Information on the real state of functioning of the fitness industry in 2016 will be presented in subsequent publications.
It should also be noted that the fitness industry is actively attracting to its activities other industries: medicine, IT technology, etc., which allows to further strengthen its position in the market of fitness services.

Conclusions

1. A characteristic for the fitness industry of different countries of the world is the development and strengthening of positions in the world arena, the greatest stability during 2012–2016, Conclusion and implementation in the mentioned period of the most successful transactions.

2. In 2013, the global fitness industry had a profit of about 75,5 billion dollars, in particular, Europe – about 32 billion dollars. There is an increase in the fitness industry in Latin America. Total revenue fitness industry in 2015 amounted to 81 billion dollars.

3. Economic problems hamper the development of the fitness industry in some countries of Europe, North and South America. Development prospects remain in emerging markets in the Asia-Pacific region, the Middle East and Latin America.

4. It was found the largest European market leaders of fitness services in 2014. These include the United Kingdom and Germany. Markets of Eastern European countries, such as Russia, Turkey and Poland, entered the top ten subjects of the fitness industry.

5. The Russian market of fitness services is quite young, so the degree of its saturation (penetration) is very low compared to other countries. The Russian market of fitness services is diverse in its segmental and regional aspects. The dynamics of the number of fitness clubs in Russia has been revealed. In the capital and large cities, a sufficient number of clubs in the premium segment, while in small cities, the fitness industry practically does not develop. The subsequent reserve of growth of the Russian market of fitness services can be based on development of an average price segment. Prospects for further development of the Russian fitness services market look favorable.

6. In 2016, most European operators of fitness clubs expected financial growth.

Prospects for further research will be directed to the study of the current state and functioning of the fitness industry in Ukraine

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Information about the Authors

Liubov Chekhovska: *PhD (Physical Education and Sport), Assosiate Professor; Lviv State University of Physical Culture, 11, Kostushko str., 79000, Lviv, Ukraine.*
ORCID.ORG/0000-0003-3833-5212
E-mail: Lyubahock@gmail.com

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An interrelation of physical and technical readiness as a basis in sport result achievement of 400 m hurdlers

Oleg Grebenyuk

Dnepropetrovsk State Institute of Physical Culture and Sports, Dnipro, Ukraine

Purpose: *to establish the relationship of physical and technical preparedness to achieve sports results of 400 m hurdlers at the stage of preliminary base preparation.*

Material & Methods: *study involved the first grade athletes in the amount of 18 people. Methods of research: pedagogical observation, pedagogical experiment, pedagogical testing of physical and technical readiness, telepodometry, methods of mathematical statistics.*

Results: *it found that the major indicators of special physical readiness in the step of preliminary base preparation are: run at 100 m. result which was 96.4% from the model; run at 200 m – 96,0% from the model; run at 400 m – 98,7% from the model; hopping run 100 m – 93,4% and jumps 20 m on one leg – 91,1% % from the model.*

Conclusion: *study of individual elements technique allows us to characterize not only the technique of movements, but also the level of physical qualities.*

Keywords: *training, physical readiness, technical readiness, model characteristics readiness of 400 m hurdlers.*

Introduction

The sports result, as is known, depends on physical, technical, tactical, psychological and integral preparedness. Conditional training division into separate relatively independent direction allows you to organize an idea of its structural content, as well as to systematize the methods, tools, and on this basis to create a system to monitor and control the process of sports training.

Achievement of sports results is possible only with a harmonious combination of all aspects of training [3; 5; 14].

But of fundamental importance in this case belongs to the technical preparedness, thanks to which the realization of all types of sports preparedness.

Analysis of scientific and methodological literature provides a basis for the conclusion that at present there is a lack of sufficient information about the technique of technical preparedness in combination with physical of 400 m hurdlers [4; 6; 18].

Some studies show the value of the optimum ratio of indicators of physical and technical preparation [1; 2].

At the same time, the question of their correlation at the stage of preliminary basic training has not yet been fully presented. The problem of developing dynamic models of physical and technical preparedness at the stage of preliminary basic training is an actual problem of the theory and methodology of athletics.

The relationship of research with scientific programs, plans, themes

The research was carried out in accordance with the theme of the plan for the research work of the department of athletics Dnepropetrovsk State Institute of Physical Culture and Sport for 2016–2020 pp. “Theoretical and methodological bases of perfection of training process and competitive activities at various stages of athletes preparation” (state registration number 011U000195).

The purpose of the research

To establish the relationship of physical and technical preparedness to achieve sports results of 400 m hurdlers at the stage of preliminary base preparation.

Objectives of the study:

1. On the basis of the analysis of scientific and methodological literature, to establish the dependence of the athletic performance of 400 m hurdlers on the combination of physical and technical readiness.

2. To develop a model of physical and technical preparedness for 400 m hurdlers at the initial stage of training.

Material and Methods of the research

The study involved athletes of the first rank in the number of 18 people. To achieve the objectives used such methods of research: pedagogical supervision, pedagogical experiment, pedagogical testing of physical and technical preparation, telepodometry, methods of mathematical statistics.

Results of the research and their discussion

It is proved that the results in the 400 m hurdles depend on many factors, and therefore the researchers paid special attention to the initial stage of training athletes [7; 8].

Specialized preparation stage of 400 m hurdlers begins with preliminary physical and barrier preparation. Therefore, the preliminary basic training phase is the immediate start of a specialized training period.

The complexity of 400 m hurdlers is due to the high level of physical and functional state, which allows, at a high level of technical preparedness, to realize speed-power capabilities in conditions of "severe" normobaric hypoxia.

The stage of preliminary basic training is characterized by a variety of physical activities with small amounts of special training. The main directions of training 400 m hurdlers have a wide development of physical qualities, an increase in coordination abilities, is the basis for the formation of barrier run techniques. A special place in the system of training takes the ability to display speed, speed-strength, speed endurance and flexibility.

Carrying out tests for general and special physical preparedness, model levels were developed that were based on the ratio of group indicators to the maximum. For model indicators, those that were obtained after a year of systematic training.

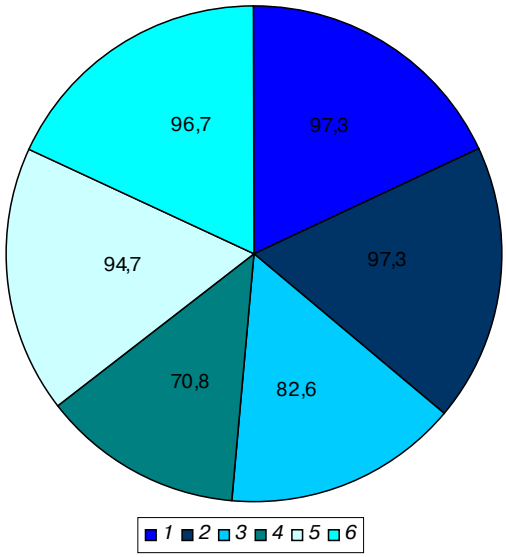

Fig. 1. Model characteristics of the general physical preparedness of 400 m hurdlers at the stage of preliminary basic training, %: *1 –standing long jump; 2 – fivefold jump; 3 – jumping up; 4 – explosive strength index; 5 – running at 30 m from the low start; 6 – running at 60 m from the low start.*

To characterize the state of general physical preparedness, six indicators were determined (fig. 1).
For testing special physical preparedness, exercises were used that contributed to the manifestation of the technical capabilities of athletes. The testing of special physical readiness determined five model characteristics (fig. 2).

Based on the studies carried out, a model for the technical specification of 400 m. hurdlers was developed, which included 14 indicators (table 1).

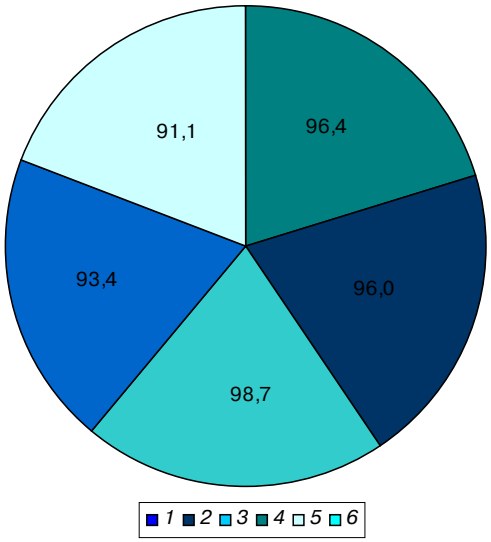

Fig. 2. Model characteristics of special physical preparedness of 400 m hurdlers at the stage of preliminary basic training, %: *1 – running at 100 m; 2 – running at 200 m; 3 – running at 400 m; 4 – jumping run; 5 – jump at 20 m on one leg.*

These results of the study are recommended in practical activities of trainers for the control of physical and technical preparedness of 400 m hurdlers.

One of the factors controlling the training process is the determination of the relationship between the level of physical and technical preparedness with the sports result [12; 21; 22]. The use of correlation analysis made it possible to establish a high level of connection between the result of 400 m hurdles and 22 indicators of physical and technical readiness.

A high level of communication was established between 400 m hurdles and physical fitness indicators:

– with the level of manifestation of speed – result of running at 30 m from the start (r=0,789) and running at 60 m. from the start (r=0,868);
– with the level of development of speed-strength qualities – result of standing long jump (r=0,773), triple jump(r=0,735), fivefold jump (r=0,793), jump at 20 m on one leg(r=0,813);
– with the level of development of speed and speed-strength endurance – result of running at 100 m (r=0,768), the result of jumping run at 100 m (r=0,889).

It is proved that the maximum manifestation of physical qualities depends on the level of technical preparedness, as a result of which a sport result is achieved [13; 19]. Correlation analysis identified a high level of connection between sports results and technical readiness indicators:

– start-up speed (r=0,898);
– distance repulsion to the barrier(r=0,728);
– resistance time for barrier attack (r=0,813);
– height of the common center of mass (CCM) above the barrier (r=0,788);
– landing angle (r=0,775);
– running steps speed (r=0,912);
– barrier step speed (r=0,827);
– running time of the first 200 m (r=0,927);

Table 1

Model characteristics of technical preparedness of 400 m. hurdlers at the stage of preliminary basic training

№	Indicators	Initial		Model	
		$\bar{X}$±m	V, %	$\bar{X}$±m	V, %
1.	Start-up speed, m·s^{-1}	5,78±0,06	7,5	6,12±0,06	7,4
2.	Distance repulsion to the barrier, sm	215,4±2,91	25,6	219,3±0,92	20,6
3.	Resistance time for barrier attack, ms	143,6±0,4	10,58	147,9±0,3	10,55
4.	Angle of attack of the barrier, deg.	62,5±0,3	8,52	63,3±0,3	6,35
5.	Height of the CCM, sm	120,5±1,3	17,5	116,5±1,2	12,7
6.	Angle of torso above barriers, deg.	38,8±0,2	5,6	33,2±0,2	65
7.	Distance from the barrier to the landing, sm	128,8±1,06	32,7	136,0±0,7	15,8
8.	Resistance time at landing, ms	117,6±0,7	16	114,5±0,4	9,8
9.	Angle of torso at landing, deg.	36,8±0,2	5,6	33,4±0,2	6,5
10.	Barrier step speed, ms	5,8±0,12	18,5	6,9±0,5	16,6
11.	Running speed, ms	7,8±1,9	7,9	8,5±0,3	7,8
12.	Running time of the first 200 m, s	25,39±0,7	12,5	24,3±0,2	7,8,5
13.	Running time of the second 200 m, s	30,8±0,8	15,7	29,7±0,7	6,7
14.	Coefficient of technical efficiency	41,7±0,1	6,5	4,56±0,6	6,1

– running time of the second 200 m (r=0,931);
– coefficient of technical efficiency (r=0,975);

The obtained results of the correlation analysis are confirmed by the literature data on the high level of the connection of the sports result with the indicators of the level of development of physical and technical readiness. Especially, in this case, it concerns speed-strength endurance [9; 10; 11].

Establishment of a significant level of correlation between individual indicators of physical fitness indicates the need for the development of certain physical qualities. Thus, the indicators at 30 m from the start and 60 m from the start have a high level of communication (r=0,787), as well as jumps by 30 m on one leg. There is a high level of connection between the indicators of standing long jump from the place and running at 30 m from the start (r=0,756).

For the first time, we used the time index of 100 m jumping run, which correlates with the 200 m run (r=0,830) and running at 400 m (r=0,813).

The conducted correlation analysis established the presence of a high level of connection between individual elements of the barrier run technique. Thus, the index of the speed of the foot steps has a high connection with the length of the running step (r=0,780), the duration of the reference reactions (r=0,815) and the step frequency (r=0,825).

The barrier step speed index has a high level of connection with the exponent of the repulsion distance during the barrier attack (r=0,789), with the resistance response during the barrier attack (r=0,795), with the distance of the landing after the barrier (r=0,812), with the indicator reaction of resistance at a landing (r=0,818) and an indicator of height of CCM above a barrier (r=0,797).

The running time of the first 200 m of the barrier distance depends on the speed of the starting acceleration (r=0,797), the speed of the running steps (r=0,818), the speed of the barrier step (r=0,825).

The running time of the second 200 m of the barrier distance has a high level of connection with the speed index of the running steps (r=0,785) and the speed of the barrier steps (r=0,857).

The existence of a high level of correlation between individual indicators of physical and technical readiness is recommended in practice as criteria for assessing the preparedness of 400 m hurdlers.

Sports result – is a rational manifestation of physical qualities on the basis of effective performance of the elements of exercise technique [15; 17].

Distribution of the training process on the physical and technical training – a conditional. The study of individual technique elements characterizes not only the level of technical preparedness, but also the level of development of physical qualities [16; 20]. Therefore, the improvement of the technique of sports exercises must be understood as the process of performing technique elements of sports exercises at a higher level of manifestation of physical qualities. Thus, the establishment of a high level of interrelation between the indicators of physical and technical preparedness of the barrier run provides an opportunity to choose more effective methods and measures to ensure the management of the training process.

The indicators of speed-strength readiness (jumps of 30 m on one foot, jumps in length from a place, fivefold jump, jumps up from Abolakov's position) have a level of interrelation (r=0,785–0,905) with parameters of starting acceleration, length of a barrier step, periods of resistance when attacking the barrier and when landing.

Speed indicators (running time at 30 m and 60 m) have a high level of interrelation with the speed indicators of the running steps and the barrier step (r=0,736–0,838).

Running time of the first and second 200 m of the barrier distance has a high level of interrelation (r=0,887) with the indices of speed-strength endurance (jumping run at 100 m).

Indicator of the coefficient of technical efficiency (CTE) has a direct time dependence on running smooth and barrier distance segments.

Thus, an arsenal of means was identified that provides an effective manifestation of the physical and technical capabilities of 400 m hurdlers.

Conclusions

1. These materials of a level correlation connection have allowed an opportunity to define quantitative characteristics of physical readiness defining a model level for a defining stage of preparation.

2. It is established that the main indicators of special physical preparedness at the stage of preliminary basic training are: 100 m run, the result of which was 96,4% of the model; running at 200 m – 96,0% of the model; running at 400 m – 98,7% of the model; jumping run at 100 m – 93,4% and jumps 20 m on one leg – 91,1% of the model.

3. The study of individual elements of technology makes it possible to characterize not only the technique of movements, but also the level of physical qualities.

4. Improved special movements techniques performing technical elements at a higher level of manifestation of physical qualities. Therefore, correlation analysis makes it possible to determine rational methods and measures to ensure correction of the training process.

Prospects for further research

Quantitative values of physical fitness determine the technical possibilities. Determination of the proportions of their ratio makes it possible to individually manage the training process.

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Information about the Authors

Oleg Grebeniuk: *Dnepropetrovsk State Institute of Physical Culture and Sports: Naberezhna Peremogy st. 10, Dnipro, 49000, Ukraine.*
ORCID.ORG/0000-0002-2355-2436
E-mail: sportsmenoleggrebenyuk@gmail.com

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Model planning an individual program of physical therapy child with broncho-pulmonary disease

Nataliya Ivasyk

Lviv State University of Physical Culture, Lviv, Ukraine

Purpose: *create a planning model individual program of physical therapy for children with broncho-pulmonary disease.*

Material & Methods: *general scientific – analysis, reflection and synthesis, comparison, abstraction.*

Results: *the model of planning of individual program of physical therapy for children with broncho-pulmonary disease consists of five interrelated functional subsystems.*

Conclusion: *the proposed model takes into consideration the clinical and functional survey data on which on defined the problem, aims and objectives of physical rehabilitation, according to the above it selected tools, forms and methods of influence, methods of execution and criteria dosing according to the individual opportunities of child with broncho-pulmonary diseases. This is achieved through changes in the objectives, content and structure of intervention in response to changes in patient condition.*

Keywords: *modeling, physical therapy, children with broncho-pulmonary diseases.*

Introduction

Reforming physical rehabilitation in Ukraine in the specialty of "physical therapy" re-raises the issue of the process of physical rehabilitation of persons with different nosologies and children with broncho-pulmonary diseases, in particular. Today, there are many studies on authoring programs for physical rehabilitation in various nosologies [5; 7; 8; 10]. However, according to the results of our study, according to the International Classification of the Functioning of Health Impairment (ICF) in two people with the same diseases, there can be different levels of functioning, and vice versa, two individuals with equal levels of functioning do not necessarily have the same health changes [4; 11; 12]. Therefore, in practical activities it is necessary for a physical rehabilitation specialist/therapist to create an individual physical therapy program for a specific patient from a typical or proposed author's program. In our works we paid attention to the individualization of the program of physical therapy of children with broncho-pulmonary diseases, taking into account their multivariance of violations [2; 3]. However, communication with both practitioners and trainees indicates that adaptation of a standard/author's physical rehabilitation / therapy program to individual patients, both clinical and functional, causes certain difficulties. To which A. Gertsik notes in his works. We agree with the research of A. Gercik, who allocates in the system of physical rehabilitation four main functional subsystems with their own purpose [1]. According to his division, the greatest difficulty in adapting classical / authoritative physical rehabilitation / therapy programs with individual patient characteristics is caused by the functional subsystem of planning.

Communication of research with scientific programs, plans, themes

The work is carried out on the theme of research work of Lviv State University of Physical Culture for 2016–2020 "Theoretical and methodical bases of physical rehabilitation of invalids with infringement of activity of the locomotor system and respiratory system" (protocol No. 8 from 19.04.2016).

The purpose of the research

Create a planning model individual program of physical therapy for children with broncho-pulmonary disease.

Material and Methods of the research

Methods: general scientific – analysis, reflection and synthesis, comparison, abstraction.

Results of the research and their discussion

The term "model" comes from the Latin word "modulus", which means measure, measure, sample and norm. In general, a model is understood as a sample, analog, similarity of an object [9]. Analyzing the application of the "model" in various spheres, one can see that each of the branches puts its value in this period. Thus, the model mathematics called symbols and system symbols, by means of which an object or process is described, doctors – picture of the disease, logic - logical circuit construction, in sports practice – tactical scheme of the game, etc.

A characteristic feature of models is their simplicity with respect to the original or real life situation, which is modeled, which is inevitable, since the original only in a limited number of relationships is displayed in the model [6].

The model of planning an individual program of physical therapy of a child with broncho-pulmonary disease is a complex formation, consists of five interrelated functional subsys-

tems:

- clinical and functional data of the patient (data from medical history and examinations);
- identification of problems (rehabilitation diagnosis);
- setting aims and objectives;
- selection means;
- Component of activities.

Therefore, the physical therapy specialist, adapting the typical / author's physical therapy program to a specific patient, after determining the clinical and functional characteristics of the patient, the aims and objectives of rehabilitation, will be able not only to select the best means of rehabilitation, but also to decide on the methodology their application, dosage, methods and form of exposure, which would give the optimal result for a particular patient.

The proposed model of physical therapy is considered on the basis of a typical clinical situation, with the possibility of individualizing the tactics of rehabilitation intervention in accordance with a specific clinical situation (fig. 1).

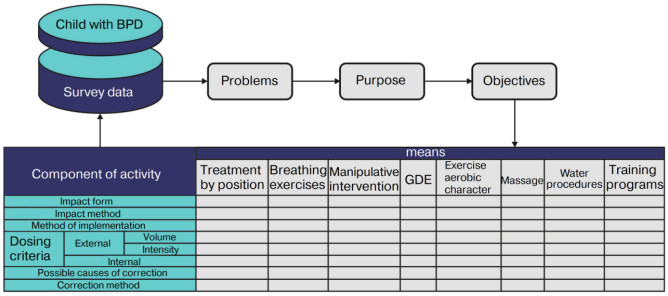

Fig. 1. Schematic representation of the model of planning an individual program of physical rehabilitation of a child with broncho-pulmonary disease

BPD – broncho-pulmonary disease, GDE– general developmental exercises, activities for each facility for clarity presented in selecting funds (tabl. 1–8)

In accordance with the above, consider a typical clinical situation with the example of an 8-year-old boy with pneumonia.

Clinical and functional data of the patient (information from the doctor and survey data):

Patient N., 8 years old. Polysegmentary left-sided pneumonia, severe course, respiratory failure – II ст. Entered to the hospital 5 days ago with t – 38,9°. Complaints about cough, headache, general weakness, shortness of breath, nausea. At the moment – t – 37,8°, complaints wet nonproductive cough, heavy sweating, RR – 28 cycles min^{-1} , HR – 100 beats min^{-1}. Auscultatory – right vesicular breathing, left on the background of weakened breathing, crepitating wheezing more on the front surface. When percussion left blunt sound.

8 sick days ago, when the temperature rose to 38,5° and there was a dry cough, weakness. After 3 days of treatment at home he was hospitalized. Acute respiratory viral infections sick 3–4 times a year. Skin pale pink. Nasal breathing is free. During the day, coughs often, but coughs rarely and little. The work included auxiliary breathing muscles, heavy sweating, posture asymmetrical circular-concave back, muscle pain in the neck area seal are more pronounced on the right. During a dream from a cough, he does not wake up, says that he gets enough sleep. Chest rise (CR) – 3 cm, chest is elastic, vital capacity (VC) is 64 % of the proper value, the respiratory rate (RR) – 28 cycles min^{-1}, heart rate (HR) – 100 beats·min^{-1}, Stange test – 9 s, Ghencea test – 3 s.

At school, the child attends physical education lessons in the main group, the physical load is well tolerated. About the methods of physical rehabilitation in diseases of the respiratory system, parents do not know anything. The effect of exercise on the state of the respiratory system in broncho-pulmonary diseases is only known that it is very useful to do breathing exercises.

Identification of problems: high temperature, slow improvement in the patient's condition; disorders of ventilation, presence of inflammatory exudate in the lung tissue, sputum shortness of breath, which is not displayed; in the work involved auxiliary respiratory muscles, painful muscular densities; increased rates of BR and HR; low endurance and functionality of the respiratory system (RS); violation of posture; risk of complication (the pleura may become entrapped) low level of knowledge of the patient and his parents on the use of physical therapy for broncho-pulmonary diseases.

Setting aims and objectives of physical rehabilitation.

Aims: recovery capabilities of the respiratory system and the whole organism.

Objectives:

Short-term: contribute to lower temperatures; to promote liquefaction and elimination of exudate; improve ventilation; prevent complications.

Long-term: to improve the mobility and elasticity of the chest and lungs; relax the auxiliary respiratory muscles; contribute

Table 1
Treatment by position

Impact form			Classes with a physical therapy specialist, self-study
Impact method			Individual, game
Method of implementation			IV, DP
Dosing criteria	External	Volume	IV 2–3 times a day, DP – 1–2 times a day
		Intensity	IV – up to 30 min, DP – 15–20 min.
	Internal		Coughing inflammatory saliva, changing respiratory noise, pulse oximeter performance
Possible causes of correction			Decrease in saturation, weakening of respiratory noises
Correction method			Change in position to improve ventilation

Note. *IV – to improve ventilation, DP – drainage positions.*

to the normalization of indicators BR and HR; increased tolerance to physical activity (improve general endurance and functional capabilities of RS) training in the implementation of certain exercises, methods of their implementation and methods of self-control; contribute posture correction.

Choice of means and component of activity (table 1–8)**:**
The choice of means and methods of their use may change in accordance with the available resources of the patient: functional and financial (eg, to purchase a certain means.) opportunities; institutions: the material-technical base, professional

Table 2
Breathing exercises

Impact form			MHG*, classes with a physical therapy specialist, self-study
Impact method			Individual, small group, game
Method of implementation			Sound (humming) static; dynamic (with ↓ t – 37,4°): SI, CE
Dosing criteria	External	Volume	S. P. lying / sitting; static – times every hour (deep breath and exhalation), dynamic combined with general development exercises 2/1 2-4 times
		Intensity	Low, slow rate, maximum amplitude
	Internal		Coughing up mucus inflammation, changes in the respiratory noise indicators pulse oximetry/heart rate, fatigue, the intensity of sweating, change in skin color, quality of movement, ability to concentrate, overall well-being of the child, the mood at performance fell and during rest
Possible causes of correction			Paroxysmal cough, hyperventilation, sensation of pain in the chest, the appearance of dry wheezing, changes in the child's mood (deterioration, the rejection of this exercise)
Correction method			Inclusion of breathing exercises delay/extended exhalation. Increase the length of rest between exercises. Reduction of the amplitude of the exercise on inspiration. Correction of exercises gaming method, dosage reduction

Note. *Here and in the future: MHG – morning hygienic gymnastics, SI – with emphasis on stretching and inhalation, CE – with emphasis on compression and exhalation, S. P. – starting position, * – after normalization of body temperature.*

Table 3
Manipulative intervention

Impact form			Classes with a physical therapy specialist
Impact method			Individual, game
Method of implementation			At a ↓ t – 37,4° – in combination DP – bounce, manual pressure, percussion, when normalizing t – percussion, vibration, rib sprung compression, rotation, coercion/ controlled coughing
Dosing criteria	External	Volume	At a ↓ t – 37,4°, when normalization t – 1–3 cycles
		Intensity	Low, medium
	Internal		Coughing up mucus inflammation, changes in the respiratory noise indicators pulse oximetry/heart rate, fatigue, the intensity of sweating, change in skin color, quality of movement, ability to concentrate, overall well-being of the child, the mood at performance fell and during rest
Possible causes of correction			Paroxysmal cough, hyperventilation, sensation of pain in the chest, the appearance of dry wheezing, changes in the child's mood (deterioration, the rejection of this exercise)
Correction method			Inclusion of exercises to elongate the exhalation. Increase the length of rest between interventions. Reducing the strength of the application when manipulating. Breathing through the pursed lips, lowering the dosage

Table 4
General development exercises(GDE)

Impact form			MHG*, classes with a physical therapy specialist, self-study
Impact method			Individual, small group, game
Method of implementation			At a ↓ t – 37,4° – on stretching/relaxing, during normalization t – adding to improve mobility and elasticity thorax/lungs for posture correction in conjunction with correction of respiratory function
Dosing criteria	External	Volume	S. P. lying/sitting; 1–2 exercises in combination with respiratory 1/2 in 2–4 times, with normalization t – ratio 1/1 4–6 times
		Intensity	low / medium, slow / medium tempo, maximum amplitude
	Internal		Coughing of inflammatory mucus, changes in respiratory noise, pulse oximetry/ heart rate, fatigue, sweating intensity, skin discoloration, the quality of the movements, the ability to concentrate, overall well-being of the child, the mood at performance fell and during rest
Possible causes of correction			Paroxysmal cough, hyperventilation, sensation of pain, the appearance of dry wheezing, changes in the child's mood (deterioration, the rejection of this exercise)
Correction method			Inclusion of breathing exercises/prolonged exhalation. Increase the length of rest between exercises. Decrease the amplitude of the exercise. Correction of exercises by the game method, reduction of dosage

Table 5
Exercise aerobic character

Impact form			Classes with a physical therapy specialist, self-study
Impact method			Individual, small group, game
Method of implementation			Equally, interval
Dosing criteria	External	Volume	5–15 min 1–2 times a day
		Intensity	Light, medium intensity
	Internal		Coughing of inflammatory mucus, changes in respiratory noise, pulse oximetry/heart rate, fatigue, sweating intensity, skin discoloration, the quality of the movements, the ability to concentrate, overall well-being of the child, the mood at performance fell and during rest
Possible causes of correction			Strong fatigue, a feeling of pain in the legs, changes in the child's mood (deterioration, the rejection of this exercise)
Correction method			Decrease in walking speed, change of terrain, with a combination of relaxation exercises, stretching

Note. *Recovery period (in some cases, subacute).*

Table 6
Massage

Impact form			Classes with a physical therapy specialist / massage therapist
Impact method			Individual
Method of implementation			Draining massage with emphasis on the impact-vibration techniques, relaxing the muscles of the neck area
Dosing criteria	External	Volume	Thorax, neck area
		Intensity	Medium
	Internal		Coughing up of inflammatory mucus, changes in respiratory noise, pulse oximeters/ heart rate, fatigue, skin discoloration, general health of the child, mood during the procedure
Possible causes of correction			Paroxysmal cough, hyperventilation, sensation of pain in the chest, neck area, a change in the child's mood (deterioration, the rejection of the procedure)
Correction method			Reducing the strength of the intervention, increasing the time for stroking. Breathing through pursed lips

Note. *Massage at temperature normalization.*

Table 7
Water procedures

Impact form			Self-study
Impact method			Individual
Method of implementation			Wet wiping, when normalizing t – comfortable shower
Dosing criteria	External	Volume	Face, thorax, feet
		Intensity	Easy, as sweating (no less than 1 time per day); daily (comfortable shower)
	Internal		Inadequate skin discoloration, general well-being of the child, mood during the procedure
Possible causes of correction			Changing the mood of the child (deterioration, the rejection of the procedure)
Correction method			Changing the wiping means, the intervention temperature, the intensity of interference

Table 8
Patient education

Impact form			Classes with a physical therapy specialist
Impact method			Individual, game
Method of implementation			Conversations, visual, practical
Dosing criteria	External	Volume	On the application of certain exercises, methods of their implementation, methods of self-control
		Intensity	Low, medium
	Internal		Fatigue, ability to concentrate, overall well-being of the child, mood during the lesson
Possible causes of correction			Fatigue, changes in mood child (deterioration, the rejection of this exercise)
Correction method			Submission of information to parents (guardian), changing the nature of the information submission

staff, providing the service of physical therapy overall climate, the patient's wishes for training in this technique, etc.).

Conclusions

The model for planning an individual program for physical therapy of a child with broncho-pulmonary disease presumes the recording of clinical and functional survey data, on the basis of which problems are identified, the aims and objectives of physical rehabilitation are set, according to which the means, forms and methods of influence, dosing according to individual data of a child with broncho-pulmonary disease. This is provided by changes in the purpose, content and structure of the intervention in accordance with changes in the patient's condition.

Prospects for further research is to develop clinical protocols of medical care at the broncho-pulmonary diseases in children, which will be part of physical therapy.

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Information about the Authors

Nataliya Ivasyk: *PhD (Physical Education and Sport), Associate Professor; Lviv State University of Physical Culture: Kosciusko Str. 11, 79007, Lviv, Ukraine*
ORCID.ORG/0000-0002-0053-2854
E-mail: Ivasyk_N@i.ua

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Modern implementation approaches to high-trained football player selection on the basis of neurodynamic properties of the upper sections of the central nervous system

Volodymyr Lyzogub
Vitaliy Pustovalov
Victoriya Suprunovich
Sergiy Hrechuha

Research Institute of Physiology named after M. Bosoy
Cherkasy National University named after B. Khmelnitskiy,
Cherkasy, Ukraine

Purpose: *based of the characteristics of neurodynamic and sensorimotor properties, to develop a technology for the selection of football players of high qualification.*

Material & Methods: *neurodynamic properties of the higher sections of the central nervous system of football players-professionals were studied using a computer device called "Diagnost-1M". The functional mobility, strength and balance of nerve processes (FMNP, SNP, BNP), as well as latent periods of simple and complex sensorimotor reactions (SVMR, CMR2–3).*

Results: *according to the indices of neurodynamic properties and sensorimotor reactions of football players of high skill level, differences. Football players who had the best indicators of neural neurodynamic properties, characterized by high efficiency expert assessments game activity.*

Conclusion: *developed and substantiated estimates of the scale of neural properties and defined criteria for assessing the suitability of highly skilled players for selection in the club and national teams.*

Keywords: *football, selection, effectiveness of game activity, neurodynamic, sensorimotor, genetics.*

Introduction

Modern football is characterized by growth of entertainment and a high level of competition among players, the technique and tactics of the game have become more complicated, the price of error has grown, requirements to the whole system of preparedness, control and correction of the training process and selection of players have increased. This requires players to identify technical, tactical, mental and physical abilities that meet the high demands of gaming [6; 8; 9]. There is a process of exhaustion of a set of tools and methods that ensure a high result of gaming activities of players. Therefore, the relevance to the development of theory and methodology, the improvement of criteria, the search for and the creation of an accessible, informative and effective step-by-step selection of high-trained football players in the Premier League and national teams. In most cases, coaching groups are interested in improving the quality of staffing teams with players, maintaining high efficiency and reliability of gaming activities, reducing training time, training and training, reducing the number of players being eliminated, increasing the stability of gaming teams, maintaining health and gaming longevity [1; 14]. The main purpose o f sports selection is to ensure maximum compliance with the individual characteristics of players to those requirements that apply to them play activity [2; 11; 12].

Despite the rather high interest of researchers and coaches in the selection problem, given the high psycho-emotional and physical stress of playing activity, the quantitative and qualitative criteria and selection criteria of high-trained football player remain insufficiently developed. The problem lies, first of all, in the absence of a unified approach to the methods of research and evaluation of results. This situation is explained by the fact that abroad, the problems of research and evaluation of neurodynamic characteristics of football players are engaged in psychology, leading to an underestimation of the biological component [15; 16; 17]. Traditionally in the countries of the former Soviet Union, particularly in Ukraine, such studies are conducted by physicians and physiologists, increased attention to physiological and underestimation of the psychological mechanisms of behavioral reactions [3; 4; 12].

At the world level and in Ukraine there is a practice and methodology for selecting players, built on the theory of individual differences in health status, physical capabilities, development of motor skills, performance of technical and tactical actions, game effectiveness, mental and constitutional features, dominance of vision, legs, asymmetry of the brain, style of competitive activity and other [1]. The presence of differences in these indicators is the basis for solving the selection problems. At the same time, researchers are showing considerable interest in the search for highly genetically determined markers, which are the most informative in the management and forecasting of gaming activities. Such criteria are distinguished by a strong and stable biological nature, and, in our opinion, they include neurodynamic, individual-typological properties of the higher parts of the central nervous system: functional mobility (FMNP), strength (SNP) and equilibrium (BNP) of nerve processes [5; 7].

Previously, using the twin method, we proved that for monozygotic and dizygotic twins, the coefficients of pair correlation (*R*) and heredity (*H*) were for FMNP – 0,65 for SNP –0,53, and for BNP – 0,56, a high dependence of these properties on genetic and small on environmental factors. Therefore, we believed that these properties are biologically stable and, due to their genetic conditionality, can be reliable criteria in the selection of players [3; 7; 13].

Therefore, the methodology is based on the research and analysis of the parameters of sensorimotor and neurodynamic properties of the higher sections of the nervous system with the aim of developing criteria and scoring scales for the selection of high-trained football player.

The purpose of the research

Based of the characteristics of neurodynamic and sensorimotor properties, to develop a technology for the selection of football players of high qualification.

Material and Methods of the research

Studies conducted 46 high-trained football player, members of the Premier League teams and the national team of Ukraine. We studied the neurodynamic properties of the higher parts of the central nervous system and sensorimotor characteristics of varying complexity, and also conducted an expert evaluation of gaming activity.

The study of individual-typological, neurodynamic properties was carried out using a computer device «Diagnost-1M». Defined: FMNP, SNP and BNP of nervous processes, as well as latent periods of simple (SVMR), complex reactions of differentiation of two of the three stimuli (CMR2–3) [10].

The level of FMNP was determined from the processing of complex visual information in the feedback mode, which consisted in differentiating positive and inhibitory stimuli (geometric figures). The FMNP measure was the time of the test task execution. The quicker the examiner performed the task related to the differentiation of 120 stimuli, the higher he had FMNP. SNP was estimated by the indicator of the total amount of processed information for 5 minutes of work on the computer. A greater amount of processed information responded to a high level of SNP. The definition of BNP provided for recording the accuracy of reactions to a moving object. BNP was judged by the total magnitude of the reactions, ahead of or late. The smaller the sum of the deviations of motor reactions (ms), the higher the BNP.

Sensor-motor reactivity was evaluated by the value of the latent periods (ms) in response to the action of stimuli of varying degrees of complexity (a simple visual-motor reaction – SVMR, and a differentiation reaction of two stimuli of three – CMR2–3). Smaller values of the latent periods correspond better sensorimotor reactivity [7].

Expert evaluation of the game activity of the players was conducted by a group of experienced coaches. The resulting statistical material was processed by a computer program Microsoft Excell.

Results of the research and their discussion

High-trained players have established the maximum, minimum and average values of the neurodynamic properties of the higher parts of the central nervous system: FMNP, SNP, BNP and latent periods of sensorimotor reactions: SVMR, CMR2–3 (table 1).

To develop a differentiated quantitative and qualitative assessment of the neurodynamic properties of high-trained football player, we used the technology of scales. Relative values of parameters obtained on the basis of their absolute magnitude, taking into account the characteristics of the standard deviation (σ) of the mean statistical. The calculated gradations of the $\bar{X}i$ value indicators for each functional class. Based on the results of high-trained football player, we have developed boundaries and scales for the distribution of players into groups that include five levels of the functional state of neurodynamic and sensorimotor properties: a high level (H), which was calculated – $\bar{X}i \leq \bar{X}-\sigma$ and corresponds to 10 points; above average (AA) – $\bar{X}-\sigma \leq \bar{X}i \leq \bar{X}-0{,}25\sigma$, which corresponds to 8 points; average level (A) – $\bar{X}-0{,}25\sigma \leq \bar{X}i \leq \bar{X}\pm0{,}25\sigma$ and corresponded to 6 points; lower than average (LA) was calculated as follows $\bar{X}+0{,}25\sigma \leq \bar{X}i \leq \bar{X}+\sigma$ and is equal to 4 points; and the low (L) level is – $\bar{X}+\sigma \leq \bar{X}i$, which was 2 points. Scales of assessments of neurodynamic and sensorimotor properties of professional football players are presented in table 2.

Such diagnostics and evaluation for each indicator allows, according to the table, to determine the individual quantitative and qualitative characteristics of individual typological properties and sensorimotor reactions of football players. Thus, according to the scales proposed by us, a group with a high level of sensorimotor properties can be classified as players who have SVMR at the level – 184 ms or less, for CMR2–3 – 249 мс and the best time. According to the results of individual-typological properties of BNP, the group with a high level included players who had FMNP – 56 s or less, for SNP – 752 or more stimuli, and for BNP the deviation was – 14 ms or less. A qualitative assessment of the resulted neurodynamic properties characterized by a high level of their development and corresponded to 10 points. Corresponding scales of assessments were developed for the remaining 4 groups of players with different levels of neurodynamic functions: above aver-

Table 1

Neurodynamic and sensorimotor properties of high-trained football players

Indicators	SVMR (ms)	CMR2–3 (ms)	FMNP (s)	SNP (stimuli)	BNP (ms)
Maximum	157,0	276,0	52,0	830,0	11,0
Minimum	236,0	359,0	66,0	610,0	28,0
Medium, $\bar{X}\pm s$	196,6±4,1	317,4±6,8	59,3±0,9	720,6±7,4	19,2±0,8

Table 2

Differential scales for assessing the level of neurodynamic properties of high-trained football players

№ c/u	Indicators	Level of properties under study				
		L	LA	A	AA	H
		2 points	4 points	6 points	8 points	10 points
1	SVMR, ms	≥231	230–216	215–200	199–185	≤184
2	CMR2–3, ms	≥311	310–290	289–270	269–250	≤249
3	FMNP, s	≥67	66–64	63–60	59–57	≤56
4	SNP, stimuli	≤659	660–684	685–719	720–751	≥752
5	BNP, ms	≥33	32–27	26–21	20–15	≤14

Table 3

Integral index of neurodynamic and sensorimotor properties for high-trained football players

№ c/u	Level of neurodynamic and sensorimotor properties	Integral index of the properties studied, points
1	High	≥41
2	Above average	31–40
3	Average	21–30
4	Lower than average	11–20
5	Low	≤10

Table 4

Evaluation of the game activity of of high-trained football players

№ c/u	Level of game activity	Index of game activity of football players, points
1.	High	9–10
2.	Above average	7–8
3.	Average	5–6
4.	Lower than average	3–4
5.	Low	1–2

age (AA), average (A), lower than average (LA) and low (L).

The general conclusion about the functional state of neurodynamic and sensorimotor properties was carried out according to the integral index, which was calculated by the sum of the points scored by the player (table 3).

Table 3 shows the classification of the integral index of the functional state of neurodynamic and sensorimotor properties in high-trained football players. The maximum score – 50, minimum – 2. We analyzed the distribution of high-trained football players according to the level of the functional state of the neurodynamic and sensorimotor properties. Low values of the integral index – ≤10 points and below the average 11–20 points, among qualified players were absent. Of the total number of players – 9% football players (4 people), were assigned to the group with a high integrated index of neurodynamic and sensorimotor properties. Their integral index was higher than 41 points. Among all athletes, 9 players (19%) found above the average level of the integral index, which was in the range of 31–40 points. Most of the players of the national team of Ukraine and the Premier League, and this is 72% (33 people), entered the group with an average value of the integral index of the functional state of neurodynamic and sensorimotor properties. They had an integral index of 21–30 points.

In order to confirm the assumption that the individual typological neurodynamic and sensorimotor properties are related to the game activity of the players, we, with the help of a group of experienced coaches, conducted an expert evaluation of the game activity and developed evaluation scales (table 4).

The experts belonged to the group of players with a high level of gaming activity – 11% of players (5 people), of the above-average level – 24% (11 people), the average level included the majority of players – 57% (26 people). According to this indicator, it was found that 8% of players (4 people) were assigned to a group with a lower than average level of gaming activity. Football players with a low score of gaming activity (1–2 points), the experts did not sing out.

Consequently, the distribution of football players on the quantitative and qualitative indicators of gaming activity and the integral index of neurodynamic and sensorimotor properties in our study coincided. Football players with high and above average gaming performance in most cases were characterized by high or above average values of the investigated neurodynamic properties of FMNP, SNP, BNP, a complex sensorimotor CMR2–3 differentiation reaction, which indicates a connection between the individual typological properties of GNI and gaming activity.

In order to establish the connection between the effectiveness of gaming activity and the functional state of neurodynamic and sensorimotor properties, we performed a correlation analysis. It was found that the correlation of the evaluation of the game activity of professional football players with sensorimotor and individual-typological properties (CMR2–3, FMNP, SNP, BNP) were within ($r=0,29–0,35$; $p<0,05$). This indicates that football players with a high and above average score of gaming activity were characterized in most cases by high values of the investigated typological properties of FMNP, SNP, BNP and differentiation reaction CMR2–3. Between rated players playing activity with indicators latent periods simple sensorimotor responses (SVMR) probable correlation is not established ($p>0,05$).

So, based on the data obtained, it was established that football players who had better indices of neurodynamic and sensorimotor properties were characterized by high estimates of the effectiveness of gaming activity, this is confirmed by

the presence of reliable correlations. Therefore, the criteria for selection can be as indicators of physical, technical, functional preparedness of football players, the playing role of players, body type, biological age, individual characteristics [2; 8; 6], and the special importance of coaching teams in the selection should provide highly genetically determined markers, which are the most informative in the management and forecasting of the game activity of players [3; 5; 7]. Such criteria, according to the results of our work, correspond to the neurodynamic, individual-typological properties of the higher sections of the central nervous system: functional mobility, strength and balance of nervous processes, as well as complex sensorimotor differentiation reactions that differ in strong and stable biological nature.

The results of a survey of football players of high qualification and their comparison with the success of gaming activities became the basis for the development and justification of criteria and recommendations regarding the gaming suitability of each candidate. Establishment of criteria for suitability is one of the important stages of our work and recommendations on selection. Based on the results of our study, it is suggested to select the contingent in the national teams and the Premier League with the distribution of football players into 4 groups: they are certainly suitable, suitable, conditionally suitable and unsuitable.

The first group should consist of unquestionably suitable football players of high qualification, capable of successfully performing technical and tactical tasks and installing a coach for the game. Such football players have a full correspondence of a high level of sensorimotor properties and neurodynamic functions and capabilities with the requirements of the game activity, presented to them by the coach The integral index of the neurodynamic and sensory characteristics of these football players should be at least 41 points.

To the second group – suitable players can be classified as football players who were characterized above the average level of neurodynamic and sensorimotor properties In the process of game activity, these football players can make minor mistakes that do not significantly affect the effectiveness of the team's playing activity. Errors, in general, can be associated with changes in working conditions, the performance of unusual functional tasks for the football player, the complication of game situations. For such football players, there is some decrease in the reserve capacity of the body. The integral index of these players on the complex of neurodynamic properties should be in the range of 31–40 points.

By the third group we included conditionally suitable football players. For them, a prerequisite is to increase the time for preparation and recovery, as well as the introduction of special training in the mode of increased workload. Purpose football players such demanding tasks associated with a significant probability of errors during their gaming activities permitted them in acute shortage of time and space. Such football players, according to our results of neurodynamic and sensorimotor studies, were characterized in most cases by an average level. The integral index of the neurodynamic properties of these football players on the set of indicators should correspond to the average level and be in the range of 21–30 points.

The fourth group consisted of unsuitable football players, whose qualification and playing activity did not meet the requirements of the re-measure league and the national team of Ukraine. These include football players who have an integral indicator of neurodynamic and sensorimotor properties below 20 points, and most of the indicators studied are classified below their average level. Additional training for unsuitable individuals were unproductive.

Thus, we have proved that the main targets, provided that selection and prediction of high-trained football players are made, should be the characteristics of genetically determined neurodynamic properties of the higher parts of the central nervous system, including FMNP, SNP, BNP and sensorimotor differentiation CMR2–3. The use of genetic approaches for the purpose of sports selection and prediction will certainly help to reduce the percentage of marriage in coaching activities, free specialists from performing unproductive work, ensure high efficiency of training football players and reserve.

Conclusions

1. It has been proved that the main targets, provided that selection and prediction of high-trained football players are made, should be the characteristics of highly genetically determined neurodynamic properties of the higher parts of the central nervous system, including FMNP, SNP, BNP and sensorimotor differentiation reactions CMR2–3.

2. Football players who had better indices of neurodynamic and sensorimotor properties were characterized by high expert estimates of the effectiveness of gaming activity, which is confirmed by the presence of reliable correlations between the studied indicators and the evaluation of gaming performance($p<0,05$).

3. The results of the study of the neurodynamic properties of players of high qualification and the evaluation scales developed on their basis allow us to substantiate the criteria and recommendations regarding the game activity of players during the selection to the teams of masters and to the teams of Ukraine.

Directions for further research

The prospect of further research is to further study the individual-typological properties of the higher sections of the central nervous system and sensorimotor rets of varying degrees of complexity of players of high skill level depending on the playing positions.

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Information about the Authors

Volodymyr Lyzogub: *Doctor of Science (Biology); Professor: Cherkasy National University. B. Khmelnitskiy, av. Shevchenko, 81, Cherkasy, 18000, Ukraine.*
ORCID.ORG/0000-0002-3001-138X
E-mail: v_lizogub@ukr.net

Vitaliy Pustovalov: *PhD (Physical Education and Sport), Assosiate Professor; Cherkasy National University. B. Khmelnitskiy, av. Shevchenko, 81, Cherkasy, 18000, Ukraine.*
ORCID.ORG/0000-0002-8625-6175
E-mail: v_lizogub@ukr.net

Victoriya Suprunovich: *PhD (Physical Education and Sport), Assosiate Professor; Cherkasy National University. B. Khmelnitskiy, av. Shevchenko, 81, Cherkasy, 18000, Ukraine.*
ORCID.ORG/0000-0003-0238-5066
E-mail: viktorys1987@ukr.net

Sergiy Hrechuha: *PhD (Physical Education and Sport), Assosiate Professor; Cherkasy National University. B. Khmelnitskiy, av. Shevchenko, 81, Cherkasy, 18000, Ukraine.*
ORCID.ORG/0000-0003-2855-4438
E-mail: viktorys1987@ukr.net

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Special aspects of movement activity of secondary general school pupils at 15–17 years of age in their spare time

Andriy Mandyuk

Lviv State University of Physical Culture, Lviv, Ukraine

Purpose: *to determine the characteristics movement activity, which is carried out secondary general school pupils at 15–17 years of age in their spare time.*

Material & Methods *study involved secondary general school pupils of 10–11 classes in Lviv, Ternopil, Ivano-Frankivsk and Khmelnytsky. The total number of students was 926 people, which is 6% of the total population. The study used such methods: analysis and synthesis, analysis of scientific and methodological literature, sociological survey.*

Results: *specificity of movement activity in spare time is determined, which is carried out by pupils of senior school age. Defined amount of daily and weekly movement activity, as well as the main priorities in the choice of forms and types of movement activity.*

Conclusion: *results of the study will be used to develop a model for optimizing the movement activity of secondary general school pupils at 15–17 years of age using the appropriate forms of movement activity, which is carried out in their spare time.*

Keywords: *movement activity, secondary general school, spare time, pupils.*

Introduction

The sphere of leisure at all times has been and remains one of the weighty components of human life. That is why the problem of spare time organization has always been in the focus of scientists [3].

Spare time is an important means of forming the personality of a young person, contributes to the processes of recovery of mental and physical performance [5]. The period of spare time is aimed at fulfilling a number of functions, in particular, the function of developing abilities and realizing the interests of the individual, the functions of entertainment, recreation and social function. In this context, an important component of leisure activity is movement activity, as an integral part of the rational lifestyle of the individual, especially school-age children. Movement activity is aimed at promoting health, developing physical potential and achieving physical perfection [6].

The period of study in grades 10-11 is characterized by an increased level of academic load, which is usually not limited to compulsory school lessons. Preparation for final exams and external independent evaluation reduces the amount of spare time that students can spend on other activities, including movement activity [4].

Finding ways to increase the level of movement activity students of secondary schools will inevitably lead to an analysis of the scope of their leisure time, as a potential reserve of the effective application of the various forms of physical education.

Movement activity of various population groups is a constant object of research among scientists, since it has a close connection with the level of health and quality of life of the individual [8]. The scientific works of this subject cover the age periods, beginning with the pre-school age [7].

V. G. Arefev investigated the influence of movement activity on the health of schoolchildren, as well as the relationship between movement activity and the development of risk factors for chronic diseases [1]. A similar contingent was investigated by A. T. Tomenko, analyzed the daily level of movement activity of schoolchildren, comparing it with the existing norms. In addition, the author studied the problems of the movement activity of students, analyzing its relationship with the level of somatic health [9].

I. R. Bodnar has established age and gender characteristics in favorite leisure activities for schoolchildren of secondary school age [2].

Despite the fact that the level of movement activity of schoolchildren is systematically investigated by scientists, the peculiarities of the movement activity of schoolchildren in their spare time have been little studied or are considered in the context of analysis of other problems. At a time when the school system of education, by virtue of its standardization, does not adequately meet the biological need of the organism for movement activity, the sphere of spare time arises as a reserve for the potential increase in the level of movement activity and the prevention of hypodynamia. This determined the choice of the research objective.

The purpose of the research

To determine the characteristics movement activity, which is

carried out secondary general school pupils at 15–17 years of age in their spare time.

Objectives of the study:

1. Identify the amount of physical activity students 10–11 classes of secondary schools.

2. Set the forms and types of physical activity undertaken by students aged 15–17 years in his spare time.

Material and Methods of the research

Study involved secondary general school pupils of 10–11 classes in Lviv, Ternopil, Ivano-Frankivsk and Khmelnytsky. The total number of students was 926 people, which is 6% of the total population.

The study used such methods: analysis and synthesis, analysis of scientific and methodological literature, sociological survey.

Results of the research and their discussion

The classical approach to the analysis of human movement activity is, first of all, determining the level of this activity (daily, weekly, during the month, etc.). To do this, apply a variety of approaches, among them: a survey, the calculation of the level of movement activity using special techniques, the use of pedometers or fitness-trackers. Determine the level of movement activity is also possible with modern gadgets that track the movement of a person with the help of a satellite. Each of these methods has its own preferences and shortcomings, which to some extent can affect the reliability of the data obtained. In this study, a sociological survey method was used that allowed us to reach a significant group of respondents from different cities of Ukraine. The sample at the level of 6% of the population allowed to obtain data with an error of less than 4%. When formulating the questions, the approaches taken to determine the level of movement activity of children in some European countries, the United States and WHO [12].

The American Heart Association for prevention of health problems during schooling recommends daily movement activity of at least 30 min [10].

An analysis of the answers to the questions concerning the day and week volume of the movement activity of pupils of the 10th–11th grades made it possible to find out how often pupils aged 15–17 are engaged in movement activity lasting not less than 30 min during the week (Fig. 1).

As can be seen from the figure, three times a week or more often engage in movement activity lasting 30 minutes and more than 75,5% of students, 40,6% of them do it daily. At the same time, we note differences in the results obtained with respect to daily movement activity: among girls this indicator was 35,1%, while among young men – 46,4%.

The data obtained also indicate that the movement activity of 25,5% of students is not systematic. In general, 30,3% of girls have movement activity lasting 30 minutes and no more than twice a week. Among young men, the same indicator is 18,4%. Despite this, we note a low level of involvement in the movement activity of girls.

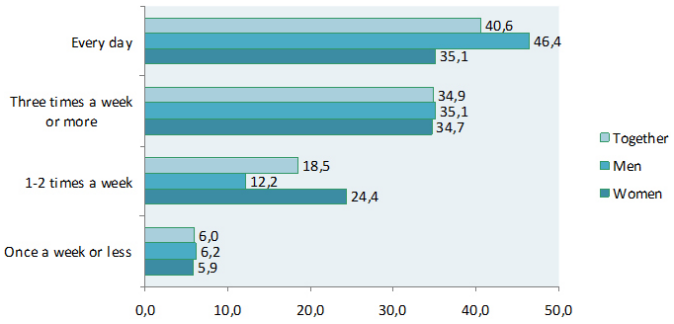

Fig. 1. Movement activity of students 15–17 years of age lasting 30 minutes or more during the week (%)

In the course of the survey, we used a different approach to determining the approximate weekly level of movement activity. Respondents responded to the question of the time spent on movement activity, the intensity of which causes shortness of breath or significant sweating. Note that this formulation is used in monitoring the level of movement activity in different countries by the World Health Organization [11]. The results are shown in Fig. 2.

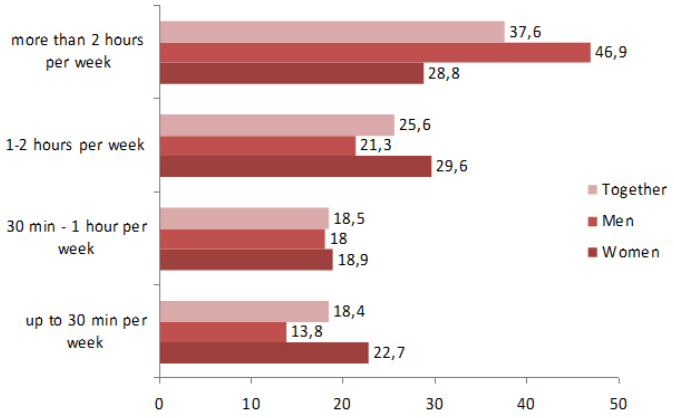

Fig. 2. Movement activity of students 15–17 years of age (%)

Based on the data obtained, it is found that 37,6% of students aged 15–17 spend on movement activity of high intensity more than 2 hours per week. Among young men, this indicator was significantly larger and amounted to 46,9%, while among girls it was at the level of 28,8%. The difference in rates between young men and girls was 18,1%.

Less was the difference in the rates of responses received among respondents who spend on high-intensity movement activity from 1 to 2 hours per week. These figures were 21,3% among young men and 29,6% among girls. The overall indicator was 25,6%.

The time for movement activity of high intensity from 30 minutes to 1 hour per week was declared by only 18,5% of respondents. Difference between the responses of girls and boys was not significant and amounted to 0,9%.

A similar indicator with a time expenditure of up to 30 minutes per week was 18,4%. In this case, there was a difference in gender-based responses: among young men the figure was 13,8%, among girls – 22,7%, the difference in indices was 8,9%.

An uncomplicated analysis allows us to state that in general 36.9% of secondary general school pupils at 15–17 years of age spend on movement activity of high intensity not more than 1 hour per week. The cumulative index of students who spend on such activity is not more than 2 hours per week, is 62,5%. At the same time among girls this indicator reaches the level of 71,2%, whereas among young men it is 53,6%.

The obtained data show that children, whose intensive movement activity is not more than 2 hours per week, are not involved in systematic training of health-training orientation. It can be concluded that a significant proportion of students in the 10–11 grades do not attend the sections and circles of the sports and sports area, or such forms of physical education do not provide the proper level of movement activity. In this context, we recall the well-known axiom about the need for at least 3 training sessions a week to achieve a positive impact on the development of the child's body.

At the second stage of the study, the most common forms of movement activity among the specified group of children were determined. Students were asked to answer this question: "In what way do you usually engage in movement activity in your spare time?". The results are shown in Fig. 3.

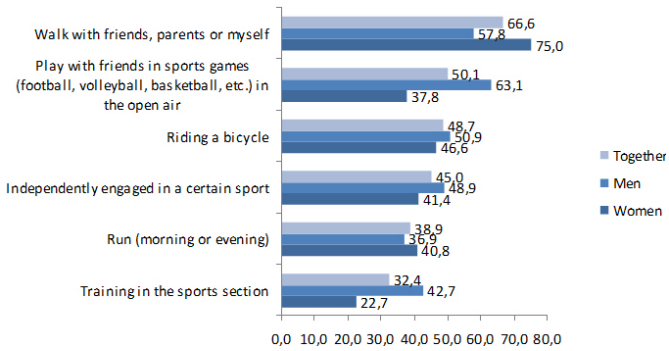

Fig. 3. Forms of embodiment of movement activity by students 15–17 years old in his spare time

Analyzing respondents' answers, we should first of all note the marked differences in gender. So, the most common form of movement activity in their free time among girls were walks, which are carried out with friends, parents or independently. This was indicated by 75% of the surveyed girls. Among young men this form of movement activity was less popular, it was indicated by 57,8% of respondents. The overall indicator was 66,6% of the respondents.

Male respondents were the most popular form of movement activity in their spare time, defined "sports games in the fresh air". This option was chosen by 63,1% of respondents. Among the girls, the mentioned form of movement activity turned out to be only the fifth in popularity, having received 37,8%. The difference in the answers between young men and girls was 25,3%.

In general, three of the most popular recreational forms of movement activity among young men included: outdoor games (63,1%), walks (57,8%) and cycling (50,9%). Among the girls, the similar distribution was as follows: walks (75%), cycling (46,6%), and self-employment in certain sports (41,4%).

It should be noted that the implementation of these forms of movement activity may be hampered by unfavorable weather conditions, especially in the autumn-winter period, which, probably, will affect the systematic nature of their implementation.

An analysis of the response rate for the involvement of pupils of the 10–11th grades in the sports sections showed 32,4% of the participants, with such a gender distribution: 42,7% among young men and 22,7% among girls. Comparison of the obtained data with the data of the week level of the movement activity of high intensity of students aged 15–17 years shows that the obtained data, both in general and taking into gender account, differ at the level of statistical error. This fact, in our opinion, confirms the correctness of the data obtained and once again confirms that the majority of pupils of the senior school age are not involved in systematic movement activity.

The above data show that practically all forms of movement activity at leisure, not counting outdoor walks, imply the performance of movement actions using elements of certain sports. That is why it is important to establish what kinds of sports students of senior school age enjoy doing at their leisure. It should be noted that, in response to the so-called "open" questions, respondents indicated a total of 58 types of sports that they do in their spare time. The vast majority of the above options, while receiving an indicator of no higher 3%. The results obtained also showed certain differences in preferences among young men and women (table 1).

Among the male respondents in the top three most popular sports that are cultivated at leisure included football (42,2%), volleyball (19,1%) and basketball (12,4%). These data coincide with the results of common forms of movement activity at leisure, among which the young men called it games in the open air. In turn, the responses of the girls were distributed as follows: volleyball (22,7%), cycling (12,6%) and running (12,4%).

As can be seen from the table, almost 14% of young men and girls aged 15–17 years did not specify any sport that they regularly or occasionally engage in their spare time. Obviously, such students are likely not at all engaged in some kind of sport in their spare time.

Regarding the sports that were the most popular among students in the 10–11 grades, it is worth noting that they are usually the most common among the variational modules that are implemented as part of the curriculum at physical education classes in general schools. The popularity of these sports can be provided by the existing infrastructure, because the equipment of most sports grounds allows you to engage in these sports.

Conclusions

In general, 75.5% of secondary general school pupils at 15–17 years of age three times a week or more often engage in movement activity lasting not less than 30 min. Every day 40,6% of school pupils exercise this movement activity. Among girls this indicator is 35,1%, among young men – 46,4%.

It is established that 37,6% of students aged 15–17 spend on movement activity of high intensity for more than 2 hours a week. Among young men this figure is 46,9%, among girls – 28,8%.

Table 1

The most popular sports, which are engaged in the leisure, students 15–17 years old

Men			Women		
№	Type of sport	(%)	№	Type of sport	(%)
1.	Football	42,2	1.	Volleyball	22,7
2.	Volleyball	19,1	2.	Not specified us one	13,9
3.	Not specified us one	13,8	3.	Cycling	12,6
4.	Basketball	12,4	4.	Running	12,4
5.	Cycling	9,6	5.	Football	12,0

The proportion of students aged 15–17 years who spend on movement activity of high intensity no more than 2 hours per week is 62,5%. Among girls this indicator reaches the level of 71,2%, among young men it is 53,6%.

The most popular forms of movement activity, which are carried out at leisure, among the young men there are: outdoor games (63,1%), walks (57,8%) and cycling (50,9%). Among the girls, the distribution of these forms was as follows: walks (75%), cycling (46,6%), and self-employment in certain sports (41,4%).

The most common kinds of sports that young men in the age of 15–17 prefer in their spare time are: football (42,2%), volleyball (19,1%) and basketball (12,4%). Girls aged 15–17 in their spare time are engaged in sports such as volleyball (22,7%) and cycling (12,6%). 12,4% of girls at leisure are engaged in running.

Prospects for further research in this direction

Further studies will be aimed at detailing the characteristics of movement activity in their spare time, taking into account not only the age and sex characteristics, but also the level of health of students in general education schools. In addition, the factors determining the movement activity of students in their spare time should be established, as well as the wishes of the children themselves regarding the desired forms of exercising such movement activity.

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Information about the Authors

Andriy Mandyuk: *Lviv State University of Physical Culture, 11, Kostushko str., 79000, Lviv, Ukraine.*
ORCID.ORG/0000-0002-9322-8201
E-mail: a.b.mandyuk@gmail.com

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An influence of sensorimotor coordination at the technical preparedness of young athletes in rhythmic gymnastics

Alla Mullagildina

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Purpose: *to reveal the influence of the level of development of sensorimotor coordination of gymnasts 8–9 years on technical preparedness in exercise with clubs.*

Material & Methods: *tested ten gymnasts for 8–9 years on eleven test exercises with clubs, revealed the level of differentiation of muscular effort and reproduction of the time interval, statistical and correlation analysis of the data was carried out.*

Results: *close correlation relations of the marks for the performance of the competitive exercise with clubs are revealed with accuracy of reproduction of the time interval (r=0,7); heteronymic circles: in front – a large facial, behind the head – medium (r=0,7); with catching the clubs in two hands on the jump "touching" after throwing the left (r=0,7).*

Conclusion: *to perform basic exercises with clubs gymnasts affect the ability to analyze spatial-temporal characteristics of motions, differentiation own muscular effort proprioceptive sensitivity and anticipation.*

Keywords: *sensorimotor coordination, gymnasts, technical preparedness, exercise with clubs.*

Introduction

A distinctive feature of rhythmic gymnastics are exercises with objects. Experts point to the ever-growing complexity of elements with objects performed by athletes in rhythmic gymnastics [2]. Rapid complication of the technique of the sport determines the increased requirements to the level of development of the coordination abilities of the gymnasts. In accordance with the research of N. A. Bernshtein [4] – the coordination of movements is built on the restriction of excessive degrees of freedom of our body, that is, their ordering and transformation into a controlled system of simple or complex movements based on sensory corrections. The specificity of rhythmic gymnastics requires from athletes a high level of sensorimotor coordination, response coordinated at the level of sensations of motor reactions to the perceived moving object with a clear idea of the positions of the links of its own body.

Analysis of the special literature on rhythmic gymnastics indicates that at present the number of studies devoted to the development of increases of gymnasts coordination abilities [1; 3; 8]. The problem of the technology of development of sensory systems in combination with the indicators of other types of training athletes is quite complex and requires in-depth study [5; 6; 7]. Stage of preliminary basic training in rhythmic gymnastics falls on the sensitive age of girls for the development of sensorimotor coordination. Gymnasts 8–9 years old are distinguished by high plasticity of the organism, increased ability to learn [2].

The relationship of research with scientific programs, plans, themes

The research was carried out in accordance with the initiative theme of the department of dance sports, fitness and gymnastics: "Model characteristics of special physical fitness of athletes in sports kinds of gymnastics»

The purpose of the research

To reveal the influence of the level of development of sensorimotor coordination of gymnasts 8–9 years on technical preparedness in exercise with clubs.

Objectives of the study:

1. Determine the primary manifestation of coordination abilities in performing basic exercises with clubs for athletes 8–9 years.

2. Identify the effect of sensorimotor coordination at the technical preparedness of young gymnasts.

Material and Methods of the research

Composed of eleven test exercises with clubs, three sensory test are selected, conducted tests of ten gymnasts 8–9 years. Statistical and correlation analysis of the data obtained.

Results of the research and their discussion

A testing program was developed to determine the level of coordination abilities that girls need to perform basic exercises with clubs, as provided by this stage of training in the Sports School. The testing program included typical exercises performed by athletes with clubs, namely the variety of circles, "mills", various throws, juggling, also the skills required for simultaneous work with two objects. Based on the results of

the motor tests, the gymnasts determined the level of development of abilities to analyze the space-time characteristics of movements, to differentiate their own muscular effort, proprioceptive sensitivity and anticipation.

Athletes have coped well with the basic element – the performance of various circles with clubs (6 points). Lower results were shown by young gymnasts in the context of complicating the basic elements by maintaining balance and performing different work with the right and left hands (5,5 points). In performing asymmetric movements with two hands in different planes and with different amplitude, the gymnast performed much better when working with the right hand than the left one (5,4 and 4,6 points respectively). Athletes showed good results in performing an elementary throw and catching the clubs in two hands (6,3 points). In the performance of successive symmetrical hands movements, circular mills athletes admitted inaccuracies (5,9 points). Gymnasts did a good job in combining the work of the body and the object, in catching the clubs in the jump "touching" (6 points; V – 15%). However, there were significant shortcomings in this exercise with prevailing left-handed – 4,9 points. There were also shortcomings in juggling clubs with left hands (5,4 and 4,6 points respectively). There were significant differences between the individual results of gymnasts, the total average values for eleven tests: from 4,0 points to 7,1 points. The shortcomings are indicated by the minimum estimates in the group: from 1 point to 5 points (table 1).

It is well known that the better the ability of gymnasts to manage movements in time and in terms of the degree of muscular effort, the more effectively the process of their special preparation. With the athletes testing of the accuracy of reproduction of the time interval (ARTI) was carried out, the ability of subjective time counting was determined (Fig. 1).

Figure 1 shows the results of testing athletes in the accuracy of muscular effort by 50% of the previous maximum effort by right and left hand. The error in the accuracy of the muscular effort was: right arm – from 0 kg to 4,5 kg, left arm – from 0,1 kg to 3,8 kg. It should be noted that the mean error in the differentiation of muscular effort with the right hand is greater than the left one (2,48 kg, 1,6 kg). As a result of testing the subjective time counting abilities, it was determined that, on average, deviations in the reproduction of a ten-second interval in gymnasts amounted to: from 1,6 s to 4,3 s. Athletes test

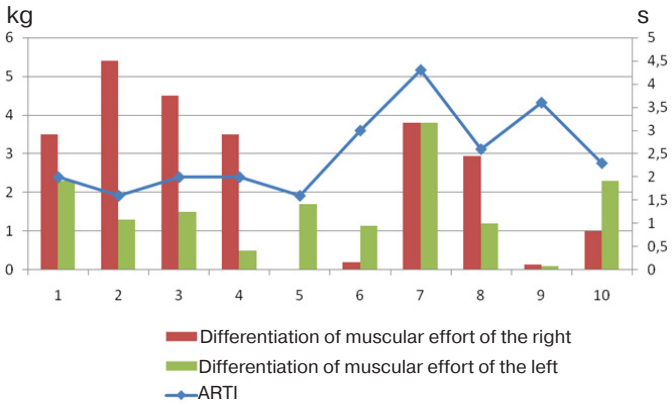

Fig. 1. Results of testing the accuracy of muscle effort and the accuracy of reproduction of the time interval

group had a greater tendency to shorten the time interval.

As a result of the correlation analysis of the studied indicators, it was revealed that the result obtained by the gymnasts at the school championship for the exercise with clubs, has close correlation with the estimates: dumping two clubs from the shoulders in the front balance (r=0,7); juggling clubs right (r=0,7) and left (r=0,8) hands. Significant correlations results of the school's championship were revealed with throws and catching of clubs in two hands (r=0,6); with catching in two hands in the jump "touching" after throwing the left (r=0,6); with accuracy of reproduction of the time interval (r=0,6); differentiation of muscular effort right (r=0,6).

Thus, young athletes showed the best results in small throws with clubs, in performing symmetrical circles with two clubs, in an elementary throw and catching two clubs. With the complication of typical work with an object with unstable balance, asymmetrical movements of hands, movements of various parts of one's own body, gymnasts had problems, and they made mistakes. Technical mistakes athletes are interlinked with the level of development of their coordination abilities, namely with the ability to analyze the space-time characteristics of movements, the differentiation of their own muscle effort, proprioceptive sensitivity and anticipation.

At the training in the children's and youth sports school gym-

Table 1

Results of testing the coordination abilities of athletes in exercises with clubs

Test	Result				
	Points*	Σ	V	min	max
1. Side circles (large, medium back, small forward)	6	1,56	26	3	8
2. Resetting two clubs from the shoulders in front balance	5,5	1,84	33	3	8
3. Varied circles: in front – Varied circles: in front – medium	5,5	1,65	30	3	8
4 Left small circles in the horizontal plane; Right – a large lateral circle forward	5,4	1,84	34	2	8
5. Right small circles in a horizontal plane; Left – a large lateral circle forward	4,6	1,58	34	1	7
6. Throw in the horizontal plane of two clubs. Catching in two hands.	6,3	1,25	19	4	8
7. "Circular mill" (hands up)	5,9	1,60	27	4	8
8. Catching in two hands in the jump "touching" after throwing the right	6	0,94	15	5	8
9. Catching in two hands on the jump «touching» after throwing the left	4,9	1,37	27	3	6
10. "Juggling", starting with the right hand	6,8	1,75	25	4	9
11. "Juggling", starting with the left hand	5,8	1,99	34	2	8

Note. ** – maximum number of points – 10.*

nasts are given one hour to warm up and prepare an individual program, the next two hours – to perform the first kind of all-around and workout the second type of all-around. At each training session, the gymnast, according to the instruction of the coach, was warming up at an intense, rapid pace, thereby reducing her. Thanks to this, 15 minutes were freed for additional work on the development of the coordination abilities required when performing elements with clubs. To develop coordination abilities, complexes of exercises without object and with object were made. In exercises without the object of the gymnast performed gradually increasing tasks for statodynamic stability, orientation in space, coordination of movements in different parts of the body, differentiation of muscle effort, sense of time, proprioceptive sensitivity and anticipation. Complexes began with general exercises, for example: the rotation of the head to the left; hands up, balance on two legs on the half-toes with closed eyes (10 accounts). Complexes of exercises without an object included elements of choreography, acrobatics, connections of body elements of various structural groups. Complexes of exercises with clubs included rolls, small throws, small throws of clubs, "semicircular mills", "street", throws of one mace, large throws, transfer in pairs, "mills" in various planes. Movements were performed from ten to twenty repetitions with increasing tempo. Complexes of exercises were applied at each training session for 1,5 months. As the exercises were assimilated and the coordination abilities of the young athletes improved, the tasks became more complicated. In the future, training combinations with clubs were composed, which included exercises from testing and elements, ligaments from the competition programs of gymnasts. The training combinations were also applied for 1,5 months on each training, the repetition of each combination – on average 2–3 times per training session.

According to the control estimation of competitive exercise with clubs was held end of the experiment. Judging was carried out in accordance with the rules of the competition. Table 2 shows the ratings of athletes according to the results of the competition in exercise with clubs at school championship rankings after control estimations, as well as the dynamics of the studied test results (table 2).

In figure 2, the number of athletes on the horizontal axis corresponds to the ratings obtained after the control training in the competition exercise with clubs. The two athletes who are the first in the ranking clearly see significant improvements in the indicators of sensory systems, namely, in improving the reproduction of the time interval by 1,7 s and 1 s, in differentiating the muscular effort on 4,1 kg and 4,2 kg (Fig. 2).

A correlation analysis was made of the results of repeated

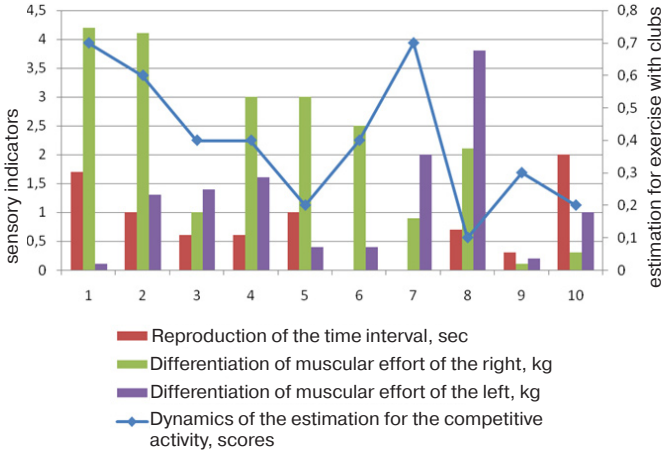

Fig. 2. Competitive ratings and changes in sensory parameters of gymnasts

testing with the marks received by gymnasts for a competitive exercise with clubs. The level of technical training of gymnasts, the evaluation of the performance of the competitive combination in the control training, has close correlation with the result for unlike circles: in front – a large front, behind the head – medium (r=0,7); with the result for catching the clubs in two hands on the jump "touching" after throwing the left (r=0,7) and with the accuracy of reproduction of the time interval (r=0,7). Significant correlations between the results of the school championship with the result for the dumping of two clubs from the shoulders in the front balance (r=0.6); with differentiation of muscular efforts of the left were revealed (r=0,4).

Thus, the analysis of the data obtained confirms that the level of technical preparedness of young gymnasts is interrelated with the level of development of their sensorimotor coordination, namely with the ability to analyze the space-time characteristics of the movements of the object and the links of one's own body, proprioceptive sensitivity and anticipation.

Conclusions

1. To perform basic exercises with clubs gymnasts need to have a high level of coordination abilities, namely the coor-

Table 2
Dynamics of the test results

Controlled indicators	Results, ratings									
	1	2	3	4	5	6	7	8	9	10
School championship, points	7,5	7,8	7,8	7,4	7,6	7	7,2	7,1	7	6,8
Ratings at the school championship	**4**	**1**	**2**	**5**	**3**	**8**	**6**	**7**	**9**	**10**
Control training, points	7,9	8,4	8,5	7,6	8	7,2	7,3	7,5	7,3	7,5
Ratings after control training	**4**	**2**	**1**	**5**	**3**	**10**	**8**	**6**	**9**	**7**
Dynamics of the marks for the competitive exercise, points	0,4	0,6	0,7	0,2	0,4	0,2	0,1	0,4	0,3	0,7
Dynamics of ratings in tests with clubs, points	1,55	1,64	1,45	1,82	1,91	1,55	1,91	2	1,64	1,64
Changes in the reproduction of the time interval, s	0,6	1	1,7	1	0,6	2	0,7	0	0,3	0
Changes in the differentiation of the muscular effort of the right, kg	3	4,1	4,2	3	1	0,3	2,1	2,5	0,1	0,9
Changes in the differentiation of the muscular effort of the left, kg	1,6	1,3	0,1	0,4	1,4	1	3,8	0,4	0,2	2

dination of symmetrical and asymmetric movements of both hands complicated by the movement of their own parts of the body and the movement of the object.

2. Close correlation links between the level of technical preparedness of gymnasts and the manifestation of their sensorimotor coordination have been revealed: the accuracy of reproduction of the time interval (r=0,7); Control asymmetrical movements of hands (unlike circles: in front - large facial, behind the head – medium) (r=0,7); with the analysis of the space-time characteristics of the movements of one's own body and object (catching the clubs in two hands on the jump "touching" after throwing the left) (r=0,7).

Prospects for further research in this direction suggest an analysis of the manifestation of the predominant coordination abilities of gymnasts in working with other subjects of gymnastic all-around.

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Information about the Authors

Alla Mullagildina: *Ph.D. (Pedagogical), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivska 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0002-9232-6387
E-mail: gimnastika.sokol@mail.ru

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An interconnection between morphological and functional development of highly trained swimmers and a result of overcoming different length distances by means of the butterfly stroke

Olga Pilipko
Alina Pilipko

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Purpose: *to investigate the influence of indicators of morpho-functional development of highly trained swimmers on the result of overcoming different length distances by means of the butterfly stroke.*

Material & Methods: *analysis of scientific and methodical literature, timing, measurement of morphological and functional indicators using individual techniques, methods of mathematical statistics. Contingent surveyed accounted for athletes who specialize in the distances of 50, 100 and 200 meters by means of the butterfly stroke and had a level of sports qualification: master of sports, international class master of sports.*

Results: *the authors determined the relationship between the degree of correlation of morphological and functional performance highly trained swimmers and sports results at distances of 50, 100 and 200 meters by means butterfly stroke; investigated the significance of morpho-functional indicators, depending on the length of the competitive distance.*

Conclusion: *significance of the indicators of anthropometric development and the functional state of athletes who specialize in swimming by means butterfly stroke differs depending on the length of the competitive distance. The definition of distance specialization of athletes by means butterfly stroke should be carried out taking into account the indicators of morpho-functional development, which most significantly affect the result of overcoming the distances of 50, 100 and 200 meters.*

Keywords: *butterfly stroke*, *athletes*, *distance*, *morphological and functional indicators*, *results*, *interconnection.*

Introduction

The problem of sports selection and orientation in the system of training highly trained athletes is one of the most important [2; 8; 10; 13].

The likelihood that the process of sports improvement unfolds in the optimal version depends largely on the stage at which the individual age development manifests a propensity for progress in a particular sport and, in accordance with it, the formation of the mainstream focus of sports activity, the selection of promising ways for its implementation [6; 11]. These circumstances, as well as the changes that occur in modern sports, have made the relevance of the problem of sports selection and orientation in its research and organizational and practical aspects.

Analysis of the literature sources made it possible to conclude that in the field of sport swimming considerable attention is paid to selection and sports orientation on the basis of taking into account individual features of the swimmers body structure [1; 3; 7].

Specialists proved that representatives of different constitutional types have different range of skills in the motor area, which are responsible for the success in every swimming styles and on every swimming race [3; 10]. In this regard, the morpho-functional characteristics of athletes are studied in depth and in a variety of ways, model characteristics are developed that serve as a guide for selection and orientation in sport swimming [4; 5; 9; 12].

At the same time, the practice of sport of higher achievements in the conditions of intensification of training and competitive activity has undergone a number of significant changes in recent years, which could not but leave an imprint on the morpho-functional characteristics of modern swimmers. Expanding the program of competitions, increasing the number of starts per year, the need for a combination of basic and additional distances – all this requires a more clear and scientifically sound definition of the athlete's distance specialization. So there is a need to conduct scientific research in this field with a view to further correction.

The relationship of research with scientific programs, plans, themes

The research was carried out in accordance with the theme of the Master Plan of Research in the field of physical culture and sports for 2011–2015: "Modeling of technical and tactical actions of qualified athletes in swimming and speed-strength disciplines of track and field athletics».

The purpose of the research

To investigate the influence of indicators of morpho-function-

al development of highly trained swimmers on the result of overcoming different length distances by means of the butterfly stroke.

Objectives of the study:

1. Determine the degree of correlation correlation between the morpho-functional indicators of swimmers of high qualification and the athletic result at distances of 50, 100 and 200 meters by means of the butterfly stroke.

2. To study the importance of morpho-functional indicators depending on the length of the race distance by means of the butterfly stroke.

3. To identify the most significant parameters of the morpho-functional development of athletes who specialize in swimming by means of the butterfly stroke at distances of 50, 100 and 200 meters.

Material and Methods of the research

To achieve the objectives were used: analysis of scientific and methodical literature, timekeeping; measurement of morpho-functional indicators using private techniques; methods of mathematical statistics.

The research was carried out during the championships and National Swimming Cups of Ukraine in the period from 2014 to 2016.

The contingents of the surveyed were athletes who specialized in distances of 50, 100 and 200 meters by means of the butterfly stroke. The total number of surveyed – 24 swimmers. Level of sports qualification: master of sports, international class master of sports.

Results of the research and their discussion

The conducted correlation analysis made it possible to reveal the degree of interrelation between the indicators of the morpho-functional development of swimmers with the sports result at distances of different length by means of the butterfly stroke.

Among the investigated parameters that significantly affect the result of overcoming the distance of 50 meters, such contact indicators were defined as VC and heart rate at rest (R equal to 0,62 and 0,60 respectively) (Fig. 1). Less important for this distance are such parameters as the downward slope, the weight of the athlete's body, the width of the shoulders, the girth of the ankle, the arm circumference in the stressed state, the linear dimensions of the thigh and the trunk.

The result of swimming distance of 100 meters by means of the butterfly stroke is significantly affected by the ankle's circumference (R=–0,76). The average degree of correlation relationship observed in parameters such as the width of the hip and VC (R is respectively –0,55 and –0,52). To a lesser extent the result affect coverage shin and knee, shoulder width, the heart rate after exercise, at rest and after sleep, arm length, and lower leg, arm span, the width of the foot and hand, shoulder girth under tension (Fig. 2).

The most significant at a distance of 200 meters are the parameters of chest circumference (on exhalation, on inspiration, at rest), heart rate after sleep, shoulder width, waist circumference, shoulder and foot length (R values fluctuate within – 0,91–0,79). Average influence on the result is such parameters as body weight, circumferential sizes of the but-

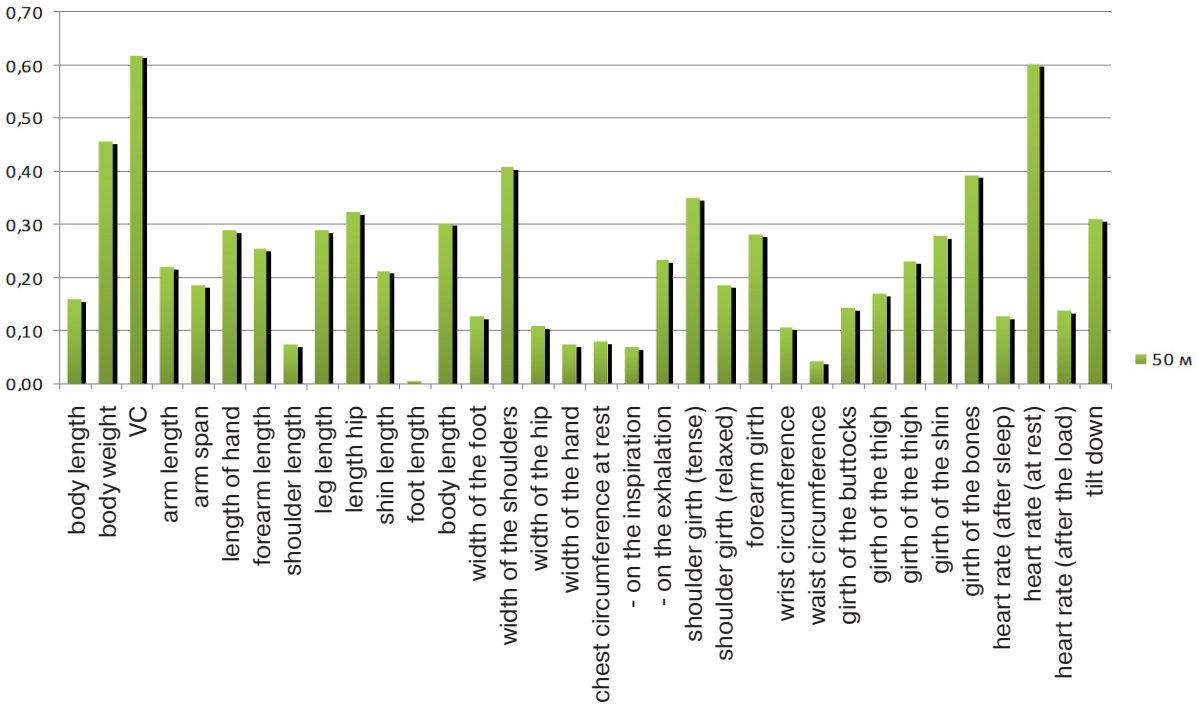

Fig. 1. The degree of the correlation relationship between the morpho-functional performance swimmers and sports results at a distance of 50 meters by means of the butterfly stroke

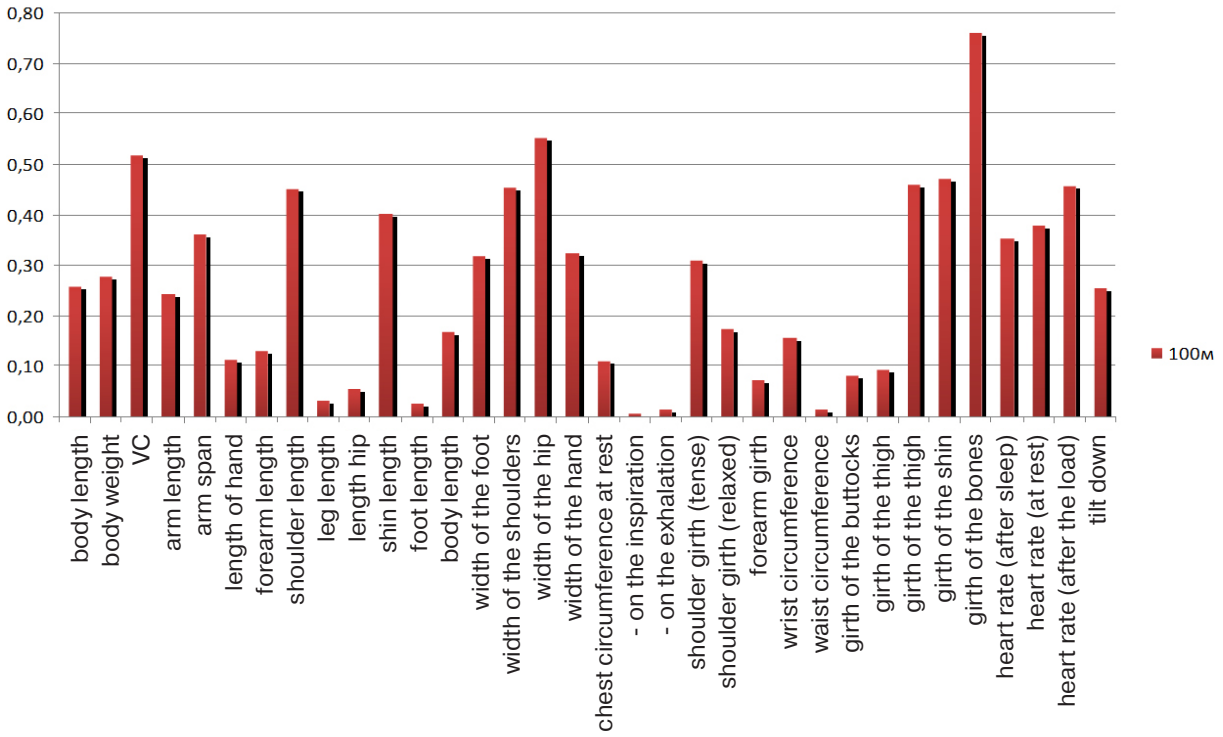

Fig. 2. The degree of the correlation relationship between the morpho-functional performance swimmers and sports results at a distance of 100 meters by means of the butterfly stroke

tocks and shin, VC and the body length (the R values are equal, respectively –0,67, –0,62, –0,59, –0,55, 0,52). To a small extent, the linear dimensions of the hip, arms, legs, legs and trunk, forearm, shoulder (in tension and relaxed states), knee and ankle, as well as the width of the pelvis, hand and foot (fig. 3).

Thus, it can be argued that in the by means of the butterfly stroke the significance of the indicators of anthropometric development and functional condition of athletes differs depending on the length of the race distance.

Attention is drawn to the fact that as the length of the distance increases, the number of indicators that significantly affect the athletic result increases.

Considering the influence of significant morpho-functional parameters on the result of swimming distances of 50, 100 and 200 meters, it became possible to divide them into several groups:

– indicators are equally important at all distances, regardless of their length;
– indicators, the importance of which decreases with increasing distance length;
– indicators, whose influence increases simultaneously with the increase in the competitive distance;
– indicators that have a close degree of correlation relationship with the sports result only at separate distances (tab. 1).

As can be seen from table 1, such an indicator as VC equally affects the result of overcoming distances by means of the butterfly stroke regardless of their length.

Table 1

Degree of correlation relationship between morpho-functional indicators of swimmers of high qualification and sporting result at distances of different length by means of the butterfly stroke

№ c/u	Indicators	Value of the correlation coefficient		
		50 m	100 m	200 m
1.	Body length	–0,16	0,26	0,52
2.	Body weight	–0,46	–0,28	–0,67
3.	VC	–0,62	–0,52	–0,55
4.	Arm span	–0,19	0,36	–0,69
5.	Shoulder length	0,07	0,45	–0,82
6.	Foot length	0,01	0,03	–0,79
7.	Width of the shoulders	0,41	0,45	–0,85
8.	Width of the hip	–0,11	–0,55	–0,49
9.	Chest circumference	–0,08	0,11	–0,84
10.	Waist circumference	–0,04	–0,01	–0,83
11.	girth of the buttocks	0,14	0,08	–0,62
12.	girth of the shin	–0,28	–0,47	–0,59
13.	Girth of the ankle	–0,39	–0,76	–0,32
14.	Heart rate (after sleep)	–0,13	–0,35	–0,87
15.	Heart rate (at rest)	0,60	–0,38	–0,28
16.	Heart rate (after the load)	0,14	–0,46	0,05

The importance of the parameter «Heart rate at rest» decreases with the length of the distance.

Influence on the athletic result of such indicators as body length, the range of the arms, the length of the shoulder and foot, the width of the shoulders, the circumference of the shank and chest at rest, and the values of the heart rate after sleep increases along with the length of the distance.

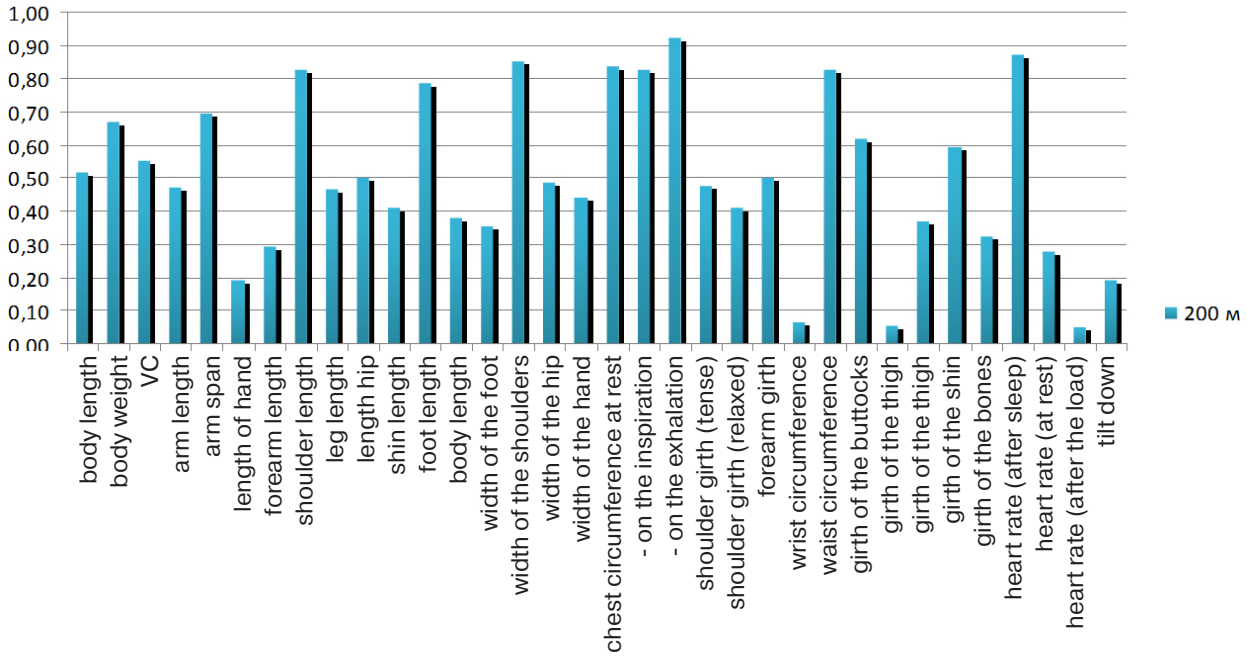

Fig. 3. The degree of the correlation relationship between the morpho-functional performance swimmers and sports results at a distance of 200 meters by means of the butterfly stroke

In turn, such a parameter as body weight predominantly affects only the result of overcoming the 50 and 200-meter segments; hip width and shin girth important for distances of 100 and 200 meters; girth of the waist and buttocks closely correlate with the result of the swimming of the 200-meter stretch; «heart rate after load» index is only relevant for a distance of 100 meters by means of the butterfly stroke.

Thus, when choosing a swimmer's distance specialization by means of the butterfly stroke, the trainer needs to pay attention to various indicators of the anthropometric development and functional state of the athlete, giving preference to the fact that they are most closely correlated with the result of overcoming the distances of 50, 100 or 200 meters

Conclusions

1. Result in swimming is closely related to the indicators of anthropometric development and functional condition of athlete.

2. Degree of correlation correlation between the morpho-functional indicators and result by means of the butterfly stroke differs significantly depending on the distance of the race distance.

3. Importance of morpho-functional parameters varies depending on the length of the race distance.

4. On the results of overcoming the distance of 50 meters are most influenced by parameters such as VC and heart rate at rest (R is equal to 0,62 and 0,62, respectively 0,60). At a distance of 100 meters important is the girth of the ankle (R=–0,76). The most significant at a distance of 200 meters are the parameters of chest coverage, heart rate after sleep, shoulder width, waist circumference, shoulder length and foot (R values vary within 0,91–0,79).

5. Definition of the distance specialization of an athlete by means of the butterfly stroke should be carried out taking into account the indicators of morpho-functional development, most significantly affecting the result of overcoming the distances of 50, 100 and 200 meters.

Prospects for further research in development of model characteristics of the structure of competitive activities and the special preparedness of highly qualified athletes specializing by means of the butterfly stroke at various lengths distances.

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Information about the Authors

Olga Pilipko: *PhD (Pedagogical), Assosiate Professor; Kharkiv State Academy of Physical Culture: Klochkivska 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0001-8603-3206
E-mail: pilipkoolga@meta.ua

Alina Pilipko: *Kharkiv State Academy of Physical Culture: Klochkivska 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0003-0421-9977
E-mail: alin4ik209@meta.ua

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Morphological and functional indicators of 10–13 year-old adolescents with the scoliosis of I–II degree

Anastasia Podolyaka
Oleg Podolyaka
Ruslan Iskandarov

Federal State Educational Institution of Higher Professional Education Cherepovets State University, Cherepovets, Russia

Purpose: *to study the features of morphological and functional indicators of 10–13 year-old adolescents suffering with the scoliosis of I–II degree, to determine the main directions in the preparation of comprehensive rehabilitation programs for improving posture in children.*

Material & Methods: *based on the analysis of the specialized literature and the generalization of the obtained data of the conducted study of 42 school-age children, which are divided into two groups – the basic (with scoliosis deformation of the spine) and the control (practically healthy children of the same age), the main directions for the compilation of comprehensive rehabilitation programs.*

Results*: It established the fact of violations of the cardiovascular and respiratory systems in children with scoliosis. Indicators of boys and girls have different directions.*

Conclusion: *preparation of corrective programs requires not only the formation and consolidation of the habit of correct posture, the creation of a muscular corset, but also the focus on improving the development of a cardiovascular and respiratory systems with a special approach to children of different sexes.*

Keywords: *scoliosis, pupils, morphological and functional indicators.*

Introduction

Problems of formation, preservation and strengthening of health of adolescence, propagation of a healthy lifestyle, rehabilitation of existing deviations from normal development have always been and remain a priority in any modern society. Scoliosis, as one of the types of curvature of the spine, is today a fairly common problem, which will subsequently occur even more often, doctor's state. [3]. Scoliosis is usually formed and progresses during active growth of the body in adolescence, especially during growth spikes in puberty. Traditionally it is believed that the cause of scoliosis is unknown in 80% of cases, in the remaining 20% it is a consequence of congenital deformations of the vertebrae [7].

There are a number of works on the formation of posture, the study of the impact of impaired posture and scoliosis on the functions of the body of children of different age groups, in which scientists point to the progression of spinal deformity at school age. The growth in this period, the static load and a decrease in motor activity, due to the learning process at school, leads to a reduction in the functional state of the musculoskeletal system, stimulates and strengthens the spine deformation [11; 12]. Despite the existence of numerous studies, available scientific data lead to various characteristics of physical and functional changes occurring in the child's body due to the appearance of scoliosis, sometimes even contradictory. Therefore, the question of further studies of children with scoliosis and the changes occurring in their body, is relevant.

The purpose of the research

To study the features of morphological and functional indicators of 10–13 year-old adolescents suffering with the scoliosis of I–II degree, to determine the main directions in the preparation of comprehensive rehabilitation programs for improving posture in children.

To achieve this purpose, the following tasks were identified:

1) to analyze and summarize the data of the special literature on the study of morphological and functional indices of the musculoskeletal system in adolescents aged 10–13 and in the treatment of scoliosis;

2) to determine the main directions for compiling comprehensive rehabilitation programs for improving the bearing in children.

Material and Methods of the research

The main following methods were used: theoretical analysis and synthesis literature data; comparison of morphological and functional indicators of adolescents 10–13 years of age; mathematical statistics for processing received data.

For the study of morphological and functional indices, 42 children of school age were studied, which were divided into two groups – the main (MG) and control (CG). The main group in-

cluded 20 children 10–13 years age with scoliotic deformity of the spine of I–II degrees (8 boys and 12 girls), in the control group – 20 practically healthy children of school age (10 boys and 10 girls). All children were subjected to anthropometric measurements with determination of body weight, height, chest circumference (CC), chest excursion (CE), Rohrer and Pinje indices were calculated, the functional state of the cardiovascular system was determined by heart rate at rest (HR), Respiratory system (Stange and Genci tests). The resulting study MG and CG parameters were compared, and the probability of differences was determined by Student's t test (tab. 1).

Results of the research and their discussion

Theoretical analysis and generalization of the specialized literature allow us to talk about the main points of getting rid of scoliosis [1; 5; 6; 8; 12].

Modern concepts of scoliosis treated as a disease, the basis of which there are violations of exchange of the connective tissue system, under which the locomotor's system occurs scoliosis deformity of the spine, leading to deformation of the hip, legs, chest, head,. It affects not only the formation of bone structures, their interrelation, the morphology and functional state of other systems, in particular, the nervous system, chest organs, abdomen [10].

In connection with the limitation of the volume of muscular activity, pronounced atrophic and dystrophic changes are observed, motor skills and coordination of movements occur [12]. The results of scientific research [4] and the experience of a number of European countries [2; 13] convincingly show that increasing the motor activity of the child and the proper planning of physical rehabilitation solves a number of problems associated with the incidence and prevalence of deformation of the musculoskeletal system, significantly increases the resistance of children to various kinds of adverse environmental factors.

As a result of statistical analysis of anthropometric measurements found that children with scoliosis observed a significant ($p<0.05$) increase in average body weight in girls and height at boys and girls. Accordingly, in children with scoliosis a significant increase in the indices of the Rohrer and Pinje indices ($p<0,05$). Anthropometric indices exceed the age norms [9] to a greater extent in children with scoliosis. There is a significant deterioration in CC parameters, although CE corresponds to the norm, which indicates the limited movement of the chest due to the pathological process. As a consequence of the foregoing, heart rate in children with scoliosis is significantly greater ($p<0,05$) compared with healthy, both in boys and girls.

The average indices of the Pinje index of both groups of children show an approximation to the "hypersthenic" (brachymorphic) type of physique, although they have a significant difference between the groups, which indicates an obvious unevenness of almost all indicators.

Samples with a delayed respiration showed that in healthy children 10–13 years of age the functional state of the respiratory system corresponds to the age norm, the values obtained for the Stange and Gentcha test parameters were within the limits of normal values. In children with scoliosis (both in boys and girls), the mean values of respiratory retention on inspiration and exhalation were significantly less than those in healthy children ($p<0,05$).

The average results of a group of practically healthy children were taken as a basis for determining the positive or negative difference in the percentage of results of children with scoliosis (Fig. 1).

Table 1

Indicators of morphological and functional features of children 10–13 years old (M±m)

	Indicators	Practically healthy children, n=20	Children with scoliosis I-II degree, n=22
Boys	Height, cm	148,8±1,40	152,4±0,77*
	Body weight, kg	45,5±1,15	47,1±1,39
	CC, cm	67,2±0,74	69,9±1,27
	CE, cm	4,85±0,12	2,05±1,54*
	Rohrer index, kg cm^{-3} ·	12,7±0,7	13,9±1,2*
	Pinje Index, cond. units	32,7±4,89	33,8±1,35*
	HR, beats.·min^{-1}	72,5±0,85	82,9±2,02*
	Stange test, s	47,4±4,82	45,9±3,64*
	Genci's test, s	25,7±2,43	23,2±3,04*
Girls	Height, cm	150,2±0,65	155,8±1,56*
	Body weight, kg	47,2±2,29	42,7±1,45*
	CC, cm	65,3±1,40	60,4±2,43*
	CE, cm	3,8±1,52	2,35±2,33*
	Rohrer index, kg cm^{-3} ·	13,9±0,7	11,3±2,5*
	Pine Index, cond. units	32,8±3,68	35,0±1,85*
	HR, beats.·min^{-1}	73,0±1,41	85,6±2,12*
	Stange test, s	43,9±3,13	39,2±2,45*
	Genci's test, s	24,0±2,92	23,7±1,81*

Note. ** – $p<0,05$.*

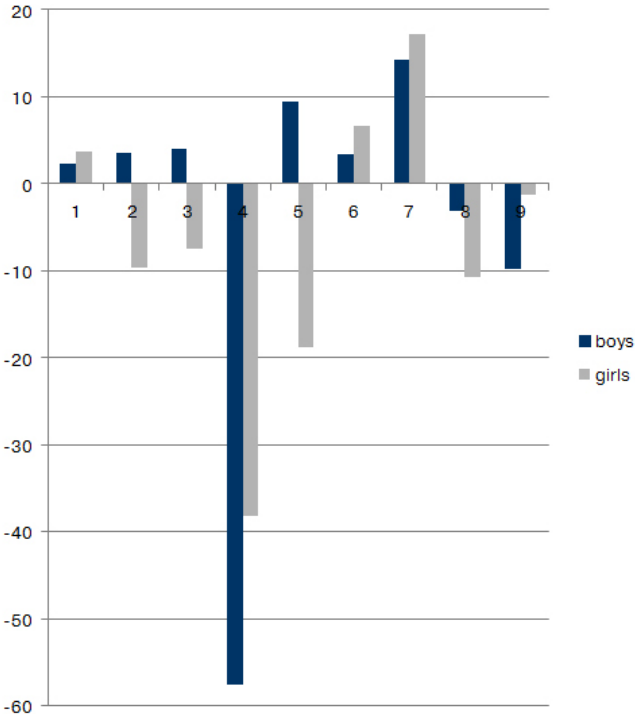

Fig. 1. Deviation of the average morphological and functional indicators of boys and girls suffering from scoliosis of I-II degree, from the average indices of a group of practically healthy children (%): *1 – Height; 2 – Body weight; 3 – CC; 4 – CE; 5 – Rohrer index; 6 – Pinje Index; 7 – HR; 8 – Stange test; 9 – Genci's test.*

The similarity of indicators is observed in the change: growth and heart rate. Indicators of body weight, CC, Rohrer index for boys and girls have the opposite changes of the indices of CG (Fig. 1).

Conclusions

1. The fact of development of violations from the cardiovascular and respiratory systems in children with scoliosis was established even at the initial stages (I–II degree). Thus, the organization of comprehensive rehabilitation programs for improving the posture in children requires not only the formation and consolidation of the habit of correct posture, the creation of a muscular corset, but also the focus on improving the development of the cardio respiratory system, training the balance, balance, coordination, enhancing the nonspecific resistance of the organism by maintaining a healthy regime of the day, tempering and nutrition.

2. Multidirectional changes in indicators require the preparation of corrective programs with a special approach to children of different sexes.

3. Most measures for the treatment of scoliosis should be performed by the patient independently, therefore, depending on how the patient treats himself; the successful disposal of the deformity of the spine depends very much.

Correct deformities in the early stages of scoliosis are possible due to comprehensive rehabilitation programs.

In the future, it is planned to develop a comprehensive rehabilitation program for children aged 10–13 with scoliosis of I–II degree

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Information about the Authors

Anastasia Podolyaka: *PhD (Physical Education and Sport); Cherepovets State University: 5, Lunacharsky prospect, Cherepovets, Vologda*

region, 162600, Russia.
ORCID.ORG/0000-0002-5842-9323
E-mail: anpodol@mail.ru

Oleg Podolyaka: PhD (physical education and sport), Associate Professor; *PhD (Physical Education and Sport); Cherepovets State University: 5, Lunacharsky prospect, Cherepovets, Vologda region, 162600, Russia.*
ORCID.ORG/0000-0001-5606-1409
E-mail: podol@inbox.ru

Ruslan Iskandarov: *Cherepovets State University: 5, Lunacharsky prospect, Cherepovets, Vologda region, 162600, Russia.*
ORCID.ORG/0000-0002-3153-8730
E-mail: rrriskanrrr@yandex.ru

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Physical rehabilitation after achilles tendon ruptures: a review of modern approaches

Ra'ad Abdul Hadi Mohammad Alalwa [1]
Volodymyr Vitomskiy [1, 2]
Olena Lazarieva [1]
Maryna Vitomska [1]

[1] *National University of Physical Education and Sport of Ukraine, Kiev, Ukraine*
[2] *SU «Scientific-Practical Medical Center of Pediatric Cardiology and Cardiac Surgery of the MH of Ukraine», Kiev, Ukraine*

Purpose: *to conduct review methodological approaches to physical rehabilitation after Achilles tendon ruptures.*

Material & Methods: *analysis and synthesis of the foreign and domestic special scientific and methodical literature on physical rehabilitation after surgical treatment of Achilles tendon rupture.*

Results: *restore function lower limb and gait parameters is a long, complex and difficult process. Qualitative rehabilitation process should be accompanied by adequate motor mode and its extension, axial load and special exercise. The most significant differences are observed in the approach concerning types of immobilization, its term and necessity at all, timing axial load. Among the options of immobilization allocated gypsuming, a variety of cast, orthosis, splints and braces. In the later stages of rehabilitation recommendations are somewhat different of terms of basic loads such as the rise of the fingers, walking without assistive devices.*

Conclusion: *problem of design protocol of physical rehabilitation after achilles tendon ruptures is not completely solved.*

Keywords: *achilles tendon ruptures, surgical treatment, rehabilitation, physical load, exercise.*

Introduction

Restoration of the normal function of the operated limb is a lengthy process, as it includes the adaptation of the ends of the achilles tendon, the normalization of the neuro-trophic disorders of the triceps muscles of the lower leg, and the restoration of motor, domestic, labor and sports skills. At each stage of the postoperative period, specialists are faced with tasks that can generally constitute a rehabilitation system for the patient. Despite the importance of the issue, there is no unanimity in the available literature about the principles and timing of the motor activation of these patients [18].

On the other hand, physical factors, adequate motor conditions and its timely expansion are among the main factors of the full restoration of the achilles tendon and increase of its strength [4]. Available knowledge on the biology of tendon regeneration and regulation mechanisms are of great importance in surgery and rehabilitation [14; 19; 27].

Postoperative restorative treatment is an important moment for achieving an optimal joint condition and functional restoration of the entire limb. However, it is necessary to take into account such opposite requirements: on the one hand – the need for protection and shaking of the operated tendon from excessive loads, and on the other hand – it is possible to minimize the negative effect of immobilization on the condition of muscles, trophic joints, proprioception [47].

In the domestic and foreign literature there is no uniform approach to the tactics of managing patients after the operative restoration of the integrity of the calcaneal (achilles) tendon [18].

The relationship of research with scientific programs, plans, themes

The research was carried out in accordance with the Consolidated Plan of research in the field of physical culture and sports for 2011–2015. On the topic 4.4. "Improving the organizational and methodological foundations of programming the process of physical rehabilitation in dysfunctional disorders in different systems of the human body". State registration number 0111U001737.

The purpose of the research

To conduct review methodological approaches to physical rehabilitation after achilles tendon ruptures.

Material and Methods of the research

Methods of research: analysis of scientific literature, synthesis and generalization.

Results of the research and their discussion

In one of the foreign studies [22] it was noted that until recently attempts to optimize the postoperative regime after surgical treatment of tendon ruptures were sufficiently empirical, the temporal characteristics and gradation of the exercise regimen lacked clear conceptual bases. The magnitude of the loads, applied in previous studies, had no clear control, and likewise did not investigate the effect of the excursion of the

operated site, and the formation of a gap in clinically significant models.

In foreign articles, it is reported that the greatest differences between different protocols and approaches to postoperative restorative treatment and rehabilitation of patients with tendon injuries cause an early postoperative period and methods of influencing tendons in the early stages of healing during the first three to six weeks. It is pointed out that early mobilization is the most common method of management after surgery on tendons from those reported in the literature. Therefore, at present, specialists should understand not only what these options represent, but why and when to use them. There is not only one correct way of carrying out rehabilitation after surgery on the tendons, and therefore a specialist who does not understand the path of development of modern methods is ill-prepared to develop an appropriate individual treatment for each patient [41].

A new approach to both surgical treatment and rehabilitation measures was proposed by R. Cetti in 1988 namely, the new tendon suture and postoperative splint for immobilization, which allows the movement without the weight in the amount of 20˚ and save equinus foot, and also create the opportunity to walk the day after the operation, subject to the possibility of only minor discomfort, promoted a rapid return to normal mobility with a normal force of plantar flexion and allowed in the future to resume playing sports at the same level as before the injury [23].

Minimization of labor costs when replacing the splint that is immobilized and the patient's discomfort in the next physical rehabilitation with progressive dorsiflexion is considered possible provided immobilization of the foot in the platigrade position, which is an alternative option in cases of open surgical stitching of the achilles tendon and sufficient for early tension stability [42].

In the literature there is evidence that with fresh ruptures of the achilles tendon and the functional method of reference, the normalization of physiological values occurs up to 3 years after the operation, Whereas in immobilization only up to 12 months, and with chronic injuries do not occur at all (deficiency of function – 7,6%) [18; 42].

Certain researchers contrast their views with traditional ones and note that the postoperative period is possible without immobilization, and movement in the joints after surgery can be allowed, but under the condition of limiting the load [35; 43], in this case, the early free movement of the ankle after reconstruction of the achilles tendon was safe with very satisfactory clinical results [43], integrity of the suture allows an immediate controlled movement of the ankle joint, the weights can be carried out after 2 months, and early movements of the foot and ankle help the remodeling of the scar tissue and prevent the formation of skin adhesions that may further interfere with the full movement of the joint [35].

The traditional approach requires maintaining immobilization over a period of four to six weeks [48], and the intermediate approach suggests the use of functional orthoses in a few days of immobilization according to the traditional method [46; 24].

There are reports of a method of surgical reconstruction of the achilles tendon, which allows not to apply immobilization of the operated limb, begin exercises with weights to restore the strength of the triceps muscles of the lower leg and to walk with the help of crutches with biomechanical phases of rolling and jerking in the early rehabilitation period. And 3 months after the operation, all patients returned to the previous level of household, professional and sports activity [16].

According to research, a functional approach in the rehabilitation of such patients also suggests an early onset of the reference axial load on the injured leg, which can be realized even at the stage of immobilization, but in the presence of long with a heel, and allows to some extent to neutralize the effect of immobilization, and in the future more quickly improve the functional results [26; 29].

In particular, N. Maffulli [31; 32] together with co-authors studied the influence of early axial load on mobilization and compared it with classical mobilization. The first group of subjects was immobilized in a gravitational ekvinus and recommended fully transferring weight to the operated leg, and the replacement of splint occurred in two weeks, which made it possible to perform complete plantar flexion and dorsiflexion not above the neutral position. Patients of the traditional method group received immobilization in full equinus, and the replacement of the splint occurred in the second week, when the ankle was fixed in average equinus, and also the fourth, when the ankle was immobilized in the plan position and allowed patients to carry weight on the leg.

Conclusions of researchers [32] amounted to the fact that the first group of patients had fewer outpatient visits, faster than twice refused to crutches, and the proposed method is safe, it does not increase the risk of recurrent fractures and reduces the time required for rehabilitation.

Domestic research M. Golovakhi and co-authors [7] confirmed the usefulness of the use of functional removable orthoses in comparison with the standard technique of the rear gypsum tire to the level of the knee joint. It was noted the possibility of safe application of the dosed load four weeks earlier than in the control group, as well as the earlier full load rejection of additional support. According to the results of the study, the functional approach positively influenced the amplitude of plantar and dorsal flexion, the level of hypotrophy and strength, the mobility of tendons (presence of adhesions between the tendon, paratenon and surrounding tissues, the limitations of the tendon slip, as well as the scale of its diameter with heterogeneity in the structure).

There is an opinion that the first-order indicators for evaluating the results of restorative treatment after the achilles tendon rupture is the quality of life. Thus, A. A. Suchak, together with co-authors [44], compared groups of patients (all patients for two weeks after the operation did not rely on the injured limb in the remaining four weeks, the first transferred weight to the limb, and the second left it unloaded). On the sixth week after the operation, the best results in the first group on the indicators of the quality of life in the spheres of physical functioning, social function, the role of emotional functioning and vitality were noted, and in six weeks after the operation there were fewer restrictions in daily activities. However, at the stage of six months, no significant differences between the groups were observed, and both groups had poor endurance of the leg muscles. There were no repeated discontinuities.

Similar conclusions on the use of functional protocols for immobilization are given in meta-analyzes and other works, namely: a more positive effect on the improvement of subjective well-being [33; 45], recovery rate [34], faster return to previous sports level [33], no effect on recovery rate [45], incidence of complications and repeated ruptures [33; 45].

On the other hand, there are facts that surgical treatment and the patient management protocol are not statistically better than the conservative approach, in terms of functional outcomes, physical activity or quality of life [40].

However, it should be noted that the effectiveness and safety of the functional approach in the immobilization period is quite dependent on the patient's awareness of what is required of him, and the limits of the expansion of the functional load, as well as the lack of the ability to independently determine possible loads and their attempts.

Therefore, since the patient can be discharged from the hospital for outpatient treatment just the day after the operation, it is important to build knowledge on the motor activity of interest and its limitations, as well as walking skills with crutches to prevent falls and injuries [28; 30]. The opinion of the surgeon is important. Active motor rehabilitation in the postoperative period is possible with the surgeon's confidence in the ability of the made tendon suture, as well as a clear understanding and performance of the patient's medical prescriptions [17].

The cases of repeated of the achilles tendon rupture in the application of the functional protocol of reference led the authors [21; 25; 17] on the idea that it is necessary to conduct careful selection of patients in order to fully implement the structure of the rehabilitation regime.

Also, in addition to the characteristics of the patient, one should take into account the characteristics of the environment in which the patient will stay after surgical treatment, namely those that affect the safety of movement and in turn depend to a certain extent on the economic development of the state [11].

In case of doubtful possibilities of the patient, it is possible to use limb fixation with a plaster bandage from the upper third of the shin to the metacarpophalangeal joints in the position of moderate flexion of the foot on 20–30° within 4 weeks after the operation, as well as the withdrawal of the foot to a neutral position and walking with a dosed load in the bandage for another 2–3 weeks. Fixation of the knee joint is considered impractical due to its insignificant influence on the tension of the achilles tendon and considerable inconvenience to the patient [17].

Analysis of the literature leads to the conclusion that the literature is more and more detailed about the period of immobilization, but no less important period after immobilization remains uncovered completely or partially.

Considering the dynamics of the restoration of the functional state and the reduction of the deficit, the scientists emphasize the need to improve and intensify the treatment during the first year to improve the final result, since the majority of patients with achilles tendon rupture are not fully recovered 2 years after the injury, and the results differ only slightly after a year and two years [39].

It should be noted the authors' opinion that existing rehabilitation programs suffer, as a rule, fragmentation, in most of them there is no clinical and morphological characteristics, a clear periodization and a detailed description of rehabilitation tools and technologies [6; 11].

A more active period of rehabilitation, namely after immobilization, using a wide range of tools and methods among the contingent of athletes was considered in the work of M. I. Gershburg and his co-authors [6], however, the features of the immobilization period were also noted. The positive effect of the use of proprioceptive and plyometric exercises, as well as biomechanical stimulation (other means of kinesis and hydroquinotherapy were the same), which was manifested in improving the contractility of the triceps muscle, the results of the complicated Romberg sample and goniometry, and also in the earlier possibility of performing motor tests.

Belarusian Research Institute of Traumatology and Orthopedics, [17] proposes the following method for post-operative patients after achilles tendon rupture :

– limb immobilization is performed via short gypsum splints, ankle fixing in position moderate (20–30°) solebending of the foot. The knee joint and toes are not fixed;

– during the first week after the intervention, foot movements and exercises are performed to gradually extend the limb in the knee joint;

– from the second week after the operation, under the condition of normal wound healing 3-4 times a day, the splint is removed and the metered foot movements are performed within a painless amplitude in order to gradually achieve a neutral position of the foot, a shinand foot massage;

– after the withdrawal of the foot to the neutral position (usually at the 3rd or 4th week), a gradual transition to the full load of the limb is carried out within 3–4 days using an orthosis that fixes the foot in a neutral position; Lessons on an exercise bike in ortega;

– after six weeks of immobilization, walking in ordinary shoes with a heel of 2 cm, metered strength exercises, swimming in the pool;

– after 3 months, easy jogging with a gradual increase in motor activity and the transition to game sports in the fifth to sixth months after surgery.

A group of researchers led by K. Nilsson-Helander [37] reported that after surgical restoration of the integrity of the achilles tendon in the group of patients, an immobilization with an ankle joint was applied for 2 weeks, after that, a functional brace was applied with gradual withdrawal of the foot into dorsiflexion for 6 weeks (to –30° in the first 2 weeks, –10° in the next 2 weeks, and +10° in the last 2 weeks). After this, the patients underwent the following protocol of rehabilitation:

– weeks 8–11 – shoes with a heel lift of 1,5 cm, crutches as necessary for another 1–3 weeks visit the physiotherapist 2–3 times a week and home exercises daily (exercise bike, exercises to increase range of motion of the ankle joint, rise

on your toes while sitting; rise on your toes while standing (2 feet), walking training, balance exercises, bench legs, flexion and extension legs);
– weeks 11–16 – shoes with a heel lift of 1,5 cm up to the 16th week, a visit to a physical therapist 2–3 times a week and daily home exercises (exercises with weight gain, rise on your toes while standing, with the increase in range to stand at the end of the plantar flexion range of 1 foot; climbing; walking on a mattress);

– weeks 16–20 – visit to the physiotherapist 2–3 times a week and home exercises (with weight and intensity increase depending on tolerance, slip, quick bounces on socks with lifting of heels, from 18 weeks climbing stairs with raised heel, side jumps, jumps on 2 legs);

– weeks 20–24 – visit the physiotherapist as necessary, exercise as the previous ones, with increasing weight and intensity, depending on the portability and jogging, lateral leaps forward;

– weeks 24 and further – the continuation of physical therapy, if necessary, group sessions (similar to aerobics), a gradual return to sports (depending on the patient's ability).

A somewhat more progressive protocol after surgical treatment proposed Nicklas Olsson [38]:

– weeks 0–2 – brace with three heel lifts, the use of crutches, high-heeled shoes on the healthy side, exercise at home daily in the brace (isometric submaximal plantar flexion, flexion-extension);

– after 2 weeks – brace with two lifts, previous exercises at home (increasing intensity) with a physiotherapist twice a week (exercise bike in a brace, exercises for a range of motion without brace to 15° with plantar inflexion and with a rubber band, lifting the heels, sitting, unloaded, walking with brace and balance exercises, sit-ups (fitness ball behind the back);

– after 4 – brace with one lift, previous exercises at home; in the exercises with the physiotherapist, the angle to 10° of plantar flexion changes, the replacement of the rubber strip, lifting on the heels, sitting, with light load;

– after 5 – брейс brace, exercises at home; In exercises with a physiotherapist angle to 0°, the use of simulators, lifting on socks, sitting, with weight, bench press;

– after 6 – use of shoes with an increased heel (bilateral) for 4 weeks, golfs to prevent swelling up to 14 weeks, home exercises (from previous studies and climbing socks, standing (up to 50% of the weight on the injured side), walking) with the physiotherapist is added lifting on the socks in the training apparatus for bench press (0° plantar flexion), squats;

– after 8 – independently at home; in the exercises with the physiotherapist to increase the intensity, rise to the socks, standing, gradually to one foot, balancing exercises on the platforms;

– after 12 weeks – regular shoes after 10 weeks, barefoot after 12 weeks, classes at home in accordance with the patient's condition; in the exercises with the physiotherapist, rapid ascent to the socks, easy running on the mattress, jumping on two legs;

– after 14 – running in the open air, if the patient has good technique, group training; return to the sport not earlier than 16 weeks.

The effect of physical exercises is also examined in the context of the effect on the elasticity characteristics of the achilles tendon regeneration and the strain rate, determined by ultrasonics, at various times after surgery and comparing parameters of different powers isometric and dynamic loads on the gastrocnemius, soleus muscle-tendon complex [5].

The researchers suggest that in athletes (force at the time of injury) occurs more rapid formation of elastic regenerate tendon (strain ratio value 2,5±0,6) within 3 weeks after surgery, a shorter time is restored tendon density. Among patients who did not actively engage in sports, the formation of elastic regenerate was prolonged for a period of more than 6 weeks (strain ratio value 3,6±1,7) after the operation and for a longer time, it becomes denser. Although all patients underwent active rehabilitation in the recommended volumes according to the terms after the operation. On the basis of the work performed, differences in recovery periods after open achilles tendon ligation were shown in athletes and patients, and are not actively involved in sports, and sonolastography is presented as an effective method of monitoring the regenerative processes of the achilles tendon after surgery, reflecting the state of elasticity of collagen fibers [5].

In the guidelines for restorative treatment after the achilles tendon rupture among athletes, the main means of rehabilitation in the early period include treatment by position, physiotherapy, isometric exercises to stimulate the muscles of the thigh and extensors of the foot, general development exercises to maintain efficiency, as well as active foot movements with the possibility of using modern orthopedic technologies (for example, brace). In the period of recovery of motor functions is recommended to use the basic means of physical exercise in the hall of medical physical training, swimming pool, as well as training in walking, as well as support - laser therapy, massage and electrostimulation of the triceps muscles of the lower leg to accelerate the remodulation of the achilles tendon and increase the contractile ability of the muscles [3; 13].

In the dissertation work Ayub Hussein conducted a study of the impact of physical rehabilitation on the functional state of the triceps muscle after surgical treatment of the achilles tendon rupture in athletes, and the rehabilitation program was divided into three periods – immobilization, rehabilitation of the ankle joint function and the three-headed calf muscle, training and recreation. Thus, the athletes of the main group during the second period used post-isometric relaxation, biomechanical stimulation, as well as a series of static strength exercises for the muscles of the shins, which supplemented the dynamic exercises. The purpose of these methods was the early elimination of contractures and muscle strengthening. In the control group were used in the exercise walking, training in the gym and the pool, pneumatic, hydraulic and manual massage. The first period was not different – athletes of both groups performed isometric exercises for the leg muscles and intensive general development exercises for healthy parts of the body [1; 12].

It was found that the athletes of the main group had advantages in the speed of restoration of the amplitude of dorsiflexia, the strength of the triceps muscle, the ability to perform a running test and the test «b walking on socks in a squat». However, for some indicators (shin circumference, plantar flexion), there was no difference in recovery rate or in the final result [1].

Physiotherapeutic procedures also occupy an important place in restorative treatment after surgical treatment.

The physiotherapy in stimulating the regeneration of tendon tissue consists in the use of various physical factors that positively influence to the reparative processes. The use of methods of physiotherapy to stimulate the recovery process is due to their favorable effect on the course of postoperative inflammation, microcirculation, redox and regenerative processes, and also the formation of connective tissue [2; 8; 18]

The methodological recommendations of the investigators [17] regarding the indications for carrying out physiotherapeutic procedures are formed as follows: magnetotherapy - postoperative edema or at the beginning of physical exercise; UHF stimulation of the healing of a postoperative wound with a dubious course of the process; ultrasonics with actovegin stimulation of regenerative processes in the tendon tissues (3 weeks and more after the intervention) electrostimulation of the calf muscles - to develop movements in the ankle (stimulation of the rear extension of the foot -anterior muscle group), for the immediate stimulation of the gastrocnemius muscle (2–3 months after the operation); paraffin therapy (on the joint area) – to facilitate the development of movements in the ankle after immobilization; massage of the lower extremities – stimulation of recovery of gastrocnemius muscle function at the 2–3 month after the intervention; ultrasonics with hydrocortisone – contraindicated, as it weakens the reparative processes in the tendon; vibromassage – contraindicated, since it can cause cystic changes in tendon regenerate. Along with this, the use of local hypothermia, UHF therapy and Bernard currents was practiced to relieve pain, reduce edema of tissues and normalize microcirculation, for improvement of trophism, blood supply and stimulation of the regenerative process, electrostimulation, ozokerito- and paraffin therapy [9; 10; 15; 20].

However, studies of the influence of specific methods of physiotherapy on the regeneration of tendon tissue are single, and the direction itself requires a further more detailed experimental and clinical justification [18; 36].

Conclusions

Standards of surgical treatment and postoperative protocols of physical rehabilitation of patients with a clearly prescribed sequence of achieving normal or almost normal function are not yet available and this problem remains unsolved.

Taking into account the results of the research, it can be concluded that the results of the restoration of functional capabilities after the achilles tendon rupture depend not only on the use of plaster bandages, langets or brace, but also on the use of physical exercises after immobilization.

Interesting and necessary for the identification of long-term benefits is the study of long-term results of treatment and rehabilitation of patients after surgical treatment of achilles tendon ruptures.

Prospects for further research in this area are to develop a physical rehabilitation program and to test the effectiveness of its impact on the function of the lower limb and the quality of life.

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Information about the Authors

Ra'ad Abdul Hadi Mohammad Alalwan: *postgraduate student, National University of Physical Education and Sport of Ukraine; 1 Phizkultury Street, Kiev, 03680, Ukraine.*
ORCID.ORG/0000-0003-1268-0894
E-mail: raad_olwan@yahoo.com

Volodymyr Vitomskiy: *PhD; SU «Scientific-Practical Medical Center of Pediatric Cardiology and Cardiac Surgery of the MH of Ukraine»: 24 Melnikov St, Kyiv, 04050, Ukraine; National University of Physical Education and Sport of Ukraine; 1 Phizkultury Street, Kiev, 03680, Ukraine.*
ORCID.ORG/0000-0002-4582-6004
E-mail: vitomskiyvova@rambler.ru

Olena Lazarieva: *Doctor of Science (Physical Education and Sport), Professor; National University of Physical Education and Sport of Ukraine: Phyzkul'tury str. 1, Kyiv, 03680, Ukraine.*
ORCID.ORG/0000-0002-7435-2127
E-mail: helenka_l@mail.ru

Maryna Vitomska: *National University of Physical Education and Sport of Ukraine; 1 Phizkultury Street, Kiev, 03680, Ukraine.*
ORCID.ORG/0000-0002-4582-6004
E-mail:vitomskiyvova@rambler.ru

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Choreographic training optimization of female gymnasts aged 8–11 years in aerobic gymnastics

Valentina Todorova

Lviv State University of Physical Culture, Lviv, Ukraine

Purpose: *optimization of choreographic training of gymnasts 8–11 years old.*

Material & Methods: *analysis of video materials; expert evaluation method; methods of mathematical statistics.*

Results: *defined parameters choreography preparation for initial training stage.*

Conclusion: *defined parameters that have a significant impact on the aesthetic component of movement activity athletes in aerobic gymnastics at initial training stage. Dynamics of improvement of choreographic preparedness in the experimental group confirms the advantage of the chosen technique with the use of the developed model of choreographic training of gymnasts aged 8–11 years.*

Keywords: *choreographic training, aerobic gymnastics, initial training, criteria for choreographic preparedness.*

Introduction

The initial training phase lasts 3-4 years on average. It is during this period that special attention should be paid to the method of teaching the elements of choreography, since at this stage the basis for further development of the of the athlete skill [5–7]. Most specialists (V. Boloban, 1988, V. N. Kurys, 1994, N. K. Menshikova, 1998; V. Smolevsky, Yu. K. Gaverdovsky, 1999, etc.). It is believed that the beginning of regular gymnastics classes, acrobatics (including aerobics) between the ages of 6-7 years. It is possible and an earlier start of sports activities, that is, from 4-5 and even from 3 years [2]. However, there are many skeptics and even opponents of this practice, especially among doctors. In our opinion, this contradiction can be solved if we consider not so much the age of the beginning of the class as the literacy of the approach to organizing and conducting classes in choreography at the initial training in aerobic gymnastics.

The relationship of research with scientific programs, plans, themes

The work was carried out in accordance with the theme of the research work "Theoretical and methodological fundamentals of managing the training process and competitive activities in the olympic, professional and adaptive sport" in accordance with the LSUPK plan for 2016-2020. (Number of state registration: 0116U003167).

The purpose of the research

Optimization of choreographic training of gymnasts 8–11 years old.

Objectives of the study:

1. To develop a model of choreographic training at the stage of initial training for gymnasts.

2. Identify the dynamics of the level of choreographic preparedness in the process of implementing the model of choreographic preparation.

Material and Methods of the research

59 gymnasts were examined from Odessa and Odessa region aged 8–11 years. The study was carried out on the basis of the Federation of Aerobic Gymnastics, School No. 81, School No. 111, Youth Sports School No. 10, Youth Sports School No. 1, Complex Sports School No. 3 (Odessa). To determine the level of choreographic preparedness, methods of expert assessments, methods of mathematical statistics.

Results of the research and their discussion

To achieve this goal, we developed a model of choreographic training for beginners (Fig. 1).

To control the choreographic preparedness, a group of five sports specialists (choreographers and trainers in aerobic gymnastics). The experts were offered a set of criteria for choreographic preparedness with a detailed description of each of them: posture, reversibility and tension of the legs, stability, accuracy of movements of hands and feet, completeness, ease and fusion of movements, musicality, and dance, illustrative and emotional expressiveness. All criteria were evaluated taking into account the requirements for the technique of performing "choreographic elements" in the aspect of the requirements of competition rules [1; 3; 4].

For a more accurate and differentiated assessment, a five-point scale was added to each of the criteria, according to which the score of "0,5 points" was raised if the criterion was very poorly formed; "1 point", if the criterion is not formed enough to successfully master the program of choreographic training; "1,5 point", if the criterion is formed sufficiently to successfully master the program of choreographic training;

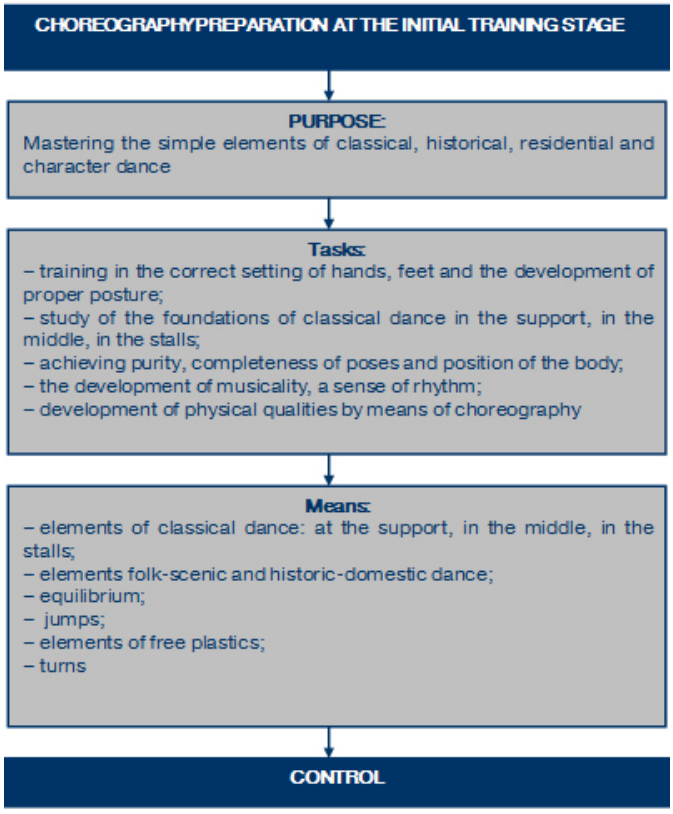

Fig. 1. Model of choreographic preparation of gymnasts at the initial training stage

"2 points", if the criterion is formed well; "2,5 points", if the criterion is formed flawlessly.

To simplify the presentation and interpretation of factual information, the boundaries of a low, sufficient and high level of athletes' choreographic preparedness. For this purpose, the index of choreographic readiness (I_{CR}), is calculated as the arithmetic mean (M=1,52) and the standard deviation (SD=0,21) of the individual choreographic readiness of all participants in the test and certain intervals of estimates that are the basis for the author's scheme for interpreting the results: low level (less than 1,2 points) – the prevalence of serious errors in the performance of most of the choreographic elements; sufficient level (1,3–1,7) – athlete assumes execution details malfunctioning equipment, reduces the effectiveness of the whole; optimal level (more than 1,8) – faultless execution of an athlete most basic choreographic elements [9].

A total of 59 athletes were trained – gymnasts of the III–I category at the age of 8–11 years (Odessa Regional Federation of aerobics) wishing to become members of approbation, which based on previous expert evaluation were assigned to the experimental group (30 participants) – EG and control (29 participants) – CG. Since the equivalence of groups by composition at the beginning of the experiment is an important condition for the reliability of its results, important detailed qualitative analysis and statistical comparison of the formation of the choreographic preparedness of athletes in these groups.

If we turn to individual data characterizing the formation of the criteria for the choreographic preparedness of the athletes of the EG at the stage of initial preparation prior to the beginning of the experiment, it can be noted that among them there are no such individuals who, according to an individual index of choreographic readiness, reach a high level. Half of them have a low level of formation of this criterion, and estimates of 50% of gymnasts correspond to a sufficient level. Accordingly, the average arithmetic value of this indicator in the group is on the verge of low and sufficient levels (I_{CP}=1,21).

The formation of individual criteria, on the basis of which the determination of this index was made, which we presented in the table 1.

Analysis of the obtained data made it possible to identify the criteria that significantly reduce the level of choreographic preparedness: "posture" – in 93,3% of gymnasts EG was formed at a low level and only 6,7% on sufficient; "accuracy of legs movements" – a low level is inherent in 93,3%; "accuracy of arm movements" – experts rated 96,7% of the athletes as low as average and 3,3%, "dance" – a low level of 76,7% and sufficient – 23,3% of gymnasts; "completeness of movements" – a low level was detected in 76,7%, sufficient – in 16,6% and high – in 6,7% of tested. Also, predominantly low values were obtained on the basis of the criteria of "mobility" (in 70% of tested), "reversibility" (in 70% of tested), "lightness" (66,6% of tested), "leg stiffness" (63,4% tested). Approximately half of the gymnasts were assessed by experts as having a low level of formation according to the criteria of "stability" (56,7%), "musicality" (56,7%) and "illustrative expressiveness" (50%). And only on the criterion of "emotional expressiveness" was determined mainly the sufficient formation of the choreographic preparedness of the gymnasts of the experimental group (in 66,7% of female athletes), in 23,3% it was at a high level and only 10% at a low.

Summarizing the results of the analysis of individual data of formation criteria choreography experimental group of athletes on the initial stage of preparation before the experiment it can be determined that the majority of the analyzed criteria, most of the participants had a low level of preparedness of the choreographic skills, however, according to individual indices of choreographic preparedness, only half of gymnasts showed a low level, and the rest – sufficient. That is, in the part of athletes insufficient formation of certain criteria was compensated by a high level of manifestation of other. This fact clearly demonstrates that the absence of the system in the choreographic preparation leads to averaging the results in the gymnasts and inhibits the growth of their skill.

As we see, the distribution of the results of expert evaluation of gymnasts from the control group into a much similar distribution in the experimental group. This is both an individual index of choreographic preparedness, and the formation of the criteria for "posture", "accuracy of legs movements" "accuracy of arm movements" "completeness", "lightness" and "reversibility". At the same time, on these and other criteria, there are certain insignificant differences in the distribution. Based on the data on the importance of group indices of formation (I_{gr}) of choreographic preparedness, it was revealed that in the experimental group this index is only 0.01 points higher than the control. In this case, the calculated value of Student's t-criterion (t=0,28) does not reach the critical value (t_{cr}=2,01), at which differences between groups can be considered statistically reliable.

The experiment lasted 11 months, in continuation of which

Table 1

Formation of the criteria for the choreographic preparedness of the athletes of the experimental and control groups at the initial preparation stage prior to the start of the experiment (%)

Criteria	Experimental group			Control group		
	Levels of criteria formation					
	low	sufficient	high	low	sufficient	high
Posture	93,3	6,7	0	82,8	17,2	0
Reversibility of legs	70,0	16,7	13,3	69,0	17,2	13,8
Leg stiffness	63,4	23,3	13,3	72,4	17,2	10,4
Sustainability	56,7	26,7	16,6	65,5	20,7	13,8
Accuracy of arm movements	93,3	6,7	0	86,2	13,8	0
Accuracy of leg movements	96,7	3,3	0	86,2	13,8	0
Completeness of movements	76,7	16,6	6,7	82,8	3,4	13,8
Lightness	66,6	26,7	6,7	75,9	20,7	3,4
Mobility of movements	70,0	23,3	6,7	86,2	3,4	10,4
Musicality	56,7	26,7	16,6	65,5	20,7	13,8
Dance	76,7	23,3	0	72,4	20,7	6,9
Illustrative expressiveness	50,0	50,0	0	44,8	51,8	3,4
Emotional expressiveness	10,0	66,7	23,3	10,3	75,9	13,8
I_{CP}	50	50	0	51,7	48,3	0

the model of choreographic training was introduced into the training process of the EG, and the CG was engaged in the traditional program of the Youth Sports School [8]. After completing the formative pedagogical experiment, the formation of the choreographic preparedness of the athletes EG and CG was reevaluated by the same experts, while the evaluation procedure remained unchanged. Thus, a comparison of these estimates with the results of the preliminary assessment will follow the dynamics of the level of choreography preparedness of sportsmen of these groups during the experiment. Individual data characterizing the formation of the criteria for the choreographic preparedness of the athletes of the experimental group at the stage of initial training at the end of the experiment indicate that among them there are none who, according to the individual choreographic preparedness index, have a low level. Most of them (70% of the tested) demonstrate a sufficient level, the rest (30% of gymnasts) reach a high level. The average arithmetic value of this indicator in the group corresponds to a sufficient level (M=1,64). The study of the distribution of subjects according to the levels of the formation of choreographic preparedness according to certain criteria indicates that the majority of athletes at the final stage of the experiment have achieved sufficient or high levels of choreographic readiness (tab. 2).

For example, only 3.3% of the gymnasts of the experimental group remained choreographed by the criterion of "reversibility", at a low level, in 66,7% – it corresponded to a sufficient level of formation, and in 30% – to a high level, by the criterion of "accuracy of leg movements", a low level corresponds to 6,7% of individual estimates, sufficient – 73,3% and high – 20%. According to the criterion «completeness» low evaluation experts predict only 10% of athletes, sufficient – 50% and high – 40%. By the criterion of "mobility", a low level is inherent in 3,3% of gymnasts, sufficient – 60% and high – 36,7%. By the criterion of "musicality" a low level was found only in 6,7%, sufficient – in 50% and high – in 43,3% of tested. A few of the subjects with a low level of choreographic preparedness were determined by the criterion "leg stiffness" (13,3% gymnasts) at a sufficient level of its manifestation in 50% and high – 36,7% in athletes, the criterion of "stability" (16,7%) at a sufficient level – 30% and a high – in 53,3% of athletes, the criterion of "lightness" (16,7%) at a sufficient level – 40% and high – in 43,3% of gymnasts, according to the criterion of "dancing" (13.3%), with a sufficient level – 43,3% and high – 43,3% of athletes and " Illustrative expressiveness" (13,3%) at a sufficient level – in 36,7% and high – in 50% of the athletes. An even more significant proportion of subjects with a low level of choreographic preparedness was determined by the criterion of "posture" (23,3% of gymnasts) with a sufficient level of its manifestation in 56,7% and high – in 20% of athletes and by criterion "accuracy of arm movements" (33,3%) at a sufficient level – 36,7% and high – in 30% of female athletes. Separately, we note that according to the criterion of "emotional expressiveness", the predominantly high degree of choreographic preparedness of the gymnasts (63,3% of athletes) was determined, 36,7% at a sufficient level, and low values are absent.

Generalization of the results of analysis of individual data of formation criteria choreography experimental group of athletes at the initial training stage at the end of the experiment gives the basis to determine, that for individual indices of choreographic preparedness and for most of the analyzed criteria, the majority of participants demonstrated an increase in choreographic preparedness from low to sufficient and even high levels. At the same time, according to certain criteria (posture, accuracy of hand movements, stretched legs, firmness, lightness, dance, illustrative expressiveness), a part of the athletes lacked the formation of choreographic readiness. Consequently, the introduction of the developed model of choreographic training into the training process of gymnasts at the initial preparation stage, although it can not guarantee all athletes attaining a high level of choreographic readiness, but can lead to a positive dynamics of its improvement.

The statistical confirmation of this conclusion was made by comparing the arithmetic mean values based on the results of the expert evaluation of the formation of the criteria for the choreographic preparedness of the athletes of the experimental group before and after the experiment using the Student's t-criterion to determine the degree of reliability of the indicated changes.

Table 2

Formation of the criteria for the choreographic preparedness of athletes experimental and control groups at the stage of initial training at the end of the experiment (%)

Criteria	Experimental group		Control group			
	Levels of criteria formation					
	low	sufficient	low	sufficient	low	sufficient
Posture	23,3	56,7	20	62,1	37,9	0
Reversibility of legs	3,3	66,7	30	27,6	65,5	6,9
Leg stiffness	13,3	50	36,7	44,8	48,3	6,9
Sustainability	16,7	30	53,3	37,9	44,8	17,3
Accuracy of arm movements	6,7	73,3	20	69	27,6	3,4
Accuracy of leg movements	33,3	36,7	30	65,5	31,1	3,4
Completeness of movements	10	50	40	41,4	55,2	3,4
Lightness	16,7	40	43,3	44,8	51,8	3,4
Mobility of movements	3,3	60	36,7	51,8	44,8	3,4
Musicality	6,7	50	43,3	44,8	48,3	6,9
Dance	13,3	43,3	43,3	48,3	34,5	17,2
Illustrative expressiveness	13,3	36,7	50	44,8	20,7	34,5
Emotional expressiveness	0	36,7	63,3	17,3	72,4	10,3
I_{CR}	0	70	30	6,9	93,1	0

The data on the value of the group formation index (I_{gr}) of the choreographic readiness presented in the table show that during the period from the beginning to the end of the experiment in the experimental group this index increased by 0,43 points. In this case, the calculated value of Student's t-criterion (t=13,77) significantly exceeds the critical value (t_{cr}=3,47), at which these changes can be considered statistically reliable at the level p<0,001.

At the same time, relying on these results, we can not say that the model developed by us has certain advantages over the traditional method of choreographic preparation, and consequently, these changes can be explained not only by the specifics of the experimental impact, but by the fact of systematic training of gymnasts during the year, under any circumstances, could lead to an increase in the level of their choreographic preparedness. Therefore, to test this assumption, it was considered advisable to conduct a similar analysis of changes in the level of choreographic preparedness of female athletes CG during the experiment.

So, referring to the individual data characterizing the formation of the criteria for the choreographic preparedness of the athletes of the control group at the stage of initial training at the end of the experiment, one can see that among them there are no those who, according to the individual index of choreographic preparedness, have a high level. Most of them (93,1%) demonstrate a sufficient level of the formation of this criterion, the rest (6,9%) have a low level. The average arithmetic value of this indicator in the group is also at a sufficient level (M=1,32).

As we see, the distribution of the results of expert evaluation of gymnasts from the control group at the stage of initial training at the end of the experiment on individual indices of choreographic preparedness and for most of the analyzed criteria has a definite shift towards a sufficient level. At the same time, in a significant part of the athletes, the insufficient formation of the choreographic preparedness was preserved according to certain criteria (accuracy of the leg movements, accuracy of the arm movements, posture, movement, dancing, illustrative expressiveness, leg stiffness, lightness, completeness, and musicality). This suggests that the conduct of training sessions on the traditional method at the initial stage of training also contributes to the growth of the level of choreographic preparedness, but most of them does not allow to reach a high level of choreographic skill.

Statistical testing changes in the formation of choreographic training of athletes in the control group after the experiment showed that in the same period of training, during which gymnasts from the experimental group achieved significant positive dynamics in the formation of choreographic preparedness; athletes from the control group demonstrated only a tendency to increase the level of its formation.

So, proceeding from the data on the value of group indices of formation (I_{gr}) of choreographic preparedness, we will determine that after the experiment in the experimental group this index became 0,32 points higher than the control. In this case, the calculated value of Student's t-criterion (t=10,37) significantly exceeds the critical value (t_{cr}=3,47) for a high level of reliability (p<0,001), and consequently the differences between the groups for the group index formation choreography readiness at the final stage of the experiment is statistically significant.

Conclusions

1. The created model of choreographic preparation, which allows to significantly increase the level of choreographic preparedness of young gymnasts.

2. It was determined that for the period of training according to the program, constructed in accordance with the model of choreographic training, the athletes experienced an increase in the level of choreographic preparedness from low (50%) and sufficient (50%) to a sufficient (70%) and high (30%), that in determining the group formation index (I_{gr}) of the choreographic readiness, its value is expressed from 1,21 points (low level) to 1,64 points (sufficient level), which is statistically significant (t=13,77) at the level p<0,001.

During the same period of training under the traditional initial

training program, the athletes experienced an increase in the level of choreographic preparedness from a low (51,7%) and sufficient (48,3%) to a sufficient (93,1%) and low (6,9%), that in determining the group formation index (I_{gr}) of choreographic preparedness is expressed in a certain upward trend, its value from 1,2 points (low level) to 1,32 points (sufficient level), can not be considered statistically reliable (t=1,93; p<0,1).

3. It was statistically confirmed that athletes in the EG, who demonstrated the state of choreographic readiness before the beginning of the experiment, the same as the gymnasts of the control group (t=0,28), after the experiment ended, they differed by a much higher level of formation of the choreographic readiness (t=10,37; p<0,001).

Thus, it has been experimentally proved that at the stage of initial training provided that training is conducted in accordance with the proposed choreographic preparation, gymnasts can achieve a significant increase in choreographic skills than when organizing classes in accordance with the traditional form of sports training in aerobic gymnastics.

The prospect of further research is to determine ways to improve the choreographic training at the initial training stage.

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Information about the Authors

Valentina Todorova: *Lviv State University of Physical Culture, 11, Kostushko str., 79000, Lviv, Ukraine.*
ORCID.ORG/0000-0002-2679-5062
E-mail: Valentina_sport@ukr.net

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Physical fitness model characteristics in wrestling

Yuri Tropin

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Purpose: *to develop model characteristics of physical preparedness of the qualified wrestlers.*

Material & Methods: *analysis of scientific and methodological literature, generalization of practical experience, pedagogical testing of the level of physical fitness, methods of mathematical statistics. Tested 30 qualified Greco-Roman wrestlers, qualified from the 1st rank to the master of sports, different ages (from 18 to 23 years).*

Results: *a set of special exercises is selected for testing the basic physical qualities of wrestlers. It is established that to test the physical fitness of wrestlers it is necessary to conduct tests of speed-strength abilities, strength endurance, agility and general and special endurance. Based on the results of pedagogical testing, model characteristics of the physical fitness of qualified wrestlers.*

Conclusion: *analysis and representation of the model became the basis for the development of evaluation criteria and forecasting of physical fitness level.*

Keywords: *model characteristics, physical fitness, wrestling.*

Introduction

One of the most pressing problems of modern sports science is the search for effective ways to achieve high results, provided the harmonious development of athletes and maintain their health. The successful solution of this problem becomes more difficult due to the intense professionalization of sports activities, a significant upward trend in the volume and intensity of exercise [9; 11; 14; 22].

Modern sports of the highest achievements make high demands on all aspects of the athlete's preparedness, in addition, the main problem of the sport of higher achievements – the impossibility of an infinite increase training loads, which leads to the need to further the search for new, more effective pedagogical means and methods in the training of highly qualified athletes [6; 17–19; 21].

In the modern methods of technical and tactical training of wrestlers, all the complex problems of improving the athletes' motor skills [1; 3; 10; 15; 20]. However, here, as in other sports, there is a characteristic specificity, which ultimately determines the level of athletes skill. Among the most actual specific problems of wrestlers technical training is the task of optimizing and improving the means and methods of developing physical qualities in terms of conducting intense fights with an active opposition of an opponent [4; 5; 7; 8; 16].

Communication of research with scientific programs, plans, themes

The work was carried out according to the plan of research of the Kharkov State Academy of Physical Culture.

The purpose of the research

To develop model characteristics of physical preparedness of the high trained wrestlers.

Objectives of the study:
– to select informative tests for pedagogical control of wrestlers level of physical readiness;
– to determine the indicators of athletes level of development of physical readiness;
– to compose the model characteristics of physical preparedness of wrestlers.

Material and Methods of the research

Methods of research: analysis of scientific and methodological information, generalization of best practical experience, pedagogical testing, modeling, methods of mathematical statistics.

Results of the research and their discussion

Physical training of wrestlers has its own specific features, which must be taken into account when building a training process and load sharing [2; 12; 13]. It is necessary to observe the correspondence between the capabilities of the organism and the requirements presented to it when choosing the means and methods of training, so we used various methods of testing dexterity, strength endurance, speed-strength qualities, general and special endurance for assessing the physical readiness of wrestlers.

Based on the results obtained, the model characteristics of the physical preparedness of high trained wrestlers of the Greco-Roman style (table).

The analysis and models presented were the basis for developing assessment criteria and predicting the level of physi-

Model characteristics of the physical readiness of high trained Greco-Roman wrestlers

№	Indicators	$\bar{X}$	δ	m
1.	Running on 30 m (s)	4,98	0,31	0,06
2.	High jump (cm)	50,97	4,79	0,87
3.	Long jump (cm)	219,20	8,94	1,63
4.	Token turn throw 10 times (s)	28,13	2,22	0,40
5.	Back arch throw 10 times (s)	30,90	2,29	0,42
6.	Throw the medicine ball (3 kg) back with both hands (cm)	9,89	0,72	0,13
7.	Throw the medicine ball (3 kg) forward from behind the head (cm)	8,89	0,67	0,12
8.	Climbing on a rope without the help of your feet (s)	6,70	0,72	0,13
9.	Pulling on the crossbar for 20 seconds (number of times)	15,57	1,15	0,21
10.	Flexion-extension arms in emphasis lying 20 s (number of times)	30,90	2,33	0,43
11.	Flexion of the trunk lying on the back for 20 s (number of times)	18,77	1,33	0,24
12.	Raising the legs on the gymnastic wall (number of times)	18,47	1,50	0,27
13.	Squatting with a partner of equal weight (number of times)	22,23	2,38	0,43
14.	Pulling on the crossbar (number of times)	30,43	4,06	0,74
15.	Flexion-extension of the arms in the support lying (number of times)	64,43	4,34	0,79
16.	Flexion-extension arms-ups on the uneven bars (number of times)	49,83	4,44	0,79
17.	The partner's uplift of the torso by the back (number of times)	15,90	1,35	0,25
18.	Running to "bridge" (5 left, 5 – right) (s)	15,09	1,35	0,25
19.	10 somersaults forward (s)	12,15	1,17	0,21
20.	Turnovers on the "bridge" 15 times (s)	34,83	2,06	0,38
21.	Running on 800 m (s)	155,83	5,65	1,03
22.	Running 2x800 m (1 min rest) (s)	320,33	10,27	1,88
23.	1 series 15 token turn throw 10 times (s)	32,13	3,34	0,61
24.	2 series 15 token turn throw 10 times (s)	32,83	4,06	0,74
25.	3 series 15 token turn throw 10 times (s)	35,97	5,46	1,00
26.	Sum of three series token turn throw (c)	100,93	12,09	2,21

cal readiness. They allow differentiating the assessment and management of physical performance of high trained Greco-Roman wrestlers at the stage of maximum realization of individual opportunities.

To plan training loads, it is necessary to increase the level of special working capacity of athletes, taking into account the requirements of competitive activity. This is also confirmed by the results of research presented in scientific papers (Y. V. Verkhoshanskii, 2014; S. Latyshev, G. Korobeynikov, L. Korobeynikova, 2014).

The data are supplemented (A. A. Primakov, 2013, E. Arslanoglu, 2015) on methods for monitoring the level of development of special physical qualities of high trained wrestlers.

Conclusions

1. Analysis of scientific and methodical literature and compilation of best practices revealed that in wrestling athletes physical redness is one of the most important components of the overall preparedness of their structure, which determines the level of special performance.

2. It is established that to test physical redness of wrestlers it is necessary to conduct tests on speed-strength abilities (running on 30 m, jumps in length and height from the place, token turn and back arch throw, throwing a medical ball (3 kg) from behind the head back and forth with both hands, climbing on the rope 5 m without help of the feet, pulling on the crossbar for 20 s, flexion-extension of the arms in the support lying for 20 s, lifting the trunk from the supine position on the back for 20 s); strength endurance (lifting the legs to the grasp with his hands in the vise on the gymnastic wall, the maximum number of sit-ups with the partner, the maximum number of pull-ups on the crossbar, maximum amount of flexion-extension of the hands in the support lying down, the maximum amount of flexion-extension of the arms in the restraint on the uneven bars, lifting the partner by grasping the trunk from standing on the parallel benches); dexterity (turns on the "bridge" 15 times, running on the "bridge" (5 – left, 5 – right), 10 somersaults forward); General (running 800 m, running 2x800 m (1 min rest)) and special endurance (three series of 15 throws across the back).

3. Application of methods of pedagogical testing and mathematical statistics made it possible to reflect the structure of the physical readiness of qualified Greco-Roman wrestlers at the stage of maximum realization of individual opportunities and develop model characteristics that can be used in the planning and management of the training process.

4. It is determined that the key characteristics of the physical preparedness of qualified wrestlers with an equal volume of technical and tactical actions became their speed-power capabilities, special endurance and the ability to overcome the growing difficulty, combining a high tempo of the bout and maintaining the effectiveness of technical action.

Further research will be aimed at drawing up model characteristics of the technical and tactical preparedness of high trained Greco-Roman wrestlers.

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Information about the Authors

Yura Tropin: *Phd (Physical Education and Sport); Kharkiv State Academy of Physical Culture: Klochkovskaya st., 99, Kharkov, 61058, Ukraine.*
ORCID.ORG/0000-0002-6691-2470
E-mail: tropin.yurij.82@mail.ru

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Dynamics of changes in the structure and morbidity level of technical college students

Elena Tserkovnaya[1]
Victor Osipov[1]
Liudmila Filenko[2]
Vladlena Pasko[2]

[1]*Kharkov National University of Radio Electronics, Kharkiv, Ukraine*
[2]*Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine*

Purpose: *to conduct a comparative analysis of the dynamics and structure of morbidity technical college students.*

Material & Methods: *analysis of scientific and methodical literature, the study of statistical reports of the city's 20th student polyclinic in Kharkov.*

Results*: it found that students major morbidity factors for noncommunicable diseases are low locomotors activity in combination with a high traffic load, deterioration of socio-economic conditions, and the growth of chronic fatigue, which leads to a reduction of compensatory-adaptation reactions of the organism. It was revealed that the highest level of prevalence have diseases of the respiratory system, vision and diseases of the nervous system.*

Conclusion: *these data suggest about the maximum growth rate of circulatory diseases, endocrine and urogenital systems, infectious and parasitic diseases in the last 10 years. This problem requires the development and implementation of various activities aimed at counteracting the risk factors of diseases among technical college students.*

Keywords: *students, morbidity, dynamics, health status.*

Introduction

The problem of students' health has always been relevant, and attracted the attention of teachers and doctors [1; 3; 5; 6; 8; 9]. This is due to the high incidence of both the adult population of Ukraine and the younger generation [2; 4].

The lifestyle of modern students has its own characteristics: low motor activity combined with a large information load, deterioration of socio-economic conditions and the growth of chronic fatigue negatively affect all body systems and lead to a decrease in its compensatory-adaptive reactions. The state of health of students is directly related to the available adaptation resources [3; 5]. Reducing the protective forces of the body leads to the emergence of various diseases. In such conditions, the functioning of the body systems of students is at the limit of opportunity and often borders on pathology.

Researches of scientists [1; 2; 4; 5; 10; 11] showed that more than 70% of students have a low and below average level of physical health.

Over the past 10 years there have been significant changes in the computerization and organization of the educational process in higher education, as well as in the number of classes and in the organization of the process of physical education.

The purpose of the research

An analysis of the dynamics and structure of the incidence of students of Kharkov National University of Radio Electronics for the period from 2003 to 2016.

Objectives of the study:
1. Conduct an analysis of the incidence of KhNURE students for the period from 2003 to 2005 and from 2013 to 2016.
2. Give a comparative description of the state of health of students for the indicated periods.
3. Investigate the dynamics of changes in the incidence of students.

Material and Methods of the research

Over the years we have been conducting a comprehensive study of the health and morbidity of KhNURE students [7; 8; 9; 10; 11]. One of the components of our research – is to study of the level of prevalence of diseases in the main systems and organs based on the annual medical examination of students by specialists of the city student polyclinic.

Research methods: the analysis of scientific and methodological literature, the study of statistical reports of the city's 20th student polyclinic in Kharkov.

Results of the research and their discussion

We analyzed the prevalence of diseases in the main systems and organs, as a result of which, that the number of students surveyed by KhNURE for the last 10 years has significantly decreased, and the prevalence (accumulated incidence, the incidence of all existing diseases) has practically not changed. This indicates a general trend towards to deterioration in the state of student's health.

In a percentage ratio, the number of diagnosed diseases increased almost 2-fold (Fig. 2).

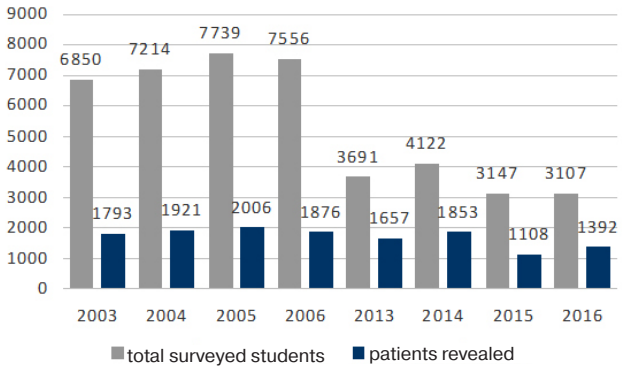

Fig. 1. Number of surveyed students and revealed diseases

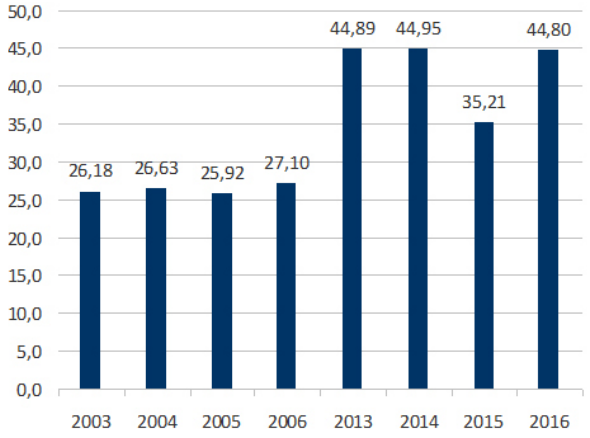

Fig. 2. Number of diagnosed diseases, %

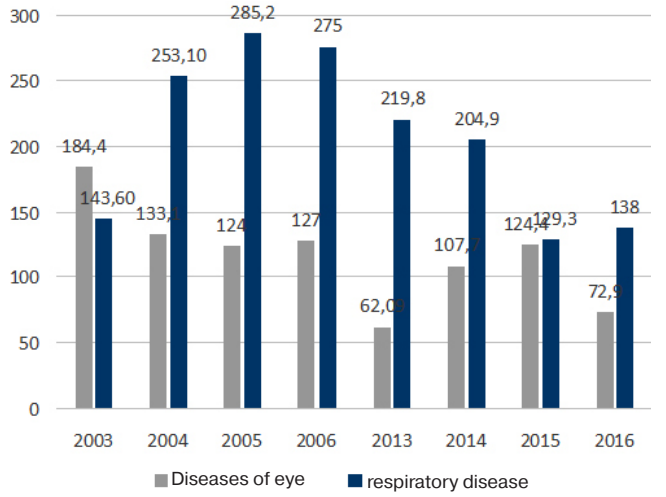

Fig. 3. The level of diseases that are undulating

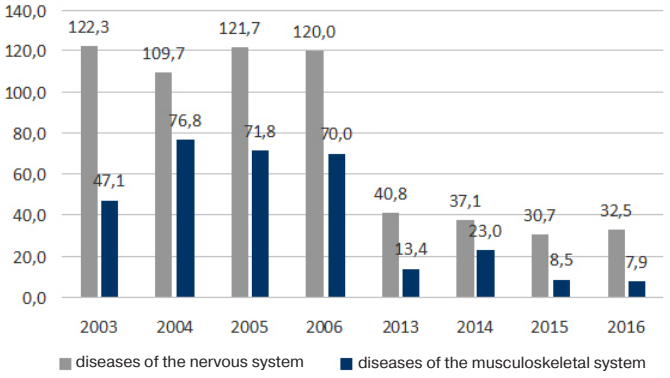

Fig. 4. The prevalence of diseases of the nervous and musculoskeletal systems

Diseases of the respiratory system (acute respiratory disease, acute respiratory viral infection, acute bronchitis) and the organs of vision throughout the entire study period constitute a large percentage of the total disease level (Fig. 3) and are undulating.

Diseases of the nervous system occupied one of the highest prevalence sites in the period from 2003 to 2006 (after respiratory and sight diseases), but in recent times there has been a significant decrease in the level of these diseases (the average value of diseases of the nervous system decreased 3,5 times). Also significantly (4 times) decreased diseases of the musculoskeletal system (Fig. 4).

At the same time, there is an increase (in 2 times) in the level of infectious and parasitic diseases (due to an increase in the incidence of pulmonary tuberculosis and yeast colpitis), diseases of the endocrine system (obesity, diabetes and thyroid diseases) and diseases of the genitourinary system (which is especially important for human reproductive health) (Fig. 5).

These official figures are incomplete due to the large number of private clinics that provide anonymous help.

The level of diseases of the circulatory system, which includes: borderline hypertension, hypertension, other heart and vascular diseases, was one of the highest among all the universities studied and was significantly higher than the average level of morbidity in higher education institutions [9], this trend continues to persist. Regarding the period of 10 years ago, the average increase in the level of these diseases increased by 80%.

On average, the level of digestive diseases increased by 10% (due to the growth of diseases such as dyskinesia of the gastrointestinal tract, gastritis and duodenitis).

Conclusions

1. As a result of the analysis, it was found that throughout the study period there was a high prevalence of respiratory, eye, nervous system diseases.

2. The maximum growth rates in recent years are inherent in circulatory diseases, infectious and parasitic diseases, diseases of the endocrine and genitourinary systems.

3. Our results confirm the findings of other authors about the deterioration of the health of students in Ukraine and confirmed the urgent need to improve preventive and medical care this contingent and the need to develop and conduct various activities aimed at counteracting the risk factors of diseases among KNURE students.

Further research is planned to be conducted in the direction of investigating the level of interrelation between the incidence and level of physical fitness of students over the last decade and the development and implementation of various measures aimed at counteracting the risk factors of diseases of students of a technical university.

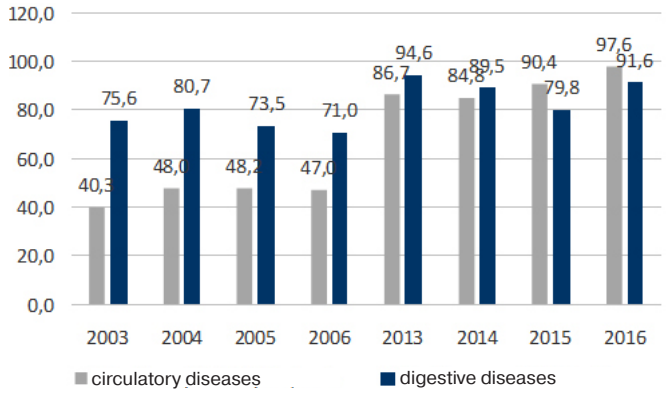

Fig. 6. Diseases of the organs of circulatory and digestive system

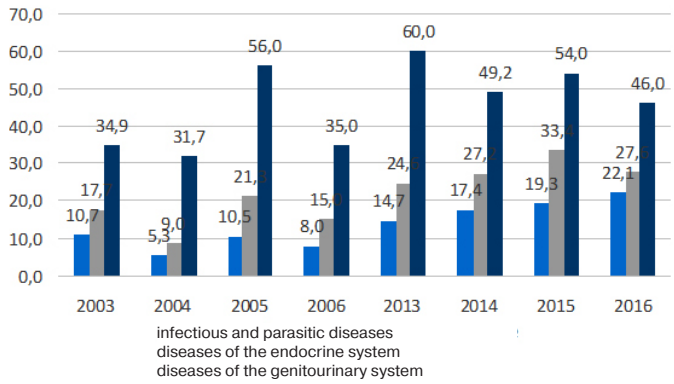

Fig. 5. Diseases which tend to increase

Conflict of interests. The authors declare that no conflict of interest.
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Information about the Authors

Elena Tserkovnaya: *Phd (Physical Education and Sport); Kharkov National University of Radio Electronics: Etc. Science, 14, Kharkov, 61000, Ukraine.*
ORCID.ORG/0000-0003-0655-9924
E-mail: luda_73_1@mail.ru

Victor Osipov: *Kharkov National University of Radio Electronics: Etc. Science, 14, Kharkov, 61000, Ukraine.*
ORCID.ORG/0000-0002-6709-4617
E-mail: omells@mail.ru

Liudmila Filenko: *PhD (Physical Education and Sport); Kharkiv State Academy of Physical Culture: Klochkovskaya str. 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0001-8215-9450
E-mail: filenkolv@mail.ru

Vladlena Pasko: *PhD (Physical Education and Sport); Kharkiv State Academy of Physical Culture: Klochkovskaya str. 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0001-8215-9450
E-mail: vladapas@mail.ru

SLOBOZANS'KIJ NAUKOVO-SPORTIVNIJ VISNIK

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Dynamics of the level of professionally applied psychophysical and psycho-physiological readiness of students of railway specialties

Anzhelika Yefremova[1]
Liudmila Shesterova[2]

[1]*Ukrainian State University of Railway Transport , Kharkiv, Ukraine*
[2]*Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine*

Purpose: *to investigate the influence of the experimental program of physical education with increased rate of professionally-applied physical training on the dynamics of psychophysical and psycho-physiological qualities of students of railway professions.)..*

Material & Methods: *in the study, 50 students (boys) of the 1st year of UkrSURT, faculty "Automation, telemechanics and communications" took part. The following research methods were used: theoretical analysis and generalization of scientific literature, pedagogical experiment, testing of professionally important psychophysical and psycho-physiological qualities, methods of mathematical statistics.*

Results: *presented result of testing of psychophysical and psycho-physiological qualities of students of experimental and control groups are. During initial testing set low level the above qualities. The influence of the experimental program on the indices of professionally important psychophysical and psycho-physiological qualities.*

Conclusions: *it found a positive effect of the experimental program of physical education with increased rate of professionally-applied physical preparation on professionally-applied psychophysical and psycho-physiological preparedness of students.*

Keywords: *psychophysical preparedness, psycho-physiological preparedness, professionally-applied physical preparation, psychophysical qualities, students.*

Introduction

New social and economic relations make high demands for modern professionals, including in the field of professional training them. This requires not only improvement of existing, but also the development and implementation of new educational programs for physical education, taking into account the specifics and conditions of professional activity.

Development of the concept of professional development specialist in the current conditions of transformation of production becomes today an important scientific and practical task, therefore the processes of forming a high professional level of competitive specialists are becoming increasingly relevant and significant.

It is known that the effective use of professional knowledge, skills and abilities is possible only with a specialist well-being, health and high efficiency, which can be purchased and developed in the course of employment is professional-applied physical preparation [2; 3]. After all, the more complex are the working conditions, the more perfect should be the level of professional psychophysical and psycho-physiological readiness future specialist, able to respond adequately and solve complex production problems [3].

L. P. Pilipay [8] found that a high professional level requires a significant overall, and in most cases, specific physical fitness preparedness.

Effective performance of tasks of professional activity by modern specialists of the railway industry in conditions of high production intensity and in combination with physical and neuro-emotional loads causes a high need for searching fundamentally new methodological approaches to the process of forming applied physical culture of future specialists. Having perfect professiographic studies of specific professional activities and taking into account their analysis, it is possible to define a fundamentally new approach to the content and organization of professionally applied physical training of students on the basis of the interaction of all mental functions, processes and states in the context of specific professional activities [9].

The study and analysis of scientific literature show that physical education helps create the necessary conditions for optimal development and improvement of physical, psychophysical and psycho-physiological qualities of future specialists, reduce the impact of negative emotions, reduce mental and physical fatigue. E. A. Kolinenko [6] believes that the sedentary lifestyle of a person leads to a worsening of cerebral circulation, and this negatively affects such mental processes as attention, memory, concentration, perception, processing and reproduction of information, etc.

Analysis of the research results of domestic and foreign authors proves the importance and the need to develop a methodology for professional-applied physical, psychophysical and psycho-physiological training of students [3; 5; 8; 11].

It is known that the basis for the implementation of professionally-applied physical training of university students is a professionalogram that reflects the requirements for the professional character of professional activity, contains information on professionally important qualities and is a kind of psychophysical model of the future specialist [9].

Scientific researches of many domestic and foreign authors show that the professional activity of specialists of railway transport makes high demands not only to the level of their physical readiness, but also to their psychophysical and psycho-physiological qualities. For a number of railway professions, long dynamic and static loads are characteristic, high coordination of hand movements, accuracy of motor actions, dexterity of hands and fingers, a sufficiently high level of attention and memory functions, a labile thinking, the ability to maintain an optimal level of efficiency and emotional stability for a long time.

Recently, many scientific works have been devoted to the study of professionally-applied physical training of specialists of various branches of production: motor transport, energy, agriculture, engineering, and others. However, the psychophysical and psycho-physiological features of the professionally applied training of railway professions, in particular, electrical engineers of railway transport, have not been practically studied. So, for today there is no information about the list of the main professionally important qualities of specialists of this specialization and the methodology of their development and improvement has not been developed. Thus, the study of the influence of special means, methods and forms of physical culture on the development and improvement of the professionally important qualities of railroad engineers is important and relevant.

The purpose of the research

to investigate the influence of the experimental program of physical education with increased rate of professionally-applied physical training on the dynamics of psychophysical and psycho-physiological qualities of students of railway professions.

Material and Methods of the research

The study involved 50 students (25 students (boys) experimental and 25 students (boys) of the control group) 1st year UkrSURT, faculty “Automation, telemechanics and communications”. Pedagogical experiment lasted two years

In the course of the experiment, the following research methods were used: analysis and generalization of scientific literature, testing of professionally important psychophysical and psycho-physiological qualities, pedagogical experiment, methods of mathematical statistics.

Results of the research and their discussion

During the experiment the students of the experimental group were engaged in physical education according to the experimental program, the students of the control group – according to the traditional.

Testing psychophysical and psycho-physiological qualities was carried out through a variety of tests that allowed to obtain reliable information about the occurrence of certain mental processes.

Based on the results of initial testing, the status of professionally important psychophysical and psycho-physiological qualities among students in the experimental and control groups was not statistically different (p>0,05) (table 1).

Analysis of the test results after the second year of training indicates a probable improvement in all the studied indicators of psychophysical and psychophysiological qualities in the students of the experimental group (p<0,05).

So, the results of the Gorbov test found that at the beginning of the experiment the assessment of the volume, distribution and switching of attention in the students of the experimental group was lower than in the students of the control group, and the arithmetic mean values in both groups corresponded to a low level. At the end of the experiment, the increase in volume, distribution and switching of attention in the students of the experimental group increased by 57,1%, in the control students, by 4,7%, which is equal to the excellent and low level, respectively.

Table 1

Indicators of professionally important attention functions of students in the experimental and control groups before and after the experiment

Indicators	Before experiment				Before experiment			
	EG	CG	Probability evaluation		EG	CG	Probability evaluation	
	$\bar{X}$±m		t	p	$\bar{X}$±m		t	p
Volume, distribution and switching of attention, c. u.	358,64±6,11	340,88±6,82	1,94	>0,05	153,72±1,54	324,76±4,33	37,25	<0,05
Selectivity of attention, c. u.	14,56±0,45	15,12±0,49	0,85	>0,05	24,88±0,07	16,28±0,39	21,54	<0,05
Sustainability of attention, c. u..	13,48±0,43	12,92±0,37	0,99	>0,05	24,12±0,27	13,36±0,24	29,39	<0,05
Voluntary attention, c. u.	20,36±0,35	19,64±0,26	1,66	>0,05	24,88±0,07	20,32±0,24	18,60	<0,05
Concentration of attention, c. u.	160,11±6,56	166,60±7,31	0,66	>0,05	380,68±38,13	190,59±10,06	4,82	<0,05

Selective attention evaluated by the Munsterberg method, at the beginning of the experiment, the students of experimental and control groups responsible assessment of "bad". For two years of classes on the experimental program, the increase in the parameters for the students of the experimental group was 70,9% and began to correspond to the "excellent" score, while in the control group students the indices rose only by 7,7% and remained at a low level.

Steadiness of attention, which was determined by the technique of "confused lines", at the beginning of the experiment, the students of both the experimental and control groups were equal to "3" points, that is, answered an unsatisfactory level on a 9-point scale. At the end of the experiment, the stability of attention in the students of the experimental group increased by 79%, in the control students – by 3,4%, that is equal to "9" and "3", respectively, which is defined as "excellent" and "unsatisfactory" level.

The results of the Burdon test, which examined the concentration of attention, were slightly higher in the beginning of the training for the students of the experimental group than for the students of the control group. At the end of the II year of training, the concentration of attention among the students of the experimental group increased by 137,8%, in the control students – on 14,4%.

Indicators of the voluntary attention level at the beginning of the experiment among the students of the control group were somewhat lower than in the students of the experimental. In general, in the students of both groups they were below the average norm. After the experiment, the indicators of voluntary attention among the students of the experimental group increased by 22,2%, which corresponded to the average rate, in the control group students – by 3,5%, that is, remained at the initial level.

Indicators of sensorimotor reactions of students in the experimental and control groups were not significantly different at the beginning of the experiment (p>0,05) (table 2).

At the beginning of the experiment, the time for simple reactions to light and sound, as well as the response time for the presence of a trait in both groups, was low.

After two years of experiment, the students of the experimental group had a 15,6% decrease in the time of a simple reaction to light and by 9,5% – the time of a simple reaction to sound. Complex reaction time in the presence and absence of feature also improved, it changes equal to 22,2% and 17%, respectively.

In the students of the control group, similar indices received minor improvements, except for the time of simple reaction to sound, where the deterioration of the results occurred 2,3%. Thus, during two years of studies, the time of a simple reaction to light decreased by 1,4%, the time of a complex reaction to the presence and absence of a sign decreased by 0,7% and 0,2%, respectively.

With the help of a teping test, the special efficiency of students was studied, where the number of clicks was calculated for every 30 seconds and the average frequency of movements for the sum of four attempts.

Comparison of the results of the teping test of the students of the experimental group before and after the experiment makes it possible to assert that there is a probability of differences between them (p <0.05), their percentage increase 20,7%. The students of the control group had no positive changes. So, after two years of training, the indicators improved only on 2,8%.

Table 2

Indicators of sensorimotor reactions of students in the experimental and control groups before and after the experiment

Indicators	Before experiment				Before experiment			
	EG	CG	Probability evaluation		EG	CG	Probability evaluation	
	$\bar{X}$±m		t	p	$\bar{X}$±m		t	p
Time of a simple reaction to light, ms	316,16±3,24	314,36±4,22	0,34	>0,05	266,76±1,88	309,84±3,62	10,57	<0,05
Time of simple reaction to sound, ms	405,04±6,37	401,04±5,47	0,48	>0,05	366,72±3,11	410,44±4,94	7,49	<0,05
Time of a complex reaction to differences in signs (the average reaction time for the presence of a characteristic), ms	994,72±10,17	998,48±13,57	0,22	>0,05	774,28±9,92	991,08±11,16	14,52	<0,05
Time of a complex reaction to signs of differences (mean reaction time for signs of), ms	991,16±9,14	994,04±18,52	0,14	>0,05	822,68±6,58	992,32±5,75	19,41	<0,05
Teping test	5,79±0,07	5,81±0,07	0,18	>0,05	6,99±0,04	5,97±0,05	16,77	<0,05
Muscular sensitivity of the leading brush with visual control, kg	30,52±0,80	31,28±0,78	0,68	>0,05	24,96±0,59	28,96±1,01	3,41	<0,05
Muscular sensitivity of the leading brush without visual control, kg	32,64±0,78	33,04±1,07	0,30	>0,05	27,84±0,95	33,12±0,66	4,43	<0,05

Table 3

Indicators of mental performance of students in the experimental and control groups before and after the experiment (E. Krepelin technique)

Indicators, c. u.	Before experiment				After experiment			
	EG	CG	Probability evaluation		EG	CG	Probability evaluation	
	$\bar{X}$±m		t	p	$\bar{X}$±m		t	p
Number of correctly composed pairs	130,00±0,33	129,84±0,32	0,35	>0,05	134,60±0,13	130,44±0,29	13,14	<0,05
Time taken to complete the test, s	254,68±8,47	275,84±9,37	1,68	>0,05	188,68±2,45	261,76±6,56	10,43	<0,05
Number of errors	5,00±0,33	5,16±0,32	0,35	>0,05	0,40±0,13	4,56±0,29	13,14	<0,05
Coefficient of efficiency	0,95±0,008	0,95±0,009	0,42	>0,05	0,99±0,003	0,96±0,008	3,77	<0,05

Kinestatic sensuality of the brush was determined by the force of compression of the dynamometer. First, the maximum force of the leading brush was determined, and then with the same hand it was necessary to compress the dynamometer by 50% of the maximum voltage without visual control.

A comparative analysis of the results of the muscle sensitivity of the leading brush without visual and visual control in the experimental group at the beginning of the experiment was slightly lower than in the control group and was assessed as a "below average" level for this age group.

After the end of the pedagogical experiment, the average indices of the muscular sensitivity of the hand without visual control in the students of the experimental group significantly increased, the difference between the visual and non-visual indices was 11,5%.

Analyzing the state of mental capacity for simple but monotonous work (E. Krepelin technique), it is necessary to note the positive dynamics of the indices of the students of the experimental group during two years of physical education. Thus, at the beginning of the experiment, the quantitative performance of work in both groups was almost the same, the number of errors averaged 5, and the time spent on the test varied from 4 min 24 s to 5 min. Coefficient of efficiency corresponds to 0,95 conventional units. However, at the end of the experiment, the number of correct answers in the experimental group 3,5%. In addition, they significantly, by 92%, reduced the number of errors in the performance of this test, the time spent on the test was reduced by 25,9%, and the efficiency factor increased by 4,2% (table 3).

In the control group, after two years of training in the traditional program, the number of correct answers improved by 0,5%, the number of errors decreased by 11,6%, the time spent on the test was reduced by 5,1%, and the efficiency factor increased by 1,1%.

Thus, analyzing the data obtained at the beginning and at the end of the pedagogical experiment, it can be asserted that the results of the study revealed positive and statistically reliable dynamics of the indices of professionally important psychophysical and psycho-physiological qualities among students engaged in physical culture under the experimental program.

Conclusions

1. Analysis of the results of the initial testing of professionally important psychophysical and psycho-physiological qualities of students of the experimental and control groups found that they did not differ statistically.

2. Under the influence of the program with the strengthened course of the professionally applied physical training of the students of the experimental group, the indicators of the quality of attention and intelligence increased significantly ($p<0,05$).

3. It is established that the indices of the professionally important psychophysical and psycho-physiological qualities of the students in the control group increased slightly, and in some cases even worsened.

Prospects for further research

Further research is planned to be directed to the development of a program of professionally-applied physical training for specialists of certain specialties of railway transport, taking into account age, state of health and physical readiness.

Conflict of interests. The authors declare that no conflict of interest.
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Information about the Authors

Anzhelika Yefremova: *senior lecturer, Ukrainian State University of Railway Transport: Feyerbaha square, 7, Kharkiv, 61050, Ukraine. PhD candidate; Kharkiv state academy of physical education: Klochkivska str. 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0002-9986-3329
E-mail: spark2005@mail.ru

Liudmyla Shesterova: *PhD (Physical Education and Sport); Assosiate Professor, Kharkiv State Academy of Physical Culture: Klochkovskaya str. 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0001-8777-6386
E-mail: shesterova1@mail.ru

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The reliability of the presented results correspond to authors

Publication of Kharkiv State Academy of Physical Culture
Kharkiv State Academy of Physical Culture
Klochkivska Str. 99, Kharkiv, 61058, Ukraine
+38 (0572) 705-21-02
sport-kharkov@mail.ru