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LEVEL OF STRENGTH DEVELOPMENT OF STUDENTS INVOLVED IN ROCK CLIMBING SPORTS SECTIONS USING EXERCISES ON DIFFERENT SIMULATORS

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Purpose: to determine the influence of rock climbing classes according to different programs on the level of strength development of students involved in rock climbing sports sections.

Material and methods: 45 student rock climbers (men) aged 18-23 participated in the study, who were engaged in rock climbing sections. The subjects were divided into three groups of 15 people each: the first - the control group (CG), included athletes who trained according to the standard method; the second - experimental group No. 1 (EG_1), included athletes who trained according to a standard program with the inclusion of specially designed exercises for the development of strength on the campus board; the third - experimental group No. 2 (EG_2), included athletes who went in for a standard program with the inclusion of

specially selected exercises on gymnastic rings. To assess the level of strength development and its dynamics, tests were used that illuminate as closely as possible the manifestations of strength in climbing, namely: hanging in the block, pulling up on the bar, pulling up to the chest, flexion of the extension of the arms in the lying position, wrist dynamometry, flexion of the hand with weights.

Results: in order to determine the influence of rock climbing lessons according to different programs on the level of strength development of students involved in rock climbing sports sections, an analysis of special indicators was carried out. So, it was revealed that the studied indicators in all groups during the experiment tended to improve.

Conclusions: it was found that exercises on a campus board and gymnastic rings have an unequal effect on the development of individual muscle groups, which allows us to conclude that it is necessary to combine these programs to ensure the diversified development of the strength of students involved in rock climbing sports sections.

Keywords: rock climbing, strength development, students, sports sections.

Introduction

Not a single sport can develop without the necessary theoretical support, in particular, in the form of developments in the theory and methodology of training and without solving the problems associated with the identification of physical fitness indicators, which largely determine the high result of competitive activity [1]. According to the results of recent years, it becomes obvious that the development of rock climbing has far outstripped its material and technical base (insufficient number of training stands, imperfection of their designs) and methodological approaches to training [9, 10].

The analysis of special literature shows that the modern scientific and methodological base in sports rock climbing is not sufficiently developed to ensure effective training of athletes. The publications on the topic of rock climbing are

mainly devoted to the development of coordination and general motor qualities [2, 5]. Foreign experts [6, 7, 8, 11, 12] have determined the determinants of physical readiness of climbers specializing in climbing on difficulty; by means of correlation analysis, the most significant physical qualities and mental processes influencing the sports and technical result for rock climbers of the 1st category in climbing on complexity. In the work of V.A. Galchinsky, L.A. Galchinsky, Yu.V. Kotchenko. [3] considered the factorial structure of physical fitness of female rock climbers, specializing in high-speed climbing in the framework of physical education at the university. The work of O. Shulga [5] is devoted to the study of the significance of the speed-strenght capabilities of the muscles of the girdle of the upper and lower extremities of climbers of 14-15 years old, specializing in speed climbing, the state of physical fitness of young climbers - Mulik K. V., Chichkunova A. Yu. [4].

Purpose of the work is to determine the influence of rock climbing on the level of strength development of students involved in sports rock climbing sections according to different programs.

Material and Methods of research

The study involved 45 male rock-climbing students aged 18-23, who were engaged in rock-climbing sections. The subjects were divided into three groups of 15 people each: the first - the control group (CG), included athletes who trained according to the standard method; the second - experimental group No. 1 (EG_1), included athletes who trained according to a standard program with the inclusion of specially designed exercises for the development of strength on the campus board; the third - experimental group No. 2 (EG_2), included athletes who went in for a standard program with the inclusion of specially selected exercises on gymnastic rings.

All groups studied three times a week with a duration of 3 hours per session. In the preparatory part of the lesson, generally accepted exercises were performed, and already at the beginning of the main part, exercises from a specially developed complex were included. At the beginning of the main part, students performed 4-5 exercises from the complex we proposed. This made it possible to perform the

exercises without errors due to the absence of fatigue. In the final part of the lesson, simple exercises were also given according to the complex we developed.

The study was conducted at the beginning of the school year and after 12 months of training. To assess the level of development of strength of students involved in sports sections of rock climbing, tests were used that as closely as possible illuminate the manifestations of strength in rock climbing.:

– hanging in a block - the subject performs hanging on a crossbar on bent arms at the elbow joint, with the formation of an angle of 90 degrees. On the command "Ready" the athlete takes a given position, and the coach starts the stopwatch.;

– pull-up on the bar - the subject grabs the bar with an average grip, grabs the bar with a brush from above. The athlete must complete the maximum number of pull-ups. The number of correctly performed times is recorded;

– pulling up to the chest - the subject grabs the bar with an average grip and grabs the bar with a brush from above. The athlete must complete the maximum number of pull-ups. The number of correctly performed times is recorded;

– flexion and extension of the arms in the lying position - performed on a flat surface. The test subject assumes a supine position, arms straightened and spread apart shoulder-width apart, brushes forward, body and legs form a straight line. On command, the participant begins to bend and unbend his arms rhythmically with full amplitude. The number of unmistakable flexions and extensions of the arms is recorded in one attempt;

– hand dynamometry - measurements are made three times with the choice of the best result. The hand holding the dynamometer should be kept parallel to the floor;

– flexion of the hand with weights - the subject sits on the bench of the simulator, takes the pancake with both hands with a grip from below, then puts his hands on a horizontal support so that the hands are in an unsupported position. Having taken the desired position, the athlete begins to perform flexion of the hand with weights.

All data obtained in the course of the experimental study were subject to processing using the methods of mathematical statistics.

Results of the research

In order to determine the influence of rock-climbing lessons according to different programs on the level of strength development of students involved in rock-climbing sports sections, an analysis of special indicators was carried out. So, it was found that the indicators that were studied in all groups during the experiment tended to improve. At the beginning of the experiment, significant differences in the studied parameters between all groups were not determined ($p>0,05$). The testing carried out at the end of the year according to the "hanging in the block" test (Table 1) revealed a significantly better result ($p<0,05$) in the experimental groups as compared with the control. So, in EG_1 the result is higher by 3,5 s in relation to the CG ($t_{1,2}=2,91$; $p<0,05$), and in EG_2 – by 3,4 s ($t_{1,3}=2,71$; $p<0,05$).

Table 1

Indicators of hanging in the block of students engaged in sports climbing sections ($n_1=n_2=n_3=15$)

Indicators		CG	EG_1	EG_2	Reliability assessment
		$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$	
Test 1: hanging in the block, s	Start of the year	52,63±1,37	51,82±0,97	51,91±1,23	$t_{1,2}=0,42$; $p>0,05$ $t_{1,3}=0,38$; $p>0,05$ $t_{2,3}=0,06$; $p>0,05$
	End of the year	69,84±1,03	73,33±0,62	73,21±0,72	$t_{1,2}=2,91$; $p<0,05$ $t_{1,3}=2,71$; $p<0,05$ $t_{2,3}=0,11$; $p>0,05$

The indicators of pulling up students by the end of the year were also significantly higher in the experimental groups in relation to the control group by 1,6 ($t_{1,2}=2,88$; $p<0,05$) and 1,4 times ($t_{1,3}=2,22$; $p<0,05$), respectively (Table 2).

Table 2

Indicators of pull-ups of students engaged in sports climbing sections ($n_1=n_2=n_3=15$)

Indicators		CG	EG_1	EG_2	Reliability assessment
		$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$	
Test 2: pull-up, number of times	Start of the year	16,9±1,4	17,0±1,0	17,3±1,2	$t_{1,2}=0,13$; $p>0,05$ $t_{1,3}=0,50$; $p>0,05$ $t_{2,3}=0,39$; $p>0,05$
	End of the year	24,7±1,0	26,3±0,6	26,1±0,5	$t_{1,2}=2,88$; $p<0,05$ $t_{1,3}=2,22$; $p<0,05$ $t_{2,3}=0,35$; $p>0,05$

The test results for the first two tests indicate that the additional use of a campus board and gymnastic rings in the training process of climbers has the same effect on the development of special strength of the arm muscles. Classes on the campus board made it possible to double the number of pull-ups, however, they did not have a statistically significant difference in comparison with the control group, in which the increase for the year was also 2 times (Table 3). The results of exercises on gymnastic rings in EG_2 are statistically significantly higher not only in relation to the CG, but also in relation to EG_1. So, the difference with CG is 1,9 times ($t_{1,3}$=3,87; $p<0,01$), and with EG_1 – 1,4 times ($t_{2,3}$=3,11; $p<0,01$).

Table 3

Indicators of pull-ups to the chest of students engaged in sports climbing sections ($n_1=n_2=n_3=15$)

Indicators		CG	EG_1	EG_2	Reliability assessment
		$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$	
Test 3: pulling up to the chest, number of times	Start of the year	6,2±0,3	6,3±0,3	6,4±0,3	$t_{1,2}$=0,22; $p>0,05$ $t_{1,3}$=0,46; $p>0,05$ $t_{2,3}$=0,22; $p>0,05$
	End of the year	12,1±0,4	12,6±0,4	14,0±0,3	$t_{1,2}$=0,92; $p>0,05$ $t_{1,3}$=3,87; $p<0,01$ $t_{2,3}$=3,11; $p<0,01$

Similar results were obtained in terms of the test "Flexion and extension of the arms in support, lying on the floor" (Table 4). Indicators of EG_2 are higher in relation to the CG by 2,6 times ($t_{1,3}$=3,87; $p<0,01$) in relation to EG_1 – by 2,6 times ($t_{2,3}$=2,80; $p<0,05$).

Table 4

Indicators of flexion and extension of arms in support, lying on the floor of students engaged in sports climbing sections ($n_1=n_2=n_3=15$)

Indicators		CG	EG_1	EG_2	Reliability assessment
		$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$	
Test 4: flexion and extension of the arms in support, lying on the floor, number of times	Start of the year	32,8±0,6	32,6±0,5	32,9±0,4	$t_{1,2}$=0,24; $p>0,05$ $t_{1,3}$=0,18; $p>0,05$ $t_{2,3}$=0,51; $p>0,05$
	End of the year	44,7±0,5	45,6±0,5	47,3±0,4	$t_{1,2}$=1,26; $p>0,05$ $t_{1,3}$=3,87; $p<0,05$ $t_{2,3}$=2,80; $p<0,05$

These two tests indicate a greater effect of exercise on gymnastic rings on the muscles of the upper shoulder girdle and deltoid back muscles. The next two tests were designed to test specific hand strength and forearm muscle strength. Thus, the indices of hand dynamometry (Table 5) at the end of the year were significantly higher in EG_1 in relation to the CG by 2,6 kg ($t_{1,2}$=3,55; p<0.01) and by 2,2 kg ($t_{2,3}$=3,04; p<0,01) in relation to EG_2, and the indices of flexion of the hand with weights (Table 6) by 2,3 ($t_{1,2}$=3,65; p<0,01) and 1,8 ($t_{2,3}$=3,43; p<0.01) times, respectively.

Table 5

Indicators of hand dynamometry of students engaged in sports climbing sections (n_1=n_2=n_3=15)

Indicators		CG	EG_1	EG_2	Reliability assessment
		$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$	
Test 5: hand dynamo-metry, kg	Start of the year	55,5±0,7	55,3±0,6	55,7±0,6	$t_{1,2}$=0,23; p>0,05 $t_{1,3}$=0,22; p>0,05 $t_{2,3}$=0,50; p>0,05
	End of the year	63,7±0,6	66,3±0,4	64,1±0,6	$t_{1,2}$=3,55; p<0,01 $t_{1,3}$=0,48; p>0,05 $t_{2,3}$=3,04; p<0,01

Table 6

Indicators of flexion of the hand with weights of students engaged in sports climbing sections (n_1=n_2=n_3=15)

Indicators		CG	EG_1	EG_2	Reliability assessment
		$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$	
Test 6: flexion of the hand with weights, number of times	Start of the year	7,5±0,4	7,6±0,4	7,7±0,4	$t_{1,2}$=0,17; p>0,05 $t_{1,3}$=0,34; p>0,05 $t_{2,3}$=0,18; p>0,05
	End of the year	12,5±0,5	14,8±0,4	13,0±0,3	$t_{1,2}$=3,65; p<0,01 $t_{1,3}$=0,91; p>0,05 $t_{2,3}$=3,43; p<0,01

Thus, it was found that the use of experimental programs is more effective in increasing the level of strength abilities of athletes-climbers. However, at the same time, exercises on the camrusboard and gymnastic rings have an unequal effect on the development of individual muscle groups, which allows us to conclude that it is necessary to combine these programs to ensure the diversified development of the strength of students involved in sports climbing sections.

Conclusions / Discussion

The analysis of special literature shows that the modern scientific and methodological base in sports rock climbing is not sufficiently developed to ensure effective training of athletes. Therefore, there is an urgent need to determine the development of what physical qualities of climbers is decisive for achieving high sports results.

Exercises on a campus board and gymnastic rings have an unequal effect on the development of individual muscle groups, which allows us to conclude that it is necessary to combine these programs to ensure the diversified development of the strength of students involved in sports climbing sections.

The results of exercises on gymnastic rings made it possible in experimental group No. 2 to obtain a statistically significant difference not only in relation to the control group, but also in relation to the group that used exercises on the camrusboard in terms of pull-ups, flexion and extension of the arms in support, lying on the floor.

At the same time, campusboard exercise yielded a statistically significant difference with respect to the group exercising on gymnastic rings in terms of wrist dynamometry and in terms of weighted flexion of the hand.

Prospects for further research are in the study of the experience of the leading coaches of Ukraine in the development of strength abilities among qualified athletes-climbers.

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References

1. Baykovskiy, YU. V. (2010), Teoriya i metodika trenirovki v gornykh vidakh sporta [Theory and methodology of training in mountain sports]: uchebno-metodicheskoye posobiye . M.: TVT Divizion, 304 p. (in Russ.).

2. Hal′chyns′ka, L. (2008), «The main factors that affect the sports result in high-speed climbing», Moloda sportyvna nauka, T.2. pp. 61-63 (in Ukr.).
3. Hal′chyns′kyy, V. A., Hal′chyns′ka, L. A., Kotchenko, YU. V. (2002), «Increasing vestibular stability and coordination of movements through climbing», Visnyk tekhnolohichnoho universytetu Podillya, №5, № 3 (48). pp. 114-115 (in Ukr.).
4. Mulyk, K. V., Chychkunov, A. YU. (2016), «The content of special development complexes aimed at the development of strength qualities of rock climbers», Mizhnarodnyy naukovyy zhurnal, №11(21), T.1. pp. 126-129. (in Ukr.).
5. Shul′ha O. (2010), «Physical fitness of athletes 14-15 years old who specialize in speed climbing», Aktual′ni problemy fizychnoyi kul′tury i sportu, № 18 (2), pp. 30-35 (in Ukr.).
6. Draper, N., Giles, D., Taylor, N., Vigouroux, L., España-Romero, V., Baláš, J., Solar Altamirano, I., Mally, F., Beeretz, I., Couceiro Canalejo, J., Josseron, G., Kodejška, J., Arias Téllez, M. J., Cabeza de Vaca, G. G. (2021), «Performance Assessment for Rock Climbers: The International Rock Climbing Research Association Sport-Specific Test Battery», International Journal of Sports Physiology and Performance, 16(9), pp. 1242-1252. (in Eng.).
7. Eva López-Rivera, Juan José González-Badillo, Vanesa España-Romero, (2022), «Which is the most reliable edge depth to measure maximum hanging time in sport climbers?», Gait & Posture, Volume 91, pp. 59-65. (in Eng.).
8. Hamilton, N. (2007), «Investigating the differences between beginners and advanced climbers», XXV ISBS Symposium, pp. 587-590. (in Eng.).
9. Kozin, S., Kozina, Z., Korobeinik, V., Cieślicka, M., Muszkieta, R., Ryepko, O., Boychuk, Yu., Evtifieva, I., Bejtka, M. (2021), «Neuro-muscular training for injury prevention of students-rock climbers studying in the specialty «Physical Education and Sports»: a randomized study», Journal of Physical Education and Sport, 21(Suppl. issue 2), pp. 1251-1259. (in Eng.).
10. Kozin, S.V. (2019), «Biomechanical substantiation of the technique of hanging in rock climbing», Zdorov'â, sport, reabìlìtacìâ, № 5(1), pp. 25-35. (in Eng.).
11. Memnier, C. M., Janot, J. M., Parker, D. L., Swan, J. G. (2000), «Physiological

and anthropometric determinants of sport climbing performance», British Journal of Sports – Medicine, № 34, pp. 359-366. (in Eng.).
12. Rovniy, A., Mulyk, K., Perebeynos, V. et al. (2018), «Optimization of Judoist Training Process at a Stage of Gradual Decline of Sporting Achievements», Journal of Physical Education and Sport, №18 (4), pp. 256–261. (in Eng.).

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DETERMINATION OF THE INFLUENCE OF THE EXPERIMENTAL PROGRAM OF BASIC ELEMENTS ON THE FORMATION OF THE FACTOR STRUCTURE OF THE ASSIMILATION OF SPORTS ACROBATICS BY YOUNG NOVICE ATHLETES

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Purpose: to study the influence of the experimental program on the formation of the factor structure of mastering the basic elements of the technique of young acrobats 6-7 years old.

Material and methods: the study involved young novice acrobats 6-7 years old school №4 in the amount of 19 people (10 guys and 9 girls). General and specific physical exercises and psychophysiological characteristics were used as tests. The factor analysis of the calculation was used, which was carried out by the statistical method developed and presented in the works of S. Spearman and G. Thompson.

Results: the conducted factor analysis made it possible to determine a number of factors that determine the quality of mastering the basic elements of sports acrobatics techniques by young athletes of 6-7 years old.

Conclusions: it was found that in the process of applying the experimental program, a redistribution of factors was carried out: 4 groups of factors were identified: psychophysiological, general preparatory, specially preparatory and others

in basic exercises ("swallow", "bridge", "standing on the shoulder blades, "forward roll", "wheel") in the direction of performing special preparatory exercises.

Keywords: sports acrobatics, basic exercises, young acrobats.

Introduction

The level of development of modern acrobatics is characterized by exceptionally high sports achievements, a significant increase in competition among athletes, which necessitates the search for new ways to improve training, especially for novice athletes, in particular, when physical and technical readiness is formed.

When mastering individual elements of the technique, it is necessary to achieve a certain level of physical qualities, without which their implementation is impossible or there is a threat of mastering movements with significant errors, which will negatively affect their structural quality. To date, there are studies of Koval S.S. (2010), Kharchenko T.P., Mulik V.V. (2009) [5, 11] about mastering the complex development of motor qualities and mastering the elements of technique in young athletes at the stage of initial training in figure skating and football, which gave a positive effect.

Today there are several approaches to teaching individual elements of technology: start learning from simple and more complex elements [2, 4, 12, 14]; training should be carried out at the beginning of the lesson [1, 6, 13]; use special training exercises, etc. [3, 15].

The problem of evaluating the technique of performing any competitive exercise is a primary task in any kind of sports and professional labor activity. Its essence lies in the fact that it is necessary not only to determine the movement of the body or individual biokinematic links, but to carry out these actions with minimal energy consumption. The availability of modern technology has greatly simplified the solution of this kind of problem [8, 10].

This problem and its solution can be considered by the example of determining the level of mastering the basic elements of acrobatics at the initial stage of the

training process. At the heart of all types of acrobatics is the individual mastering of the basic elements of the technique of such exercises as: "swallow", "stand on the shoulder blades", "forward roll", "bridge". One of the objectives of the study was to establish a correlation between the use of each exercise for mastering the technique of basic elements. At the same time, the position was taken into account that for the effective mastering of basic elements, special preparatory exercises should correspond in terms of the structure of movement, the structure of efforts and the mechanisms of forming a united functional system that ensures their implementation [7, 9, 11, 12].

Therefore, the sequence and combination of the use of exercises for mastering the individual basic elements of acrobatics was established. At the initial stage, first of all, it is required to master the structure of movements (both in static poses and in the dynamics of execution), and the structure of efforts while holding the poses. Only after mastering the individual components of special poses is it possible to switch to dynamic efforts during the performance of first individual exercises, and then in combination. In this regard, it became necessary to determine motor actions and motor qualities at the expense of individual muscle groups, as well as the level of their manifestation when performing a separate exercise.

Connection with scientific programs, plans, themes. The study was carried out in accordance with the initiative theme of research work for 2016-2020. under the title "Psycho-sensory regulation of motor activity of athletes in situational sports" (state registration number № 0116U008943). The role of the author in the completed topic was to substantiate the methodology for mastering the basic elements of the technique of young acrobats at the initial stage of training.

Purpose of the study is to develop and experimentally implement programs for mastering the basic elements of acrobatics techniques by beginner athletes 6-7 years old.

Material and Methods of research

Factor analysis was carried out on the basis of the stage of control tests. The obtained data, which serve as the basis for correlation analysis, is a measure of the

static relationship of two or more variables. At the same time, the classical Bravais-Pearson correlation coefficient is intended to characterize the tightness of communication in a two-dimensional distribution and a linear relationship between the studied indicators. Thus, correlation analysis is the starting material for factor analysis, the greater the value of r, the greater the tightness of the relationship between the features. Factor analysis consists in converting the intercorrelation matrix of tests into a matrix of factorial loads of lower dimension. Most often, when conducting factor analysis, the processing of the correlation matrix by the method of principal components is used, and the procedure for isolating the principal components is basically similar to rotation, which maximizes the variance (varimax) of the original space of variables.

Results of the research

The conducted factor analysis allowed to determine a number of factors that determine the quality of mastering the basic elements of sports acrobatics by young athletes of 6-7 years old. So, by the beginning of the study, four groups of factors were identified that characterize the formation of the exercise "swallow" (Table 1).

The most significant is the psychophysiological factor (factor 1), the indicators of which affect the performance of the "swallow" and amount to 42,7% (Table 1) with a correlation level of indicators of 0,64-0,88.

The second factor is special-preparatory (26,0%), consisting of exercises that partially correspond to the structure of movements of this exercise with an average level of correlation. (t=0,42-0,64).

The third factor - general physical fitness (20,2%) includes exercises that have below the average level of correlation (t=0,36-0,40) of the influence of these exercises on the performance of the "swallow" exercise.

The fourth factor is made up of scattered other indicators (psychological, coordination and others) in the amount of 11,1% with an insignificant level of correlation of the impact on the performance of the specified exercise.

After the introduction of the author's program, the interest was redistributed for each of the factors (Table 2). Thus, the first factor (psychophysiological) decreased to

35,7%, which is 7,0% less, while the second factor (special training) increased to 35,0% (+ 9,0%), and the contribution of general physical training (the third factor) changed significantly (from 20,2% to 19,1%), as well as the fourth factor (other indicators), decreased to 10,2% of the total sample.

Table 1

Factor structure of the formation of the basic exercise of sports acrobatics "Swallow" novice athletes, at the beginning and end of the study

№	Indicators		F1	F2	F3	F4
1	Flexion and extension of the arms in the lying position	at the beginning			0,36	
		at the end			0,34	
2	Flexion and extension of the legs, keeping the angle in the hanging with the back to the gymnastic wall	at the beginning			0,38	
		at the end			0,36	
3	Long jump from a place with a push of both legs	at the beginning			0,40	
		at the end			0,38	
4	Bend forward while sitting on the floor with legs apart	at the beginning			0,39	
		at the end			0,39	
5	Running for 30m	at the beginning			0,28	
		at the end			0,29	
	Swing your leg while facing the gymnastic wall	at the beginning		0,42		
		at the end		0,56		
7	Maintaining balance, standing on one leg against the gymnastic wall	at the beginning		0,56		
		at the end		0,59		
8	Maintaining balance, standing on one leg from 3-4 s to 10-12 s	at the beginning		0,64		
		at the end		0,66		
9	Balance on two legs with closed eyes	at the beginning		0,48		
		at the end		0,54		
10	Balance on one leg with closed eyes	at the beginning		0,60		
		at the end		0,62		
11	Romberg's test is complicated	at the beginning	0,64			
		at the end	0,62			
12	Test Biryuk	at the beginning	0,68			
		at the end	0,66			
13	Equilibrium "swallow"	at the beginning	0,88			
		at the end	0,88			
14	Vestibular dynamic test	at the beginning	0,65			
		at the end	0,60			
15	Dynamic balance 1	at the beginning	0,60			
		at the end	0,58			
16	Dynamic balance 2	at the beginning	0,65			
		at the end	0,61			
17	Vestibular dynamic test	at the beginning	0,31			
		at the end	0,32			
%		at the beginning	42,7	26,0	20,2	11,1
		at the end	35,7	35,0	19,1	10,2

During the exercise "bridge", three main factors were formed. The most significant exercises of special physical training (37,6%), the components of psychophysiological training are 33.4%, general physical training – 18,3%, and other indicators – 10,7% (Table 2).

Table 2

The factor structure of the formation of the basic exercise of sports acrobatics "Bridge" of novice athletes at the beginning and end of the study

№	Indicators		F1	F2	F3	F4
1	Flexion and extension of the arms in the lying position	at the beginning			0,41	
		at the end			0,40	
2	Flexion and extension of the legs, keeping the angle in the hanging with the back to the gymnastic wall	at the beginning			0,43	
		at the end			0,41	
3	Long jump from a place with a push of both legs	at the beginning			0,27	
		at the end			0,26	
4	Bend forward while sitting on the floor with legs apart	at the beginning			0,34	
		at the end			0,32	
5	Running for 30m	at the beginning			0,26	
		at the end			0,27	
6	Swing your leg while facing the gymnastic wall	at the beginning		0,56		
		at the end		0,76		
7	Maintaining balance, standing on one leg against the gymnastic wall	at the beginning		0,54		
		at the end		0,58		
8	Maintaining balance, standing on one leg from 3-4 s to 10-12 s	at the beginning		0,60		
		at the end		0,72		
9	Balance on two legs with closed eyes	at the beginning		0,58		
		at the end		0,74		
10	Balance on one leg with closed eyes	at the beginning		0,64		
		at the end		0,72		
11	Romberg's test is complicated	at the beginning	0,54			
		at the end	0,52			
12	Test Biryuk	at the beginning	0,62			
		at the end	0,60			
13	Equilibrium "swallow"	at the beginning	0,40			
		at the end	0,41			
14	Vestibular dynamic test	at the beginning	0,47			
		at the end	0,45			
15	Dynamic balance 1	at the beginning	0,49			
		at the end	0,47			
16	Dynamic balance 2	at the beginning	0,51			
		at the end	0,50			
17	Vestibular dynamic test	at the beginning	0,41			
		at the end	0,43			
%		at the beginning	33,4	37,6	18,3	10,7
		at the end	27,9	43,8	18,2	10,1

The introduction of an experimental program for mastering the technique of performing the exercise of "bridges" to a greater extent increased the significance of special physical training exercises, which reached 43,8% (at the beginning of 37,6%) due to a decrease in the contribution of psychophysiological indicators (from 33,4% to 27,9 %) and general preparatory exercises, which remained at the same level (18,3 and 18,2%) (Table 2). Our indicators, which are not included in the first three factors, also underwent changes (from 10,7 to 10,1), which indicates a more specialized influence of the experimental method.

The stand on the shoulder blades requires the manifestation of the strength qualities of the muscles of the lower extremities and the abdominal press, as well as coordination of movements. At the beginning of the study, the psychophysiological parameters associated with maintaining the stand on the shoulder blades had the greatest contribution to the performance of this exercise. This especially concerns the performance of the Romberg (r=0,02) and Biryuk (r=0,64) and dynamic equilibrium (r=0,63) tests included in factor 1 (r=0,58; 37,0%) of total (Table 3). The second factor (special-preparatory) was formed by the indicators of special exercises (r=0,50; 31,3%), and the third factor (general-preparatory) was formed by exercises that, in their structure of movements, do not correspond to individual elements of the specified special-preparatory exercise (r=0,36; 11,6%) The remaining indicators, not included in the first three factors, were 11,6%.

The introduction of the experimental technique did not have a significant impact on the formation of the factor structure that affects the implementation of the "stand on the shoulder blades" (Table 3).

The first factor (psychophysiological) is more significant, the indicators of which have a significant impact on the coordination of movements (r=0,58; 35,2%). The contribution of the second factor slightly increased (from 31,3% to 33,0%), leaving the third factor at the level of 20,4%, and the rest of the indicators – by 11,4%.

Performing the "forward rol" exercise depends mainly on the work of the vestibular analyzer, therefore the first factor consists of psychophysiological

indicators (r=0,56; 36,9%) (Table 4). The average group indicator of the special preparatory factor is r=0,51 (31,6%), and the general preparatory factor is 0,36 (20,05). The rest of the indicators are 11,5%.

Table 3

The factor structure of the formation of the basic exercise of sports acrobatics "Stand on the shoulder blades" ("Birch") of novice athletes at the beginning and end of the study

№	Indicators		F1	F2	F3	F4
1	Flexion and extension of the arms in the lying position	at the beginning			0,35	
		at the end			0,36	
2	Flexion and extension of the legs, keeping the angle in the hanging with the back to the gymnastic wall	at the beginning			0,41	
		at the end			0,44	
3	Long jump from a place with a push of both legs	at the beginning			0,37	
		at the end			0,36	
4	Bend forward while sitting on the floor with legs apart	at the beginning			0,39	
		at the end			0,41	
5	Running for 30m	at the beginning			0,27	
		at the end			0,27	
6	Swing your leg while facing the gymnastic wall	at the beginning		0,32		
		at the end		0,34		
7	Maintaining balance, standing on one leg against the gymnastic wall	at the beginning		0,48		
		at the end		0,52		
8	Maintaining balance, standing on one leg from 3-4 s to 10-12 s	at the beginning		0,49		
		at the end		0,50		
9	Balance on two legs with closed eyes	at the beginning		0,58		
		at the end		0,64		
10	Balance on one leg with closed eyes	at the beginning		0,65		
		at the end		0,67		
11	Romberg's test is complicated	at the beginning	0,62			
		at the end	0,62			
12	Test Biryuk	at the beginning	0,64			
		at the end	0,63			
13	Equilibrium "swallow"	at the beginning	0,51			
		at the end	0,50			
14	Vestibular dynamic test	at the beginning	0,52			
		at the end	0,54			
15	Dynamic balance 1	at the beginning	0,60			
		at the end	0,60			
16	Dynamic balance 2	at the beginning	0,63			
		at the end	0,62			
17	Vestibular dynamic test	at the beginning	0,52			
		at the end	0,53			
%		at the beginning	37,0	31,3	20,1	11,6
		at the end	35,2	33,0	20,4	11,4

The use of a specialized program largely influenced the formation of the second factor, the indicators of which increased from 31,6% to 33,0%, but the first (psychophysiological) factor remained the leading factor (36,9 and 36,7%). At the same time, the general preparatory factor and other indicators decreased from 20,0% to 19,2% from 11.5% to 11,1% (Table 4).

Table 4

The factor structure of the formation of the basic exercise of sports acrobatics "forward roll" of novice athletes athletes as of the beginning and end of the study

№	Indicators		F1	F2	F3	F4
1	Flexion and extension of the arms in the lying position	at the beginning			0,34	
		at the end			0,31	
2	Flexion and extension of the legs, keeping the angle in the hanging with the back to the gymnastic wall	at the beginning			0,40	
		at the end			0,38	
3	Long jump from a place with a push of both legs	at the beginning			0,36	
		at the end			0,32	
4	Bend forward while sitting on the floor with legs apart	at the beginning			0,42	
		at the end			0,40	
5	Running for 30m	at the beginning			0,26	
		at the end			0,25	
6	Swing your leg while facing the gymnastic wall	at the beginning		0,38		
		at the end		0,45		
7	Maintaining balance, standing on one leg against the gymnastic wall	at the beginning		0,46		
		at the end		0,48		
8	Maintaining balance, standing on one leg from 3-4 s to 10-12 s	at the beginning		0,60		
		at the end		0,66		
9	Balance on two legs with closed eyes	at the beginning		0,58		
		at the end		0,68		
10	Balance on one leg with closed eyes	at the beginning		0,52		
		at the end		0,56		
11	Romberg's test is complicated	at the beginning	0,54			
		at the end	0,60			
12	Test Biryuk	at the beginning	0,52			
		at the end	0,58			
13	Equilibrium "swallow"	at the beginning	0,48			
		at the end	0,46			
14	Vestibular dynamic test	at the beginning	0,63			
		at the end	0,68			
15	Dynamic balance 1	at the beginning	0,60			
		at the end	0,68			
16	Dynamic balance 2	at the beginning	0,62			
		at the end	0,66			
17	Vestibular dynamic test	at the beginning	0,56			
		at the end	0,60			
%		at the beginning	36,9	31,6	20,0	11,5
		at the end	36,7	33,0	19,2	11,1

Table 5

The factor structure of the formation of the basic exercise of sports acrobatics "Wheel" of novice athletes at the beginning and at the end of the study

№	Indicators		F1	F2	F3	F4
1	Flexion and extension of the arms in the lying position	at the beginning			0,50	
		at the end			0,51	
2	Flexion and extension of the legs, keeping the angle in the hanging with the back to the gymnastic wall	at the beginning			0,46	
		at the end			0,48	
3	Long jump from a place with a push of both legs	at the beginning			0,42	
		at the end			0,40	
4	Bend forward while sitting on the floor with legs apart	at the beginning			0,41	
		at the end			0,40	
5	Running for 30m	at the beginning			0,29	
		at the end			0,28	
6	Swing your leg while facing the gymnastic wall	at the beginning		0,41		
		at the end		0,43		
7	Maintaining balance, standing on one leg against the gymnastic wall	at the beginning		0,61		
		at the end		0,62		
8	Maintaining balance, standing on one leg from 3-4 s to 10-12 s	at the beginning		0,60		
		at the end		0,61		
9	Balance on two legs with closed eyes	at the beginning		0,58		
		at the end		0,64		
10	Balance on one leg with closed eyes	at the beginning		0,56		
		at the end		0,58		
11	Romberg's test is complicated	at the beginning	0,65			
		at the end	0,65			
12	Test Biryuk	at the beginning	0,62			
		at the end	0,63			
13	Equilibrium "swallow"	at the beginning	0,60			
		at the end	0,56			
14	Vestibular dynamic test	at the beginning	0,66			
		at the end	0,67			
15	Dynamic balance 1	at the beginning	0,62			
		at the end	0,64			
16	Dynamic balance 2	at the beginning	0,65			
		at the end	0,67			
17	Vestibular dynamic test	at the beginning	0,53			
		at the end	0,56			
%		на початок	40,3	28,8	21,4	10,2
		на кінець	40,8	29,3	21,3	8,6

The most difficult exercise to perform is the "Wheel", during which motor activity involves the movement of different parts of the body in space (Table 5). Therefore, the first factor takes the leading place (40,3%) in the formation of the dynamic structure of movements. Through the use of Romberg's tests (r=0,65) and

Biryuk (r=0,62), as well as the vestibular-static test (r=0,66) and dynamic balance 1 (r=0,62) and dynamic equilibrium 2 (r=0,65). Factor 2 (special preparatory) has an average correlation index r=0,55 and 28,8% of the total variance. General preparatory (factor 3) has 21,4%, and other indicators – 10,2% of the total variance.

The use of the experimental technique left the significance of the factors at the same level (the first factor – 40,3 and 40,8%), the second – 28,8 and 29,3%; the third – 21,4 and 21,3%. Along with this, the content of other factors decreased – from 10,2 to 8,6% (Table 5).

Conclusions / Discussion

In the course of the study, it was found that under the influence of the experimental methodology, the percentage of factors that determine the quality of mastering the basic elements of sports acrobatics by young athletes of 6-7 years old were reorganized.

In the exercise "Swallow" at the beginning of the study, factor 1 (psychophysiological) was 42,7%, factor 2 (special preparatory) – 26,0%, factor 3 (general physical fitness) – 20,2%, factor 4 (other indicators) – 11,1%. By the end of the study, factor 1 was 35,7%, factor 2 – 35,0%, factor 3 – 19,1%, factor 4– 10,2 %.

In the exercise "Bridge": factor 1 – 33,4% at the beginning of the study, 27,9% at the end of the study; factor 2 – 37,6% and 43.8%, respectively; factor 3 – 18,3% and 18,2%, respectively; in factor 4 – 10,7% and 10,1%, respectively.

In the exercise "Stand on the shoulder blades": factor 1 – 37,0% and 35,2%; factor 2 – 31,3% and 33,0%; factor 3 – 20,1% and 20,4%; factor 4– 11,6 % and 11,4 %.

In the "Forward roll" exercise: factor 1 – 36,9% and 36,7%; factor 2 – 31,6% and 33,0%; factor 3 – 20,0% and 19,2%; factor 4 – 11,5% and 11,1%.

In the exercise "Wheel": factor 1 - 40.3% and 40.8%; factor 2 – 28,8% and 29,3%; factor 3 – 21,4% and 21,3%; factor 4 – 10,2% and 8,6%.

Thus, the use of special auxiliary exercises for each basic exercise contributed to an increase in the value of the factor that determines special physical preparedness (factor 2).

Prospects for further research. The obtained results make it possible to purposefully use separate special-preparatory exercises when constructing training in basic acrobatic exercises for young novice athletes.

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References

1. Boloban, V. N. (1988), Metodika otbora detey dlya zanyatiy akrobatikoy. Sportivnaya akrobatika. [Methodology for selecting children for acrobatics. Sports acrobatics] Kiyev: Vishcha shkola, pp. 59-64. (in Russ.).

2. Bernshteyn, N. A. (1991), O lovkosti i yeye razvitii [On agility and its development]. Moskva: Fizkul'tura i sport, 288 p. (in Russ.).

3. Volkov, L. V. (2002), Teoriia i metodika detskogo i iunosheskogo sporta [Theory and methodology of children's and youth sports]. Kiev : Olimpiiskaia literatura, 295 p. (in Russ.).

4. Issurin, V. B. (2016), Podgotovka sportsmenov XXI veka: nauchnye osnovy i postroenie trenirovki [Training of athletes of the XXI century: scientific foundations and construction of training]. Moskva: Sport, 464 p. (in Russ.).

5. Koval, S. S. (2010), «Investigation of the relationship between speed qualities and technical and tactical actions of young football players 8-12 years old», Slobozhanskii naukovo-sportivnii visnik, No 1, pp. 99-102. (in Russ.).

6. Kostiukevych, V. M. (2007), Teoriia i metodyka trenuvannia sportsmeniv vysokoi kvalifikatsii [Theory and methodology of training highly qualified athletes]: navchalnyi posibnyk. Vinnytsia: Planer, 273 p. (in Ukr.).

7. Matveev, L. P. (1999), Osnovy obshhej teorii sporta i sistemy podgotovki sportsmenov [Fundamentals of the general theory of sports and the system of training athletes]. Kiev: Olimpijskaja literatura, 320 p. (in Russ.).
8. Platonov, V. N., Sakhnovskii, K. P. (1988), Podgotovka iunogo sportsmena [Training of a young athlete]. Kiev : Radianska shkola, 288 p. (in Russ.).
9. Platonov, V. N. (2017), Dvigatelnye kachestva i fizicheskaia podgotovka sportsmenov [Motor qualities and physical training of athletes]. Kiev: Olimpiiskaia literatura, 656 p. (in Russ.).
10. Pomazan, A. A. (2011), «Motor characteristics of boys 4-6 years to determine the prospects for gymnastics», Pedahohika, psykholohiia ta medyko-biolohichni problemy fizychnoho vykhovannia i sportu, Vyp. 10, pp. 57-60. (in Ukr.).
11. Senytsia, A. I., Senytsia, M. M., Perederii, A. V. (2010), Sportyvna akrobatyka [Sports acrobatics]: navchalna prohrama dlia dytiacho-yunatskykh sportyvnykh shkil. Vinnytsia, 92 p. (in Ukr.).
12. Chernykh, T., Mulyk, V., Skalii, T., Okun, D. (2020), «The use of special preparatory exercises for the assimilation of the basic elements of sports acrobatics by young novice athletes», Slobozhanskyi naukovo-sportyvnyi visnyk, No. 6 (80), pp.11-16. doi:10.15391/snsv.2020-6.002. (in Ukr.).
13. Kharchenko, T. P., Mulyk, V. V. (2009), «Research of reliability and informativeness of tests for definition of static and dynamic balance at young figure skaters of 7-9 years», Slobozhanskyi naukovo-sportyvnyi visnyk. Vyp. 3. pp. 82-84. (in Ukr.).
14. Chernykh, T., Mulyk, V., Okun, D. (2019), «Study of the level of physical fitness of young acrobat athletes at the initial stage of training», Slobozhanskyi naukovo-sportyvnyi visnyk, No. 5(73), pp. 61-65, doi:10.15391/snsv.2019-5.010 (in Ukr.).
15. Taboada-Iglesias Y., Abalo R. (2018), «Lesiones en los deportes acrobaticos gimnasticos y disciplinas afines», Trances, No. 10(1), pp. 21-44. (in Esp.).

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ANALYSIS OF COMPETITIVE ACTIVITY OF HIGHLY QUALIFIED WRESTLERS

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Purpose: to analyze the competitive activity of highly qualified Greco-Roman wrestlers.

Material and methods: analysis of scientific and methodological information and Internet sources; generalization of best practices; video-computer analysis of the competitive activity of highly qualified wrestlers; methods of mathematical statistics. A specialized computer program "Martial Arts Video Analysis" was used to analyze the fights. A total of 30 final fights (fight for the first and third places) of highly qualified Greco-Roman wrestlers at the 2020 World Cup were analyzed.

Results: based on the analysis of scientific and methodological information, Internet sources, and generalization of leading practical experience, it was found that successful training of wrestlers of any level is impossible without careful consideration of major trends in wrestling, which can be established with sufficient accuracy when analyzing the structural components of competitive activity of the world's leading athletes. It has been established that at the 2020 World Cup, the winning wrestlers have a larger technical and tactical arsenal (10 holds) than those

who lost (5 holds). The analysis of indicators of competitive activity allowed to determine that the wrestlers-winners and those who lost the number of technical and tactical actions, their effectiveness, the interval of attack decreases in the second period. The efficiency of the reception of the winning wrestlers in the second period (69.5 %) is higher than in the first one (61.8 %), and those who lost in the first period (12.2 %) are better than in the second (8.7 %). This is due to the fact that at the end of the fight the loser carries out many unsuccessful attacks in order to win back.

Conclusions: the analysis of competitive activity showed that the largest number of times during the fight, the winning wrestlers perform in the ground - turn over (0.72 times), in the rack - dumping (0.32 times), and those who lose held in the ground - countermeasures (0.06 times), in the rack - dumping (0.24 times). A significant number of points wrestlers-winners receive at the beginning of the fight by increasing the number of different technical and tactical actions and the effectiveness of their implementation.

Keywords: Greco-Roman wrestling, indicators, technical actions, competitive activity, highly qualified athletes, computer program.

Introduction

An analysis of recent publications allows to confirm that in recent years the quality of scientific research in martial arts has increased significantly. This is due to the expansion of communication opportunities, both in person and online in various scientific conferences, meetings, communication platforms ResearchGate, LinkedIn, social networks, access to videos of official championships, World and Europe Cups, as well as the possibilities of modern computer technology.

Researchers, in order to increase the efficiency of the training process, study various aspects of martial arts in competitions. Thus, N. V. Boychenko, R. I. Belyaninov (2017) analyzed the indicators of competitive activity in wrestling, mainly in terms of strategy and tactics. V. I. Shandrygos, V. V. Yaremenko, R. V. Pervachuk (2018) studied the results of participation of wrestlers from different

countries in the 2018 European Championship after changes in the rules of competition to increase the number of weight categories. Researchers G. O. Ogar, V. D. Sereda (2019) made a comparative analysis of the intensity of competitive fights based on the study of materials of the world and Ukrainian championships among cadets in 2019. Experts P. Bartik, N. Boychenko, M. Kurylenko (2014) recommend, in order to objectively determine changes in the parameters of technical and tactical skills of wrestlers, there should be recording and transcribing of their competitive fights.

To study the level of showing the parameters of competitive activity, experts use different means, namely: pedagogical observation, analysis of competition protocols of different levels, expert evaluation of combat operations, video-computer analysis of both biomechanics of movements and various actions in a duel [5, 11, 15, 16].

In our opinion, the most effective means of assessing competitive activity is video-computer analysis. Viewing video clips of combat situations at competitions allows us to identify a particular action, conditions, and evaluation of its implementation more accurately.

Connection of work with scientific programs, plans, and themes. The study was conducted under the research topic of the Kharkiv State Academy of Physical Culture «Optimization of the training process in martial arts» (state registration number 0121U112873).

Purpose of the study is to analyze the competitive activity of highly qualified Greco-Roman wrestlers.

Material and Methods of research

The following methods were used in the study: analysis of scientific and methodological information and Internet sources; generalization of best practices; video-computer analysis of the competitive activity of highly qualified wrestlers; methods of mathematical statistics.

To analyze the fights, a specialized computer program «Martial Arts Video Analysis» was used, which was developed at the Department of Martial Arts with the

support of specialists from the Department of Informatics and Biomechanics of Kharkiv State Academy of Physical Culture [9]. You can get acquainted in detail with the work of this program in the AppStore (Martial Arts Video Analysis). Based on the viewing of video fragments of combat situations at competitions, the program allows to identify and record the technical and tactical action, time, and evaluation of its implementation, to carry out an analytical review of the results.

A total of 30 final fights (fight for the first and third places) of highly qualified Greco-Roman wrestlers at the 2020 World Cup were analyzed.

Results of the research

Based on the analysis of scientific and methodological information, Internet sources, and generalization of leading practical experience, it was found that successful training of wrestlers of any level is impossible without careful consideration of major trends in wrestling, which can be established with sufficient accuracy in analyzing the structural components of leading athletes of the world [1, 10, 14, 15].

Analysis of the competitive activity of highly qualified wrestlers with the help of a specialized computer program «Martial Arts Video Analysis», allowed us to obtain the following results. It has been established that the winners of the 2020 World Cup have a larger technical and tactical arsenal (10 holds) than those who lost (5 holds). The analysis of competitive activity showed that the largest number of times during the fight the wrestlers-winners perform: in the parterre - turn over (0.72 times), the effectiveness of this action is 100 % and it brings 1.44 points; in the rack - dumping (0.32 times), the effectiveness of this action is 100 % and it brings 0.62 points. Those who lost the greatest number of times during the fight perform: in the parterre - countermeasures (0.06 times), the effectiveness of this action is 100 % and it brings 0.10 points; in a rack - dumping (0,24 times), but the efficiency of this hold makes only 14 % and it brings 0,06 points (Table. 1).

The analysis of indicators of competitive activity allowed to determine that the winning fighters and those who lost the number of technical and tactical actions, their effectiveness, the interval of attack decreases in the second period. The efficiency of

the hold of the winning wrestlers in the second period (69.5 %) is higher than in the first one (61.8 %), and those who lost in the first period (12.2 %) are better than in the second (8.7 %). This is due to the fact that at the end of the fight the loser carries out many unsuccessful attacks in order to win back (Table 2).

Table 1

Analysis of technical and tactical training of highly qualified Greco-Roman wrestlers at the 2020 World Cup (WC) (n=30)

№	Technical and tactical actions	Winner			Those who lost		
		1	2	3	1	2	3
Parterre							
1	Turnovers	0,72	1,44	100	0,04	0,06	100
2	Turnover with grip of hand and head	0,10	0,20	100	-	-	-
3	Reverse belt turnover	0,06	0,14	100	-	-	-
4	Back belt throws	0,34	0,68	100	-	-	-
5	Reverse belt throws	0,04	0,06	100	-	-	-
6	Countermeasures	0,06	0,06	100	0,06	0,10	100
Rack							
7	Takedowns in parterre	0,20	0,34	83	0,06	0,06	100
8	Back arch throws	0,18	0,68	80	-	-	-
9	Knocking over	0,32	0,62	100	0,24	0,06	14
10	Pushing out of mat	0,24	0,24	100	0,20	0,20	100

Note: 1 - the average value of technical and tactical actions for all fights (number of TTD); 2 - the average value of points scored for technical and tactical actions for all fights (points); 3 - efficiency of technical and tactical action (%).

Table 2

Indicators of competitive activity of highly qualified Greco-Roman wrestlers at the 2020 World Cup (WC) (n=30)

№	Indicators	Winner			Those who lost		
		1 period	2 period	For two periods	1 period	2 period	For two periods
1	TTD*, number of times	3,8±0,43	3,2±0,46	3,5±0,32	1,9±0,24	1,8±0,20	1,8±0,16
2	Results rating, point	3,5±0,48	3,0±0,37	3,3±0,31	0,4±0,17	0,3±0,16	0,4±0,12
3	Interval of the bout, s	17,3±2,64	37,3±9,17	26,9±4,82	19,9±5,07	38,9±10,55	29,1±5,86
4	Effectiveness, %	61,8±4,15	69,5±5,50	65,5±3,45	12,2±4,59	8,7±3,59	10,5±2,95

Note: TTD - technical and tactical actions

It was found that the winning fighters and those who lost the effectiveness of the attack during the fight in the first minute of the first and second period is the

highest. This is due to the fact that each of the fighters at the beginning of each period tries to gain an advantage and then keep it (Fig. 1).

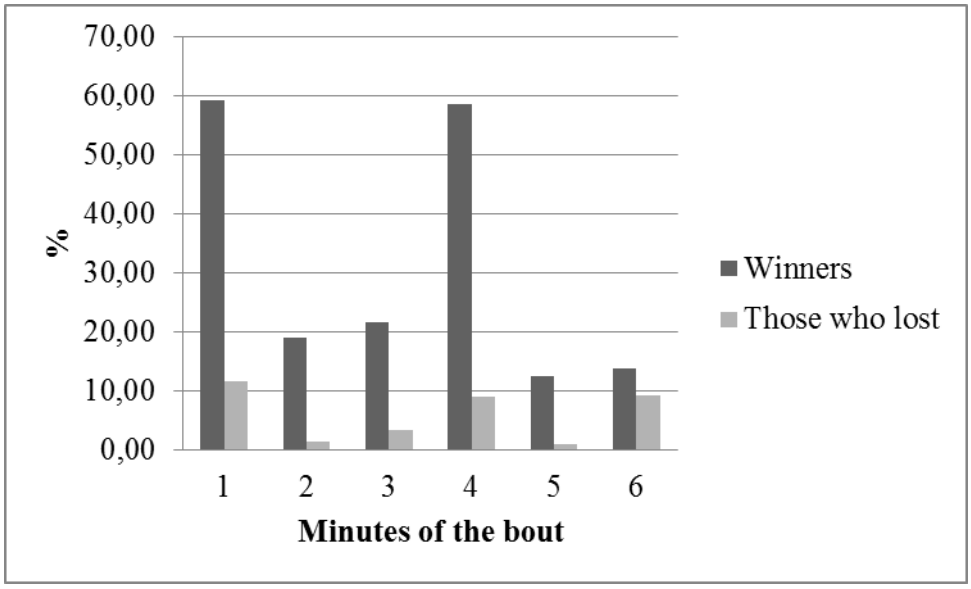

Fig. 1 Dynamics of effectiveness of the attack in the clashes of winners and losers

The analysis of the variety of technical actions by periods shows a decrease in the number and efficiency of their performance both in the winning wrestlers and in the losers (Table 3). In our opinion, this is due to the peculiarities of the use of the arsenal of technical and tactical actions.

Table 3

Variety of technical actions and their effectiveness at the 2020 World Cup (WC) (n=30)

Periods	Winners		Those who lost	
	Variety of actions, number	Effectiveness, %	Variety of actions, number	Effectiveness, %
1 period	1,8±0,17	100,0±0,0	0,3±0,11	23,3±7,72
2 period	1,7±0,16	96,2±3,51	0,2±0,12	17,9±7,24
For two periods	1,8±0,12	98,2±1,71	0,3±0,08	20,7±5,32

Conclusions / Discussion

The analysis of performances at competitions is given great importance: by means of the analysis of competitive activity indicators of technical and tactical

readiness of highly skilled judokas were determined (Boychenko N.V., etc., 2020), the methodology of the training system of difficult technical and tactical actions in freestyle wrestling is developed (Kashevko V. A., 2008), tracked the performances of judo athletes of different ages (Julio U., and et. al., 2011). Based on the performance of athletes at the 2017 World Championship, a comparative analysis of the strongest and Ukrainian Greco-Roman wrestlers (Radchenko Y., et al., 2018) was carried out, similar studies were conducted in freestyle wrestling (Boyko V. F., et al., 2014) and women's wrestling (Latyshev M. V., et al., 2019).

It has been established that at the 2020 World Cup, the winning wrestlers have a larger technical and tactical arsenal (10 holds) than those who lost (5 holds). The analysis of competitive activity showed that the greatest number of times during the fight the wrestlers-winners perform in the ground - turn over (0.72 times), in the rack - dumping (0.32 times), and those who lose spend in the ground - countermeasures (0.06 times), in the rack - dumping (0.24 times). A significant number of points wrestlers-winners receive at the beginning of the fight by increasing the number of different technical and tactical actions and the effectiveness of their implementation.

The analysis of indicators of competitive activity allowed to determine that the winning fighters and those who lost the number of technical and tactical actions, their effectiveness, the interval of attack decreases in the second period. The efficiency of the hold of the winning wrestlers in the second period (69.5 %) is higher than in the first one (61.8 %), and those who lost in the first period (12.2 %) are better than in the second (8.7 %). This is due to the fact that at the end of the fight the loser carries out many unsuccessful attacks in order to win back.

Prospects for further research will be aimed at analyzing the competitive activity of athletes in other martial arts.

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References

1. Boyko, V. F., Malinsky, I. I., Andreytsev, V. A., Yaremenko, V. V. (2014), «Competitive activity of highly qualified freestyle wrestlers at the present stage», Physical education of students, No.4, pp. 13-20. (in Russ).

2. Bartik, P., Boychenko N. V., Kurylenko, M. M. (2014), «Special features of mental performance in sports fighting», Problems and prospects for the development of sports games and martial arts in higher education, No. 1, pp. 18- 22. (in Ukr.).

3. Boychenko, N. V., Belianinov, R. I. (2017), «Indicators of the mental performance of wrestlers», Martial Arts, No.3, pp. 23-26. (in Ukr.).

4. Boychenko, N. V., Devil, I. I., Pirog, Y. A., Alexev, A. F. (2020), «Analysis of indicators in the mental performance of high-grade judo judges of light wagon categories», Martial arts, No.1, pp. 4-12. (in Ukr.).

5. Golokha, V. L., Romanenko, V. V. (2021), «Analysis of the wrestlers at the Championship of Ukraine 2020 to rock with the great fight», Martial arts, No.1, pp. 12-19. (in Ukr.).

6. Kashevko, V. A. (2008), «Analysis of the structure of mental performance and methodology of the system for the creation of folding technical and tactical actions in the willy borotbi», Young sports science of Ukraine, No.1, pp. 86-92. (in Ukr.).

7. Latyshev, N. V., Rybak, L. N., Golovach, I. A., Korolev, B. I., Lyashenko, E.O., Kvasnitsa, O. M. (2019), «Analysis of performances participants of the European championships among cadets in women's wrestling», Slobozhanskiy naukovo-sportivniy visnik, No.(73), pp. 45-50. (in Russ).

8. Ogar, G. O., Sereda, V. D. (2019), «Preceding the intensity of the magical wrestlers in the style», Martial arts, No.4, pp. 62-71. (in Ukr.).

9. Romanenko, V. V., Golokha, V. L., Alekseev, A. F., Kovalenko, Y. M. (2020), «Methodology for evaluating the mental performance of one-fighters for victorious computer technologies», Slobozhanskiy naukovo-sports visnik, No.6 (80), pp. 65-72. (in Ukr.).
10. Shandrigos, V. I., Yaremenko, V. V., Pervachuk, R. V. (2018), «Analysis of the performances of the fighters of the Russian lands at the European championship 2018 of the rock and the fight against the middle of the choloviks», Martial arts, No.4(10), pp. 80-90. (in Ukr.).
11. Biac, M., Hrvoje, K., Sprem, D. (2014), «Beginning age, wrestling experience and wrestling peak performance-trends in period 2002-2012», Kinesiology, No.46(S-1), pp. 94-100. (in Eng.).
12. Julio, U., Takito, M., Mazzei, L., Miarka, B., Sterkowicz, S., Franchini, E. (2011), «Tracking 10-year competitive winning performance of judo athletes across age groups», Percept Mot Skills, No.113, pp. 139-149. (in Eng.).
13. Radchenko, Y., Korobeinikov, G., Korobeinikova, L., Shatskikh, V. Vorontsov A. (2018), «Comparative analysis of the competitive activity of the Ukrainian greco-roman style wrestlers», Health, sport, rehabilitation, No.4, pp. 91-95. (in Eng.).
14. Tropin, Y., Chuev, A. (2017), «Technical and tactical readiness model characteristics in wrestling», Slobozhanskyi herald of science and sport, No.3, pp. 64-67. (in Eng.).
15. Tropin, Y., Pashkov, I. (2015), «Features of competitive activity of highly qualified Greco-Roman style wrestler of different manner of conducting a duel», Pedagogics, psychology, medical-biological problems of physical training and sports, No.3, pp. 64-68. (in Eng.).
16. Tünnemann, H. (2016), «Scoring Analysis of the 2015 World Wrestling Championships», International Journal of Wrestling Science, No.6(1), pp. 39-52. (in Eng.).

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PHYSICAL THERAPY AT THE STAGES OF RECOVERY AFTER REVISION ENDOPROTHESIS OF THE HIP JOINT

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Purpose: scientific substantiation, development and evaluation of the effectiveness of the program of physical therapy of patients in the revision endoprothesis of the hip joint.

Material and methods: analysis of literary sources, indicators of blood pressure and pulse, anthropometry, goniometry, testing on the SCALE of VAS, mathematical statistics. The contingent of the studied was compiled by patients of the State Institution "Institute of Spine and Joint Pathology named after Prof. M.I.Sitenko AMNU in the number of 19 people divided into 2 groups, the main - 10 and control - 9. The duration of the developed intensive FT program for patients of the main group is 37 days, 10 days, the preoperative period - before surgery and 27 days after (early postoperative - 5 days, late postoperative - 7 days, early recovery - 15 days). Patients of the control group at the same time underwent a rehabilitation course according to the generally accepted method.

Results: dynamics, blood pressure and pulse indicators, anthropometry, goniometry of the hip and knee joints, intensity of pain syndrome on the SCALE of VAS, determined that all the indicated indicators were statistically better in patients of the main group.

Conclusions: during revision endoprosthesis, the patient's body should be prepared to prevent postoperative complications with the help of means and methods of physical therapy; patients of both groups had improved indicators of cardiovascular hemodynamics, indicators of dynamics of braided hip size, volume of movements in the hip and knee joints, testing the intensity of pain on the SCALE of VAS. However, in patients of the main group, in comparison with patients of the control group, a significant (statistically proven) improvement of all indicators was found; observations confirmed that segmental-reflex massage can be carried out in the early stages of rehabilitation; the studies obtained in dynamics make it possible to affirm that we have proven the high efficiency of the developed program of physical therapy of patients in the revision endoprothesis of the hip joint, which allows us to significantly improve the condition of the musculoskeletal system and the body as a whole.

Keywords: revision endoprothesis, hip joint, physical therapy.

Introduction

Injuries and diseases of the locomotive system (LMS) occupy one of the first places in terms of distribution among the population of different countries of the world, which is primarily associated with physical inactivity and an increase in the adverse effects of the environment, the presence of harmful industries, and low quality products. It is these conditions that are often the causes of incapacity for work, disability, and in severe cases can lead to death. In addition, they are a significant socio-economic problem for society.

The greatest discomfort in normal conditions of human life is caused by damage to the lower extremities, in particular, quite common diseases and injuries of

the hip joint (HJ), which provides mobility and body resistance. This pathology often leads to a deterioration in the activity of the entire LMS)(Buryanov O.A. (2015); Pustovoit B.A., Tets A.B (2019)) [1; 2].

Coxarthrosis is a chronic progressive lesion of the HJ related to serious human diseases. Dysfunctions of support and mobility of the lower extremities in patients with grade III – IV coxarthrosis lead to a significant decrease in working capacity and an increase in the level of disability. Numerous statistical data indicate not only a significant incidence of coxarthrosis, but also the absence of a tendency to decrease it. Disability for these diseases is 62-65%. Long-term coxarthrosis disease leads to the development of pain in the HJ, a decrease in the strength of the muscles of the diseased limb, contractures and restrictions on movement (Korzh M.A. (2012); Igla G.G., Buryanov A.A., Klimovichsky V.G. (2014))) [3; 4].

Conservative therapy is ineffective, and improvement occurs only in the initial stages of the disease. In this regard, the problem of rehabilitation treatment of this category of patients has now gone beyond the boundaries of medical science, has acquired great social significance (Roy I.V., Babova I.K., P. Belaya (2010); Zamorskiy T.V., Buchinsky S.N. (2017)) [5;6].

About 2 million hip fractures are registered annually in the world, of which 57% are hip fractures. There is evidence that mortality in the elderly is 14-36% within 1 year after fracture. With ineffective conservative treatment, surgical treatment is more effective, in particular, the most progressive technology is hip arthroplasty (HA) in order to obtain the last opportunity to improve the functions of the diseased joint [3; 4].

The growth in the number of primary HJ replacement operations in the world and in Ukraine inevitably leads to an increase in the absolute number of complications, including periprosthetic infection. According to modern literature, its frequency ranges from 0,5 to 3,0% [1]. In absolute numbers, these are hundreds and thousands of cases. In this case, the only way to treat patients is the repeated revision hip arthroplasty (RHA).

Today, despite the abundance of publications on the methods and ways of

treating injuries and diseases of the HJ, the study of rehabilitation measures for this pathology remains insufficient, first of all, approaches to the development and use of physical therapy (PT) methods in medical practice. The most urgent problem remains the problem of complex phased PT in orthopedic patients after RHA. When using the means and methods of PT, it becomes possible to prepare the patient's body for surgery, prevent postoperative complications, and increase the efficiency of the performed surgical intervention.

In the special literature, the problems of PT in patients after HA are widely covered (Glinyana O.A., Papadyukha Yu.A. (2011)) [7]. Nevertheless, insufficient attention has yet been paid to PT issues at RHA. Many researchers differ in the timing of patient activation, the duration of the recovery course, scattered information about the forms and content of PT activities, which generally indicates the need to solve the problems of improving the PT program for patients with RHA (Mansirov Asif Baglar oglu, Litovchenko V.A., Bezyazychnaya O.V. (2018), Babov KD (2017)) [8; 9]. It becomes obvious that the development of modern PT programs for patients with RHA is an urgent problem of modern trauma science and PT.

Connection of work with scientific programs, plans, themes. The study was carried out in accordance with the initiative research topics for 2019-2021. "Rehabilitation technologies for pathology of joints and ligamentous apparatus" (state registration number 0120U104881) and for 2021-2025 "Theoretical and methodological foundations of physical therapy and occupational therapy for organic and functional disorders of organs and systems of the human body in health care practice" (state registration number 0121U110141).

Purpose of the study is to scientifically substantiate, develop and evaluate the effectiveness of the PT program for patients with RHA.

Objectives of the study:

1. Based on the study of special scientific literature, analyze the etiology, pathogenesis, clinical characteristics, diagnosis and modern approaches to the prescription of PT for patients with RHA.

2. To study the functional state of the examined patients with RHA before starting the PT program.

3. Develop a PT program for patients with RHA.

4. To establish the effectiveness of the developed PT program for patients with RHA based on the study of the dynamics of the parameters of the functional state of patients.

Material and Methods of research

The study was carried out during 2017-2020 in the clinic of the State Institution “Institute of Pathology of the Spine and Joints named after prof. M.I. Sitenko National Academy of Medical Sciences of Ukraine ", which is the base of the Department of Physical Therapy of the Kharkov State Academy of Physical Culture. The selection of patients in the groups was carried out randomly; 19 patients with endoprosthesis instability were selected, who were tested at all stages of the study and were divided into two groups. There were 10 people in the MG, including 4 men (40%) and 6 women (60%), age restrictions ranged from 58 to 67 years, the average age among men was 63,5 years; among women – 64 years old.

In the CG there were 9 patients, including 4 men (44,5%) and 5 women (55,5%), age restrictions ranged from 57 to 68 years, the average age among men was 63 years; among women – 62 years.

The given comparative data on sex, age and volume of treatment of patients with MG and CG (Table 1) can be compared, compared and used for scientific analysis and pedagogical research.

Table 1

Comparative table of groups by age and gender

Group		Gender		Age
		Men	Women	
MG (n=10)	Abs.	4	6	62,5±3,6
	% in the group	40	60	
CG (n=9)	Abs.	4	5	61±3,4
	% in the group	44,5	55,5	
Statistical significance of the difference between groups		p>0,73		p>0,51

The objectives of the work within the framework of the study were to determine the clinical and functional state of the patient and his lower limb, as well as to create a PT program and evaluate the effectiveness of its use in RHA in the preoperative, postoperative (early and late) and early recovery periods. When performing this task, the following research methods were used: analysis of sources of special scientific literature; collection of anamnesis; biomedical methods (anthropometry, goniometry, hemodynamic parameters, understanding the intensity of pain syndrome); medical and pedagogical observations; methods of mathematical statistics

Anthropometry. In order to identify the presence of edema, hypotrophy or atrophy of muscles accompanying the patient's condition with coxarthrosis before and after RHA, the index of the thigh volume was determined using a centimeter tape. The reference point for measurement was the proximal edge of the patella, from which the volumetric dimension of the thigh is measured 25 cm higher. The condition of the diseased hip is characterized by the presence of pronounced atrophy of the muscles of the thigh after an earlier HA operation. The volumetric size of a healthy thigh is measured in the same way. The difference in indicators was used to compare the state of the limbs before and after PT.

The medical and biological methods also include the determination of the heart rate (HR) and the level of blood pressure (BP), which are important indicators characterizing the function of the cardiovascular system (CVS).

Goniometry. Determination of the range of motion in the knee joint and knee joint was determined using a protractor; the range of motion in the healthy joint was taken as the norm.

Measurement results consist of 3 digits: angle of end position; neutral position - 0^o; the angle of the end position opposite to the swing motion. The HJ has 3 axes of rotation in 3 planes, so 6 movements are possible in it. It should be noted that patients after RHA have movement limitations. The movements of internal and external rotation in the HJ after RHA are prohibited for the patient to perform, since they can cause subluxation or dislocation of the endoprosthesis. The

movement of the abduction is permissible only up to 30-40°, while the norm reaches 45°. The adduction movement is only possible to the midline, since crossing the legs can cause subluxation or dislocation of the endoprosthesis. In the knee joint, 2 types of movements are possible – flexion and extension. The starting position for measuring flexion and extension movements is on the back, therefore, these measurements taken during the study did not cause any inconvenience to the patient.

Visual analogue scale of pain (VAS). It was used to assess pain syndrome in patients according to the generally accepted method (in mm). In the course of the study, medical and pedagogical observation was carried out on the basis of external signs of fatigue and objective studies of the pulse and blood pressure at rest and during PT.

Methods of mathematical statistics. The research results were processed by the methods of variation statistics. In cases of group differences at p 0,05, they were assessed as statistically significant, at p<0,001 – statistically highly significant, at p>0,05 - statistically insignificant..

PT methods in CG patients. PT was carried out according to the scheme adopted in medical institutions. Preoperative preparation was not performed. In the early postoperative period, the following was carried out: breathing exercises (BE), remedial gymnastics (RG) – movements in healthy limbs, isometric gymnastics for the lower extremities. In the late postoperative period – RG twice a day, magnetotherapy, classical massage of healthy limbs and back muscles. In the early recovery period – RG, classical massage of healthy limbs and back muscles.

PT methods in patients with MG. In the course of the study, an intensive PT program was developed for patients with MG, which included the following methods: RG, therapeutic massage (TM), physiotherapeutic treatment (EMS of the muscles of the lower limb, magnetic and laser therapy, mechanotherapy). The duration of the intensive PT program is 37 days, 10 days – before RHA (preoperative period) and 27 days after (early postoperative – 5 days, late postoperative – 7 days, early recovery – 15 days).

Preoperative period (10 days). During this period, the patient was prepared for the future surgical intervention, which included not only physical training, muscle strengthening, but also gaining confidence in the positive result of treatment; the patient was familiarized with the developed intensive PT program for all periods of treatment. Patients with MG received: RG – two sessions a day for 20-25 minutes; TM course – daily massage of the paravertebral zones, as well as massage of a healthy leg three times a day for 10 minutes; physiotherapy apparatus treatment - daily electromyostimulation (EMS) of the quadriceps muscle, two sessions of 10 minutes each.

Early postoperative period (5 days). Carried out: BE (10-15 minutes 6 times a day); isometric exercises - from the first day; from the second day – EMS to strengthen the quadriceps and sciatic muscles; mechanotherapy using a computerized electric bus - two sessions of 30 minutes each; sparing TM. In order to reflex activation of blood and lymph microcirculation in the operated tissues, segmental reflex massage was performed. First, starting from the second day after the operation, massage of a symmetrical healthy limb, paying special attention to working out the thigh (in the initial position, bending the knee joint at a right angle, massaged the back surface of the limb), then straightening the limb, massaged it in front. Massage techniques: stroking, squeezing, superficial rubbing, active kneading of muscles with fascinating and pressing kneading and rubbing of the tendons of the muscles being massaged. At the end of the procedure, the base of the palm and the pads of four fingers were rubbed around a large swivel; EMS of the thigh muscles – 20 minutes from day 4.

Late postoperative period (7 days). Carried out: RG, 25-30 minutes, twice a day for all joints of a healthy limb and small joints of the operated limb; walking (on crutches) 1-2 times a day (5-10 minutes) with an assistant physical therapist; mechanotherapy using a computerized electric splint – three sessions daily for 30 minutes; TM - after the permission of the orthopedist to lie down on the healthy side, segmental reflex massage was performed, starting from the paravertebral zones of the spinal segments of the lumbosacral spine. Massage techniques: straight and line

rubbing, "saw" technique along and across, spiral kneading and deep circular rubbing (20 min); EMS of thigh muscles (20 min.) Twice a day; laser therapy of active zones of the lower extremities (15 min.)

Early recovery period (15 days). Carried out: RG – two sessions of 45 minutes each; walking (on crutches) 3-4 times a day (15-20 minutes) with an assistant physical therapist and independently, gradually increasing the distance and pace of walking; self-massage techniques were applied; magnetotherapy of active zones of the lower extremities (15-20 min.)

Results of the research

The study of the dynamics of hemodynamic parameters after the PT program showed that, upon repeated examination, the indicators of heart rate, systolic blood pressure and diastolic blood pressure statistically improved both in patients with MG and in patients with CG (Table 2).

Table 2

Dynamics of hemodynamic parameters in patients with both MG and CG after PT

Indicators	Norm	Research periods		t	p
		Primary research	Repeat research		
MG (n=10)					
Heart rate, beats / min	60-84	88,69±0,98	72,62±0,82	12,77	<0,001
SAT, mm Hg	100-129	138,06±2,56	130,7±1,65	5,32	<0,05
DAT, mm Hg	60-80	85,63±1,99	71,34±0,96	4,15	<0,005
CG (n=9)					
Heart rate, beats / min	60-84	87,98±1,23	78,66±0,92	6,01	<0,001
SAT, mm Hg	100-129	139,91±3, 61	136,37±2,80	1,86	<0,05
DAT, mm Hg	60-80	86,48±2,13	76,91±1,40	2,20	<0,05

In CG patients, the heart rate decreased by 18,1% in comparison with the primary examination, the SBP level decreased by 5,8%, the DBP level decreased by 16,7%. In CG patients, the heart rate decreased by 10,5% in comparison with the primary examination, the SBP level decreased by 2,6%, the DBP level decreased by 11,1%.

Comparing the hemodynamic parameters in patients of both groups, we can conclude that, upon repeated examination, the indicators of heart rate, systolic blood

pressure and diastolic blood pressure in patients with MG after using the PT program were somewhat better than in patients with CG.

Anthropometry. The volume of the muscle mass of the thigh after the measures of the PT program with RHA increases slowly and depends on many factors, the main of which are RG, TM and physiotherapy procedures in the form of EMS. The dynamics of the circumferential dimensions of the thigh was characterized by an improvement (an increase in size due to an increase in muscle mass) (Table 3, Figure 1).

Table 3

Dynamics of the circumferential dimensions of the thigh in patients with MG and CG after PT (cm)

Group	Primary research	Repeat research	Statistical indicator
MG (n = 10)	47,8±0,95	51,3± 0,8	P<0,05
CG (n=9)	48,0±0,51	49,1±0,6	P>0,05

Coverage indicators improved in patients of both groups, but it should be noted that the improvement in the muscle mass of the thigh in patients in the MG was statistically better than in patients in the CG.

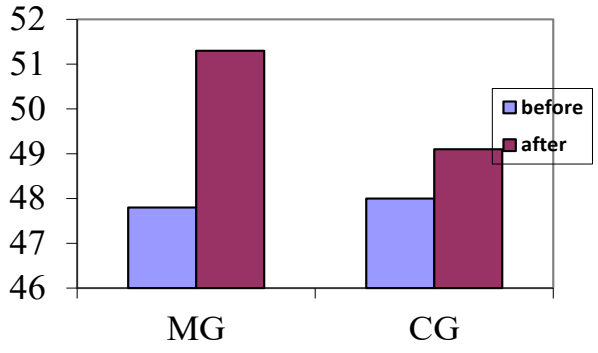

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Fig. 1. Diagram of the dynamics of the circumferential dimensions of the thigh after PT (cm)

Goniometry. The range of motion in the hip joint and knee joint before treatment and PT was significantly less than normal values. At the repeated

goniometry, which occurred after the end of PT, the range of motion in the knee joint in both groups increased statistically (p0.005), but if in patients in the MG it reached the level of 104,4°±1,5°, then in the patients in the CG it was statistically significantly (p<0,001) smaller – 92,6 °±1,6° (Table 4, Figure 2).

Table 4

Dynamics of indicators of goniometry of the knee and hip joints (in degrees)

Parameter	MG (n=10)	CG (n=9)	Statistical indicator in the group
Flexion in the knee joint (degrees) before PT	84,4±2,5	85,6±3,2	P>0,05
Flexion in the knee joint (degrees) after PT	104,4 ± 1,5	92,6 ± 1,6	P<0,005
Statistical indicator between groups	P<0,001		
Flexion in the hip joint (degrees) before PT	50,5±3,1	51,0±2,6	P>0,05
Flexion in the hip joint (degrees) after PT	93,3 ± 1,9	82,6 ± 1,8	P<0,05
Statistical indicator between groups	P<0,001		
Extension in the hip joint (degrees) before PT	-13,7±1,9	- 14,2±1,7	P>0,05
Extension in the hip joint (degrees) after PT	2,0 ± 0,7	- 4,3 ± 1,4	P<0,05
Statistical indicator between groups	P<0,05		

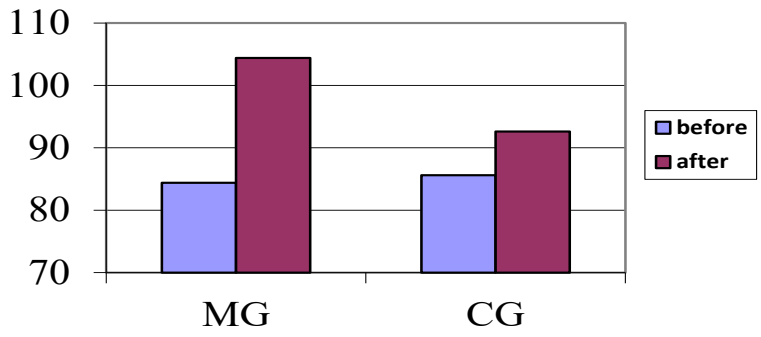

Fig. 2. Diagram of the dynamics of goniometry (flexion) of the knee joint after the PT program (degrees).

A similar pattern was observed in the HJ goniometry. After PT, repeated goniometry revealed that flexion in the knee joint in both groups statistically increased ($p<0,05$), but if in patients in the MG it reached the level of 93,3°±1,9°, then in patients in the CG it was statistically ($p<0,005$) smaller – 82,6°±1,8° (Table 4, Fig. 3).

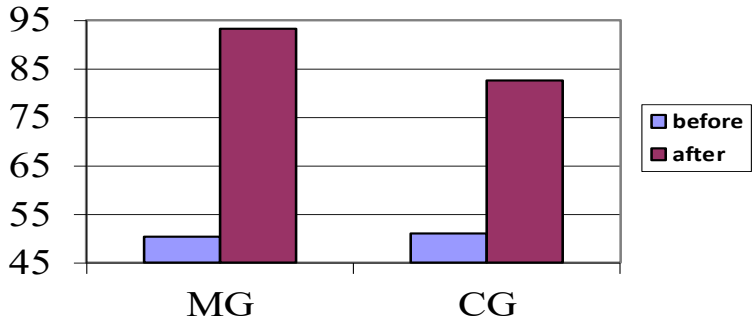

Fig. 3. Diagram of the dynamics of goniometry (flexion) of the hip joint after the PT program (degrees)

The volume of extension in the hip joint in both groups increased statistically ($p<0,05$), but if in patients in the MG it reached the level of 2,0º±0,7°, then in the patients in the CG it was statistically ($p<0,05$) smaller – -4,3°±1,4° (Table 3, Fig. 4).

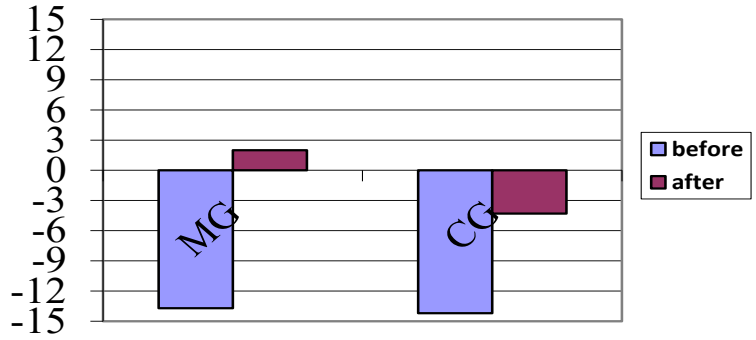

Fig. 4. Diagram of the dynamics of goniometry (extension) of the hip joint after the PT program (degrees)

The intensity of the pain syndrome. In both groups, the pain syndrome decreased significantly (p<0,001). But in patients with MG it was 14,2±6,1 mm, which was statistically significantly less (p<0,001) than in patients with CG – 34,6±7,2 mm (Table 5, Fig. 5.) .

Table 5

Dynamics of pain intensity testing indicators on the VAS scale (mm)

Parameter	MG (n = 10)		CG (n = 9)		Difference between groups
	Primary research	Repeat research	Primary research	Repeat research	Statistical indicator between groups p<0,005
VAS	63,8±7,4	14,2±6,1	64,8±8,3	34,6±7,2	
Difference	p<0,001		p<0,05		

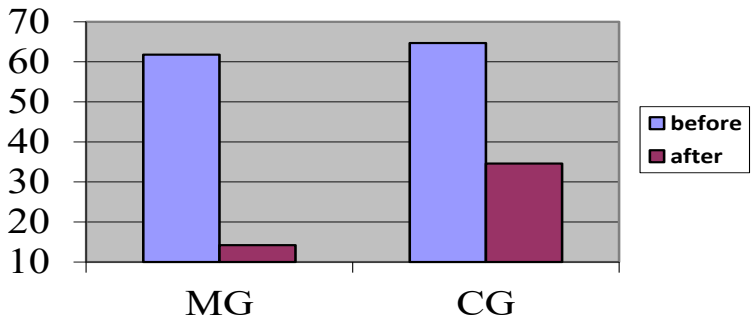

Fig. 5. Diagram of the dynamics of pain tests (VAS scale) (mm)

Thus, the conducted dynamic multicomponent study of the state of patients with MG and CG who underwent the corresponding PT programs confirmed the statistically efficiency of the developed PT program.

Conclusions / Discussion

The most important problem of modern physical therapy for patients undergoing revision hip arthroplasty is their return to a quality life.

It is known from many scientific sources that the greatest discomfort under normal conditions of human life is caused by injuries of the lower extremities, in particular, diseases and injuries of the hip joint (HJ) are quite common, which provides mobility and resistance of the body. This pathology often leads to a

deterioration in the activity of the entire LMS. Conservative therapy is ineffective, and improvement occurs only in the initial stages of the disease. The increase in the number of operations of primary endoprosthetics of the knee joint in the world and in Ukraine inevitably leads to an increase in the absolute number of complications. In this case, the only way to treat patients is the repeated revision hip arthroplasty. It becomes possible to prepare the patient's body for such an operation, to prevent postoperative complications with the use of means and methods of physical therapy.

In the scientific literature, the problems of PT in patients after endoprosthetics are widely covered, however, insufficient attention has been paid to the issues of PT in RHA, which, in general, indicates the need to solve the problems of improving the PT program for patients.

The developed PT program for patients with RHA, which lasted 37 days and was distributed over 4 recovery periods, has shown its effectiveness. The analysis of the results obtained showed that the patients of both groups showed an improvement in these indicators. But in the patients of the main group, compared with patients in the control group, a significant (statistically proven) improvement was revealed: hemodynamic parameters, dynamics of the circumferential dimensions of the thigh (due to an increase in muscle mass), range of motion (goniometry) in the hip and knee joints, testing the intensity of pain on a scale VAS, which complements the results obtained by other researchers (Glinyana O.A., Papadyukha Yu.A. (2011), Mahomed N.N. (2003)). The conducted observations confirm that segmental reflex massage can be carried out in the early stages of rehabilitation, which accelerates the processes of tissue regeneration after surgery. This complements the work Sliwinski M., Sisto S. (2006) [11], Vissers M.M., Bussmann J.B., Verhaar J.A.N., Arends L.R., Furlan A.D., Reijman M. (2011) [12].

Consequently, the totality of the results obtained in the dynamics of the study allows us to state that we have proved the high efficiency of the developed program of physical therapy for patients with revision hip arthroplasty, which can significantly improve the condition of the musculoskeletal system and the body as a whole.

Prospects for further research in this direction are aimed at using such methods as hydrokinesis therapy and taping in physical therapy programs.

Conflict of interest. The authors state that there is no conflict of interest that may be perceived as prejudicial to the impartiality of a state, public or commercial organization.

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References

1. Bur″yanov, O. A. (2006), Travmatolohiya ta ortopediya [Traumatology and Orthopedics]: pidruchnyk. Kyyiv, 435 p. (in Ukr.).

2. Pustovoyt, B. A., Tets, A. B. (2019), «The use and impact of a comprehensive program of physical therapy in the treatment of patients with coxarthrosis of 2-3 degrees», Slobozhans'kiy naukovo-sportivniy vísnik, №1 (69). pp. 31-36. (in Russ.).

3. Korzh, M. O. (2012), «The current state of the problem of joint replacement in Ukraine», Bol′, sustavy, pozvonochnyk, № 1 (05). pp. 10-12. (in Ukr.).

4. Holka, H. H., Bur″yanov, O. A, Klymovyts′kyy, V. H. (2014), Travmatolohiya ta ortopediya [Traumatology and orthopedics]: pidruchnyk. Vinnytsya, 416 p. (in Ukr.).

5. Roy, I. V., Babova, I. K., Bila, P. (2010), «Vyznachennya efektyvnosti etapnoyi reabilitatsiyi khvorykh pislya endoprotezuvannya kul′shovoho suhloba za faktom povernennya do pratsi», Suchasni pidkhody do orhanizatsiyi vidnovlyuval′noho likuvannya pratsivnykiv zaliznychnoho transportu: materialy naukovo-praktychnoyi konferentsiyi, Odesa, pp. 48-54. (in Ukr.).

6. Zamors′kyy, T. V., Buchyns′kyy, S. N. (2017), Vidnovlennya pislya endoprotezuvannya kul′shovoho suhloba [Recovery after hip arthroplasty]: metodychni rekomendatsiyi. Kyyiv, 76 p. (in Ukr.).

7. Hlynyana, O. O., Papadyukha, YU. A. (2011), «Rehabilitation algorithm after primary hip arthroplasty», Pedahohika, psykholohiya ta medyko-biolohichni problemy fizychnoho vykhovannya ta sportu, №8, pp. 30-32. (in Ukr.).

8. Mansyrov, Asif Bahlar ohly, Lytovchenko, V. O., Bez″yazychna, O. V. (2018), «Vplyv reabilitatsiynykh zakhodiv na yakist′ zhyttya patsiyentiv pislya endoprotezuvannya kul′shovoho suhloba», Fizychna reabilitatsiya ta rekreatsiyno-ozdorvchi tekhnolohiyi, №1. pp. 11-17. (in Ukr.).
9. Babov K.D. (2017), «Actual problems of early rehabilitation of patients after hip joint replacement», The International Scientific Congress The 60-th Session of General Assembly of the World Federation of Hydrotherapy and Climatotherapy. Italy, 156 p. (in Eng.).
10. Mahomed N.N. (2003), «Rates and outcomes of primary and revision total hip replacement in the United States Medicare population», J. Bone Joint Surg, Vol. 85-A, №1, pp. 27 – 32. (in Eng.).
11. Sliwinski M., Sisto S. (2006), «Gait, quality of life, and their association following total hip arthroplasty», Physical Therapy, № 29(1), pp.10 – 17. (in Eng.).
12. Vissers M.M., Bussmann J.B., Verhaar J.A.N., Arends L.R., Furlan A.D., Reijman M. (2011), «Recovery of physical functioning after total hip arthroplasty: systematic review and meta-analysis of the literature», Physical Therapy, №91, pp. 615 – 629. (in Eng.).

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INFLUENCE OF HEALTH-IMPROVING MOTOR ACTIVITY ON THE VEGETATIVE BALANCE OF OLDER WOMEN

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Purpose: based on the analysis of modern special literature to study the autonomic balance in the elderly by conducting cardiointervalography in the dynamics of physical activity.

Materials and methods: 60 elderly women were involved in the study. Women Gr.1 (n=24) are relatively healthy; women Gr. 2 (n=17) with periodic increase in blood pressure to 150/90 mm Hg; women Gr. 3 (n=19) with constant blood pressure of 150/90 - 160/100 mm Hg, but drug therapy was not taken. Cardiointervalography was recorded using the CardiolabPlus computer system.

Results: women Gr.1 had a balanced effect of sympathetic and parasympathetic divisions of the autonomic nervous system. In Gr.2 on the background of normal initial autonomic tone in orthostatic test observed hypersympathicotonic reactivity. In women, Gr.3 established the development of stress in the body of regulatory autonomic and humoral systems. A health program was developed, which was presented by the educational part, morning hygienic gymnastics and health walking. Dynamics of changes in women Gr. 2 indicated the improvement of vegetative-stabilizing properties, reducing the intensity of the

mechanisms of autonomic regulation of the ANS, due to the influence of health and motor activity. In women Gr.3 observed a positive trend. However, the initial vegetative tone fluctuated within eitonia with pronounced hypersympathicotonic reactivity. A high index of stress after orthostatic testing indicates the presence in the body of women Gr.3 voltage of regulatory autonomic and humoral systems, which is a consequence of uncontrolled increase in blood pressure.

Conclusions: the results of the study indicate the presence in older women of autonomic imbalance with a predominance of activity of the sympathetic division of the autonomic nervous system and overstrain of regulatory systems. The development of programs of health and physical activity will help to improve the state of health, prolong the active and full life of the elderly and the elderly.

Keywords: old age, cardiointervalography, heart rate variability.

Introduction

In the structure of the population of many countries, there is a tendency towards an increase in the number of the elderly population. By 2050, one in four people in Europe and North America will be 65 years of age or older. The number of people aged 80 and over is projected to triple: from 143 million in 2019 to 426 million in 2050 [2]. In this connection, there is a need to formulate the concept of active aging of the population to improve the quality of life and the involvement of a person in old age in social and professional life.

The World Health Organization (WHO) defines active aging as the process of developing and maintaining functional ability that promotes well-being in old age. The implementation of this concept presupposes, first of all, the formation of a person's sense of responsibility for the process of his own aging. Second, the ability to fulfill your potential for physical, social and psychological experiences throughout your life. Third, actively participate in community life and employment opportunities throughout life [9].

In the activity of the cardiovascular system, a significant role belongs to the autonomic nervous system (ANS), which, in turn, has two divisions: sympathetic and parasympathetic. From a physiological point of view, the ANS is a regulator of the activity of internal organs and metabolism. Several studies have confirmed that a decrease in heart rate variability (HRV) is an indicator of the risk of increased mortality from acute cardiovascular diseases. It has been proven that overall cardiovascular mortality is 5.3 times higher among people with low HRV [15]. The risk of sudden cardiac death is determined by a number of factors, one of which is an imbalance in autonomic regulation. A recognized means of assessing the peculiarities of the functioning of the nervous autonomic system is heart rate variability, which makes it possible to predict with sufficient reliability the risk of developing peculiarities of disturbances in electrophysiological processes in the myocardium. The results of studies of autonomic regulation in persons of mature age are contradictory [3,14]. At the same time, understanding the peculiarities of autonomic dysfunction in the elderly will allow for effective prevention of cardiovascular diseases through the selection of health-improving programs.

In connection with the above, society is in search of effective means that could reduce morbidity, improve the health of the elderly population, and prolong the active and fulfilling life of the elderly and the elderly. As a rule, all activities lead to the selection and use of drug therapy, sometimes causes a deterioration in health and further leads to a rejection of an active life [11, 12]. Unfortunately, society pays little attention to physical education, which is an effective and affordable means to improve all the functional capabilities of the body, especially in the elderly [1, 13]. Regular exercise not only slows down the aging process of muscle tissue, helps to maintain strength, improves posture and gait, stabilizes blood pressure, heart rate, prevents salt deposition in joints, but also helps the body cope with overstrain and stress, and also improves overall the physical state. Thus, in the process of systematic physical education, gradual changes in the body occur: the metabolism, the activity of the cardiovascular and respiratory systems improve, the level of physical fitness, vitality, working capacity and quality of life of the elderly increase [7, 8,13].

Communication of work with scientific programs, plans, themes. The work was carried out in accordance with the priority thematic area No. 76.35 "Medical and biological substantiation of the recovery measures and the appointment of physical rehabilitation means for young people of varying degrees of fitness." State registration number 0116U004081.

Purpose and objectives of the study - based on the analysis of modern special literature, to study the vegetative balance in the elderly using cardiointervalography in the dynamics of health-improving motor activity.

Material and Methods of research

As part of the implementation of state policy in the system of improving the population on the basis of the problem research laboratory of the KSAPC, the “School of Active Aging” was organized, aimed at creating conditions for improving the quality of life of women. The study involved 60 elderly women. At the first meeting, attention was drawn to the fact that all the women under study over the past 3-4 years had a decrease in physical activity, eating disorders, weight gain, spontaneously occurring headache, fluctuations in blood pressure. At the beginning of the study, the patients were divided into three groups. Gr. 1 women (n=24) are relatively healthy; women Gr. 2 (n=17) with intermittent increase in blood pressure up to 150/90 mm Hg, women Gr. 3 (n=19) with constant blood pressure values 150/90 – 160/100 mm Hg. All women involved in the study did not take drug therapy. *Cardiointervalography* is one of the methods for assessing heart rate. The method is based on a mathematical analysis of the variability of the sinus heart rate as an indicator of the adaptive-compensatory activity of the whole organism. The cardiointervalography was recorded using the CardiolabPlus computer system (produced by the Research Institute "KhAI-Medika", Kharkov). To study the statistical characteristics of the rhythm, 100 cardiocycles were analyzed. The following indicators were calculated: mode (Mo), mode amplitude (AMo), variation range (DX s), stress index (SI, expressed in%). Vegetative reactivity was assessed by the ratio SI2/SI1. SI in well-developed individuals ranges from 80 to 140 conditions units The results were statistically processed using the statistical software package

Statistica 6.0. All ethical principles for medical research have been followed according to the WMA declaration (Helsinki, 2013).

Results of the research

Elderly women regularly attended the "School of Active Aging" for 3 months. Before starting work on the program, all women underwent cardiointervalography. As can be seen from Table 1, healthy women (Gr. 1) are characterized by relatively high heart rate variability. This is evidenced by a sufficient difference between the maximum and minimum duration of the cardiac cycle - the variation range. At rest, they exert a balanced influence of the sympathetic and parasympathetic parts of the autonomic nervous system, as indicated by the indicator of the amplitude of the mode. Taking into account the value of the stress index, the intensity of the mechanisms of autonomic regulation of the ANS in women in this group is low. When performing the orthostatic test in women of group 1, the activation of the sympathetic part of the nervous system moderately increased, as evidenced by a decrease in the mode indicator, an increase in the amplitude of the mode and the stress index, but its activation does not bring the stress index value beyond the balance of the ANS work, as indicated by the vegetative indicator.

Table 1

Characteristics of heart rate variability in elderly women Gr. 1 (n=24), Gr. 2 (n=17) and Gr. 3 (n=19)

Indicators	Gr.1 (n=24) X±m	Gr.2 (n=17) X±m	Gr.3 (n=19) X±m	p_1	p_2
Mode $(Moe)_1$	0,84±0,03	0,94±0,06	0,91 ± 0,12	>0,05	>0,05
Mode amplitude $(Amo)_1$	18,12±1,19	19,65±1,07	26,29±2,27	>0,05	<0,05
Dx_1	0,24±0,05	0,31±0,02	0,31±0,09	>0,05	>0,05
Stress index (SI_1)	52,71±5,74	57,62±5,04	87,24±12,17	>0,05	<0,05
Mode (Mo_2)	0,67±0,04	0,58±0,02	0,81±0,08	<0,05	<0,05
Mode amplitude $(Amo)_2$	19,78±1,15	24,18±1,19	41,14 ± 3,27	<0,05	<0,05
Dx	0,21±0,02	0,15±0,01	0,28 ± 0,18	<0,05	<0,05
Stress index (SI_2)	83,62±9,83	117,4±15,66	178,25±34,14	<0,05	<0,05
SI_2/SI_1	1,85±0,32	2,04±0,31	2,91±0,54	<0,05	<0,05

Remark: p1 - comparison between Gr.1 and Gr.2; p2 - comparison between Gr. 1 and Gr. 3

According to the data of cardiointervalography of women, in comparison with the indicators of healthy women (Gr. 1), there was an insignificant increase in mode, variation range, an increase in the amplitude of the mode and the stress index, which indicates the activation of both the sympathetic part of the nervous system and

parasympathetic influences. When performing the orthostatic test in women (Gr. 2), in comparison with the indicators of women (Gr. 1), there was a significant decrease in mode and variation range; an increase in the amplitude of the mode and the stress index ($p<0,05$), which indicates the activation of both the sympathetic and parasympathetic parts of the autonomic nervous system. These changes in women (Gr. 2) during the orthostatic test testified to sympathicotonic control of the heart rhythm, that is, there is some prevalence of the parasympathetic division of the ANS in the regulation of the heart rhythm. Indeed, based on the indicators in this group, we can talk about the negative impact of fluctuations in blood pressure on the vegetative balance.

In women of group 3 with constant high blood pressure, we found that against the background of a significant increase in the amplitude of the mode and the stress index, the mode and variation range increased, which indicates an increase in the activation of both sympathetic and parasympathetic influences. However, during the orthostatic test against the background of a decrease in the mode, an increase in the amplitude of the mode and the variation range, there was a significant increase in the stress index with significant hypersympathicotonic activity. At the same time, a high SI2 index indicates the development of tension in the regulatory autonomic and humoral systems in the body.

An important role in improving the quality of life of this category of women should be the development of health programs. The goal and objectives of the program are to maintain the vital activity of older women through an active lifestyle, psychological health, social interaction, etc. The developed wellness program was presented by talks on wellness topics, morning hygienic gymnastics and health walking. During the morning hygienic gymnastics, women performed a set of conventional physical exercises aimed at muscle relaxation, balance, coordination of movement, and training of the vestibular apparatus. The duration of the lesson is 20-30 minutes. During morning hygienic exercises, women were advised to pay more attention to breathing exercises.

Wellness walking is the most accessible type of physical activity, which does not require special training and material costs, in the process of which improves the work of all organs and systems of the body. At the beginning of the program, 3-5 women in light clothing walked for 45 minutes a day, first at a slow pace of 70-80 steps per minute for a distance of 1500 m to 2000 m. Starting from the 8th day, a route was assigned with a length of 2000 to 2500 m, the walking speed was gradually increased to 90-100 steps per minute for 60 minutes. It was recommended to monitor breathing: 2 steps - inhale, 3-4 steps - exhale [5, 10].

The educational part of the program included conversations with women on the formation of their stable beliefs in the need to change their lifestyle, correct eating behavior and fulfill the requirements of health and physical activity, the mechanism and consequences of cardiovascular diseases and their prevention. Given the prevalence of coronavirus infection, women were monitored remotely using telecommunications technology. The dynamics of changes in cardiointervalography with orthostatic test is presented in Table 2.

After repeated cardiointervalography with orthostatic test in women of group 2, regardless of the initial index, the SI1 was lower than during the initial examination. There was a decrease in the amplitude of the mode, the variation range, compared with the initial indicators, and the stress index decreased (52,62±6,05 versus 57,62±5,04), that is, the stress index during the repeated study fluctuated within the limits of eutonia. When performing the orthostatic test, there was a decrease in the amplitude of the mode and the variation range, a significant decrease in the stress index ($p<0,05$). And although the indicator of autonomic reactivity decreased (SI2/SI1=1,71±0,21 against), no statistical significance was observed ($p>0,05$). However, the activation of autonomic reactivity in women (Gr. 2) by the value of the stress index within the balance of the ANS work, that is, the autonomic reactivity has become in the normotonic type. A decrease in the index of tension and autonomic reactivity indicates an improvement in vegetative stabilizing properties, a decrease in the tension of the mechanisms of autonomic regulation of the ANS in women (Gr. 2) due to the influence of health and motor activity.

Table 2

Dynamics of cardiointervalography indices with orthostatic test in elderly women Gr. 2 (n=17) and Gr. 3 (n=19)

Indicators	I Gr.2 (n=17) X±m	Gr.2 (n=17) X±m	Gr. 3 (n=19) X±m	Gr. 3 (n=19) X±m	p_1	p_2
Mo_1	0,91±0,06	0,78±1,03	0,94 ± 0,12	0,87±0,06	<0,05	>0,05
Amo_1	19,65±1,07	18,34±1,14	26,29±2,27	25,62±2,17	>0,05	>0,05
Dx_1	0,31±0,02	0,27±0,07	0,31±0,09	0,28±0,02	>0,05	>0,05
SI_1	57,62±5,04	52,62±6,05	83,62±12,17	81,92±25,71	>0,05	>0,05
Mo_2	0,98±0,02	0,81±0,02	0,97±0,08	0,89±0,02	>0,05	>0,05
Amo_2	24,18±1,19	21,18±1,10	29,14±3,27	28,00±1,59	>0,05	>0,05
Dx_2	0,15±0,01	0,21±0,02	0,28 ± 0,18	0,19±0,02	>0,05	>0,05
SI_2	117,4±15,66	90,27±12,17	178,25±34,14	167,12±14,12	<0,05	>0,05
SI_2/SI_1	2,03±0,31	1,71±0,21	2,34±0,54	2,04±0,33	>0,05	>0,05

Примітка: p_1 – динаміка у жінок Гр.2; p_2 – динаміка у жінок Гр.3

Women (Gr. 3) showed a positive trend in all cardiointervalography indicators, but none of them underwent statistically significant changes. The initial autonomic tone varied within the limits of eutonia with pronounced hypersympathicotonic reactivity. A high index of SI2 indicates the presence of tension in the regulatory autonomic and humoral systems in the body of women (Gr. 3), which is a consequence of an uncontrolled increase in blood pressure.

Thus, this study confirms the conclusions of many scientists that with an increase in blood pressure, the influence of not only the sympathetic part of the nervous system increases, but also the activation of the parasympathetic part, which leads to the development of severe cardiac disorders.

Conclusions / Discussion

Thus, the results of this study indicate the presence of autonomic imbalance in older women with a predominance of the activity of the sympathetic division of the autonomic nervous system and overstrain of the regulatory systems. Such data can be considered as a predictor of the occurrence of potentially threatening conditions of the cardiovascular system, especially in the presence of an uncontrolled increase in blood pressure, which is confirmed by the data of the authors (O.I. Grinov, L.V. Glushko (2017), Kovalenko, S.A. (2017) [4,6]. The data obtained indicate the need for cardiointervalography with orthostatic test for elderly people, as a screening method for identifying a group of people at risk of developing threatening cardiac

arrhythmias, and for further, more advanced, examination and development of preventive measures for each individual. All of the above is confirmed by the work of V. Jandackova, et al. (2016), Yadav R. (2017), Andreeva Ya.A., Mirny D.P. (2017) [3, 14, 15].

Thus, the development of health-improving and motor activity programs will contribute to improving the health status, prolonging the active and full life of the elderly and the elderly. All women are recommended to continue to study according to the program, and women (Gr. 3) are additionally recommended to undergo an in-depth examination with a family doctor.

Prospects for further research in this direction are associated with cardiointervalography in women Gr. 2 and Gr. 3 after 6 months of active health and motor activity.

Conflict of interest. The authors state that there is no conflict of interest that may be perceived as prejudicial to the impartiality of a state, public or commercial organization.

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References

1. Agranovich, N. V., Anopchenko, A. S., Knyshova, S. A., Pilipovich, L. A. (2015), «Organizing and conducting health groups for the elderly and senile people is an important element that contributes to the prolongation of active longevity», Sovremennye problemy nauki i obrazovaniia, No. 1-1. (in Russ.).

2. Andrieieva, O., Hakman, A. (2021), «Theoretical basis of active aging of the population of Ukraine», Teoriia i metodyka fizychnoho vykhovannia i sportu, № 1, pp. 13–18 DOI: 10.32652/tmfvs.2021.1.13–18. (in Ukr.).

3. Andreieva, Ya. O., Myrnyi, D. P. (2017), «Heart rate variability in young people with obesity of alimentary-constitutional genesis», Aktualni problemy suchasnoi

medytsyny: Visnyk ukrainskoi medychnoi stomatolohichnoi akademii, № 4-2 (60). (in Ukr.)
4. Hryniv, O. I., Hlushko, L. V. (2017), «Relationship between heart rate variability and daily blood pressure profile in patients with hypertension», Klinichna ta eksperymentalna patolohiia, T.16, №4 (62), pp. 30-36. (in Ukr.)
5. Kochuieva, M. M., Rubanб L. A., Tymchenko, H. A. (2018), «Effectiveness of physical rehabilitation of patients with cardiopulmonary pathology», Mizhnarodnyi medychnyi zhurnal, T. 24, № 4(96), pp. 11–14. (in Ukr.)
6. Kovalenko, S. O. (2017), «Characteristics and theoretical foundations of methods for analyzing heart rate variability», Ukrainskyi zhurnal medytsyny, biolohii ta sportu, № 2, pp. 223-233. (in Ukr.)
7. Krutsevych, T. Iu., Bezverkhniaia, H. V. (2010), Rekreatsiya v fizicheskoy kul'ture raznykh grupp naseleniya: uch. posobye, K.: Olymp.l-ra, 248 p. (in Russ.)
8. Lukovska, O. L., Solohubova, S. V. (2011), «Factors of morphofunctional state of the body of women of the first mature age, significant for the construction of fitness training», Pedahohika, psykholohiia ta medyko-biolohichni problemy fizychnoho vykhovannia i sportu, № 5, pp. 46-50. (in Ukr.).
9. Pimenova, O. (2019), «Human aging in modern conditions: features and prospects for active longevity», Sotsiolohichni studii, № 2 (15), pp. 30–34. DOI: https://doi.org / 10.29038/2306-3971-2019-02-30-34. (in Ukr.)
10. Putiatina, H., Ruban, L. (2020), «Improving the quality of life of elderly women by means of health and recreational physical activity», Molodizhnyi naukovyi visnyk Skhidnoievropeiskoho natsionalnoho universytetu imeni Lesi Ukrainky. Fizychne vykhovannia i sport, Lutsk, Vyp. 34, pp. 56-61. (in Ukr.)
11. Ruban, L., Zharova, I. (2020), «Attitudes towards the health of young women with hypertension», Slobozhanskyi naukovo-sportyvnyi visnyk, № 5(79), pp. 33-37. (in Ukr.).
12. Shpahyn, S. V. (2015), «The role of physical activity in the prevention and health promotion of people of retirement age», Vestnik Tambovskogo universiteta. Seriya: Gumanitarnyye nauki, №. 3, pp. 106–110. (in Russ.)

13. Andrieieva O., Hakman A., Kashuba V., Vasylenko M., Patsaliuk K., Koshura A. and Istyniuk I. (2019), «Effects of physical activity on aging processes in elderly persons», Journal of Physical Education and Sport, Vol. 19, Art 190, pp. 1308–1314. (in Eng.)
14. Jandackova V., Scholes S., Britton A. and et al. (2016), «Are Changes in Heart Rate Variability in MiddleAged and Older People Normative or Caused by Pathological Conditions? Findings from a Large Population Based Longitudinal Cohort Study», J. Am Heart Assoc., №5, pp. 1–13. (in Eng.)
15. Yadav R., Yadav P., Yadav L. and et al. (2017), «Association between obesity and heart rate variability indices: an intuition toward cardiac autonomic alteration; a risk of CVD», Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, №10, pp. 57–60. (in Eng.)

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FEATURES OF PHYSICAL DEVELOPMENT, SPECIAL SWIMMING AND TECHNICAL PREPAREDNESS OF QUALIFIED WATER POLO PLAYERS WHO PERFORM THE FUNCTION OF CENTRAL DEFENDERS

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Purpose: to determine the features of physical development, special swimming and technical preparedness of qualified water polo players who perform the function of central defenders.

Material and methods: analysis and generalization of literary sources, anthropometric and physiological measurements, timing, assessment of special swimming, physical and technical preparedness by using tests, methods of mathematical statistics. The contingent of the surveyed consisted of athletes who have the playing role of central defenders. The level of their sports qualifications corresponded to the titles of master of sport of Ukraine and candidate for master of sports of Ukraine in water polo. The total number of surveyed people is 10 athletes.

Results: characterized the components of the structure of special preparedness of qualified water polo players who perform the function of central defenders, researched the degree of interconnection between indicators of the level of physical development, special swimming and technical preparedness of defense players, determined the profile parameters of the structure of special preparedness, which determine the effective actions of central defenders in men's water polo.

Conclusions: the structure of the special preparedness of qualified water polo players who perform the functions of central defenders has its own characteristics.

Athletes of this playing role are characterized by significant linear dimensions of the limbs and their segments, hand strength, powerful motor actions during the game, fast overcoming distances with the ball, and long-distance throws. The defense players have the closest correlation relationship between the indicators of technical and special swimming preparedness. Determination of the features of the structure of special preparedness on the basis of a complex analysis of parameters, which reflecting the level of physical development, technical and special swimming preparedness of players of different roles, allows to effectively differentiate the training process in modern water polo.

Keywords: water polo, central defenders, structure of special preparedness, components, interconnection, model characteristics.

Introduction

The search for ways to optimize competitive and training activities in sports today does not lose its relevance.

Modern world practice, scientific research convincingly shows that the highest achievements can have only gifted athletes, which characterize by rare morphological properties, high level of physical and mental abilities, perfect technical, tactical skills, etc [2; 8; 13; 14].

Given the fact that water polo is a sport that is complicated by actions in the aquatic environment, in order to effectively solve situational problems that arise during the game, water polo players should have a high development of physical qualities, the optimal level of swimming and technical preparedness [1; 3; 4; 5; 6; 11; 12].

A comprehensive study of these components determines the ways to optimize the process of competitive activity in water polo [7; 9; 10; 15].

Despite the significant amount of information which accumulated in this direction, there are a number of issues that need in-depth study.

One of them is to determine the features of the structure of special preparedness of players of different roles, to identify the degree of relationship between its main components.

Research in this area will provide information that can be used to improve the training process, as it is possible to correctly place the emphasis of training influences and, as a consequence, to achieve high results in modern water polo.

Purpose of the study – to determine the features of physical development, special swimming and technical preparedness of qualified water polo players who perform the function of central defenders.

Objectives of the study:

1. Describe the components of the structure of special preparedness of qualified water polo players who perform the function of central defenders.

2. Investigate the degree of relationship between indicators of the level of physical development, special swimming and technical preparedness of qualified water polo players who have the role of central defenders.

3. Determine the profile parameters of the structure of special preparedness, which determine the effective actions of defenders in men's water polo.

Material and Methods of research

The following methods were used to solve the tasks: analysis and generalization of literary sources, anthropometric and physiological measurements, timing, assessment of special swimming, physical and technical preparedness by using tests, methods of mathematical statistics.

The study was conducted in the period from 2018 to 2020. The surveyed contingent consisted of 10 athletes who had the level of sports qualifications: Master of Sport of Ukraine and Candidate for Master of Sports of Ukraine in water polo and had the playing role of central defenders.

Results of the research

Peculiarities of the structure of special preparedness of qualified water polo players, who have the role of central defenders, were determined on the basis of a study of the level of their physical, technical and special swimming preparedness.

Among the parameters of physical development we considered: body length and weight, linear dimensions of the upper and lower extremities and their segments, brush strength (right and left hand), test results for the number of pull-ups, barbell bench press and running on 1 km. The total number of studied parameters was 10 indicators.

On the basis of the received digital material the profile which reflecting a level of physical development of players of the given role was constructed (Fig. 1).

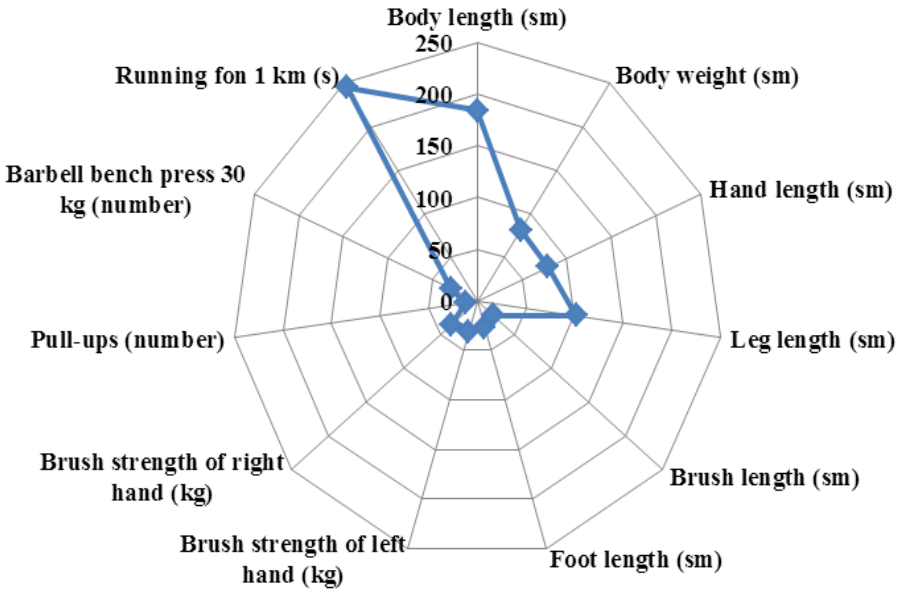

Fig. 1 The level of physical development of qualified water polo players who perform the function of central defenders

As can be seen from figure 1, the central defenders characterize by significant values of the linear dimensions of the lower extremities and their segments (leg and foot length are 101,6±5,5 cm and 26,56±0,98 cm, respectively), brush strength (right 34,63±1,4 kg and left arm 31,19±1,56 kg), mean values of height and body weight (184,1±5,69 cm and 81,6±8,04 kg), length of upper extremities and their segments (values of arm and hand length are 79,1±2,64 cm and 21,31±1,57 cm, respectively). Players of this role show quite high results in tests, which indicate the level of development of strength abilities and special endurance.

The greatest differences occur in such indicators as: length and weight of the body, the length of the lower extremities, the number of pull-ups and barbell bench press, the results of running on 1 km (Fig. 2).

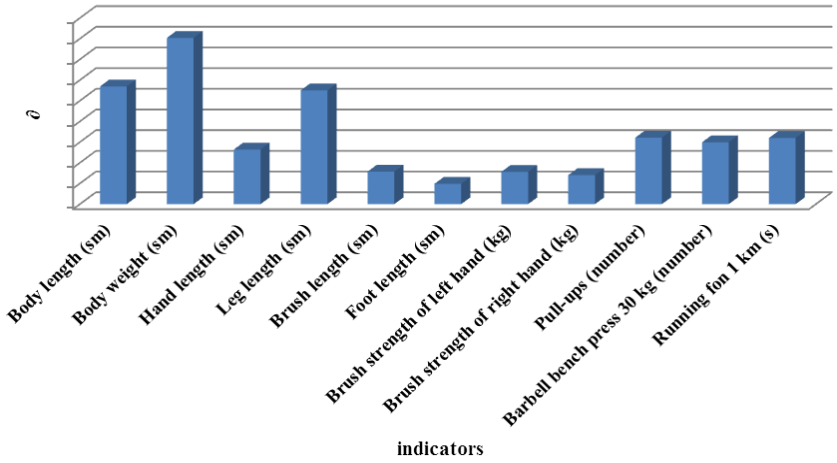

Fig. 2 Values of standard deviation of physical development indicators of central defenders

The technical preparedness of qualified water polo players, who perform the functions of central defenders, was assessed by the following test indicators: «50 m ball handling», «main throw from the place», «4x25 m ball handling», «throw range».

The obtained results indicate that the studied athletes quite quickly overcome the distance of 50 meters with the ball (32,64±0,97 s), show good results in the throwing distance (29,8±1,87 m). At the same time, the accuracy of the goal during the main throw from the place of water polo players of this group is equal to 64% of the maximum.

Among the indicators of technical readiness, the biggest discrepancy recorded in the results of the throw range (Fig. 3).

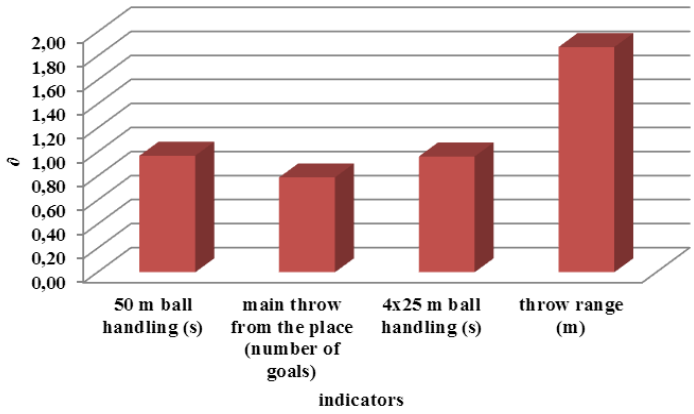

Fig. 3 Values of standard deviation of indicators of technical preparedness of central defenders

The main criteria of special swimming preparedness were the results of such tasks as: «10 jumps», «10 shifts», «30 jumps», «100 m crawl», «200 m crawl».

As can be seen from the results, the values of the studied parameters of players of this role are at the level of average values. Thus, 10 jumps are performed by athletes in 12,03 ± 0,36 s, 30 jumps are performed in 38,32 ± 1,9 s, the time required for them to overcome 100 and 200 meters by water polo crowl is 60,76 ± 11,97 s and 132,35 ± 2,57 s, respectively.

The largest scatter of values was recorded in such parameters as: «30 jumps», «100 m crawl», «200 m crawl» (Fig. 4).

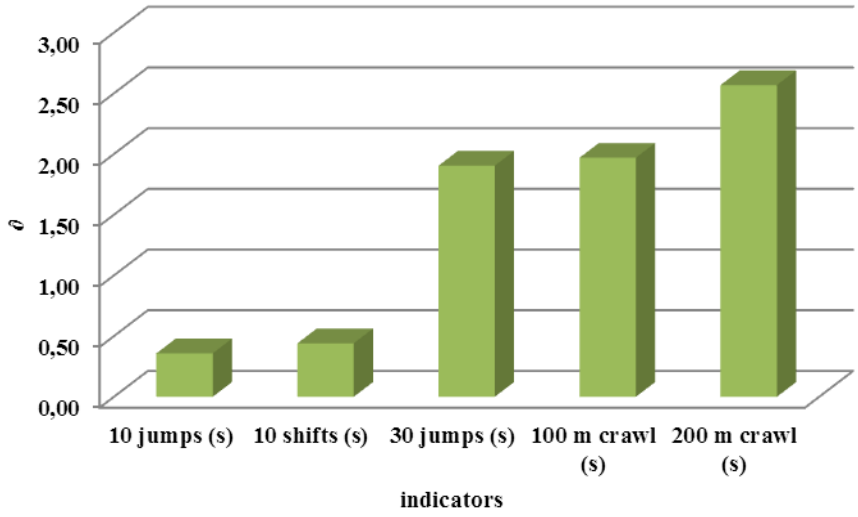

Fig. 4 Values of standard deviation of indicators of special swimming preparedness of central defenders

Thus, the analysis of the components of the structure of special preparedness allows us to state that the players who perform the functions of central defenders have significant values of the linear dimensions of the lower extremities and their segments, brush strength, which allows them to make powerful motor actions during the game, quickly cover the distance with the ball, show good results in throwing range.

After examining the degree of relationship between the indicators of the level of physical development, special swimming and technical preparedness of defensive players, we received the next picture (Table 1-3).

Table 1

The degree of correlation between indicators of physical development and technical preparedness of qualified water polo players who perform the function of central defenders

Indicators	50 m ball handling	Main throw from the place	4×25 m ball handling	Throw range
Height	-0,35	-0,25	0,15	0,62
Weight	0,40	-0,60	0,69	0,69
Arm length	-0,18	-0,28	0,29	0,72
Leg length	-0,10	-0,25	0,09	0,40
Brush length	-0,46	-0,08	-0,24	0,07
Foot length	-0,20	-0,18	0,02	0,32
Brush strength of left hand	0,00	0,15	-0,20	0,02
Brush strength of right hand	-0,37	0,38	-0,43	0,28
Pull-up	-0,36	0,75	-0,70	-0,59
Barbell press 30 kg	-0,47	0,48	-0,56	-0,10
Running on 1 km	0,72	-0,55	0,55	-0,39

As can be seen from table 1, there is a certain connection between the indicators of physical development and technical preparedness of water polo players who have the role of central defenders.

Thus, the height of the athlete and the length of his upper limbs significantly affect the throwing distance (r=0,62 and 0,72, respectively), which is associated with the biomechanical structure of the throwing movement.

The weight of the player correlates with the effectiveness of the main throw from the place, the range of the throw and the test performance «4x25 meters ball

handling» (r=-0,60, 0,69 and 0,69, respectively). Athletes with a lot of weight while moving gain inertial acceleration in the water, which allows them to have an advantage over other players in the specified indicators of technical skill.

The results of tests that reflect the level of physical preparedness of water polo players, namely pull-ups and running on 1 km, are closely related to all technical parameters.

In turn, the number of barbell press significantly correlates only with the test «4x25 meters ball handling» (r=-0,56).

Conducted correlation analysis of the relationship between indicators of physical development and special swimming training in skilled central defenders showed that there is a relationship between parameters such as height and length of the brush and the time to overcome the distance of 100 and 200 meters by water polo crowl (r is - 0,62, - 0,60 and -0,64, -0,54, respectively) (Table 2).

Table 2

The degree of correlation between indicators of physical development and special swimming preparedness in qualified water polo players who perform the function of central defenders

Indicators	10 jumps	10 shifts	30 jumps	100 m by water polo crowl	200 m by water polo crowl
Height	-0,05	0,05	0,04	-0,62	-0,60
Weight	0,76	0,53	0,71	0,35	0,47
Arm length	0,04	0,06	0,21	-0,45	-0,48
Leg length	0,10	0,20	0,04	-0,30	-0,24
Brush length	-0,29	0,02	-0,41	-0,64	-0,54
Foot length	0,00	-0,08	0,06	-0,30	-0,15
Brush strength of left hand	-0,16	-0,45	-0,11	-0,10	-0,03
Brush strength of right hand	-0,36	-0,55	-0,32	-0,38	-0,27
Pull-up	-0,64	-0,41	-0,69	-0,20	-0,07
Barbell press 30 kg	-0,39	-0,47	-0,46	-0,37	-0,16
Running on 1 km	0,56	0,51	0,39	0,57	0,49

Obviously, the high height and large area of the support surface, which is achieved due to the length of the brush, allows the athlete to increase the «step» of the rowing cycle, which improves his speed parameters.

High weight and high level of strength give water polo players an advantage in performing jumps and active motor actions in the water.

The value of r between such parameters as «body weight» - «10 jumps», «body weight» - «10 shifts», «body weight» - «30 jumps» is equal to 0,76; 0,53; 0,71 respectively.

Indicators of brush strength and time spent on 10 shifts are correlated at the level of r=-0,55. The average degree of correlation exists between the pull-up and the result of the test «10 jumps» (r=-0,64) and «30 jumps» (r=-0,69).

Also related are the results of running on 1 km and the time of 10 jumps (r=0,56), 10 shifts (r=0,51), overcoming 100 meters by water polo crawl (r=0,57).

The study of the degree of correlation between the indicators of technical and special swimming preparedness of water polo players allowed to determine that they significantly affect each other (Table 3).

Table 3

The degree of correlation between the indicators of technical and special swimming preparedness in qualified water polo players who perform the function of central defenders

Indicators	50 m ball handling	Main throw from the place	4×25 m ball handling	Throw range
10 jumps	0,84	-0,80	0,89	0,20
10 shifts	0,66	-0,81	0,81	0,00
30 jumps	0,84	-0,71	0,90	0,27
100 m by water polo crowl	0,78	-0,32	0,48	-0,07
200 m by water polo crowl	0,65	-0,17	0,40	0,02

As can be seen from table 3, the central defenders have a close relationship with the parameters: «10 jumps» - «50 m ball handing» (r=0,84), «10 shifts» - «50 m ball handing» (r=0,66), «30 jumps» - «50 m ball handing» (r=0,84), «100 m crawl» - «50 m ball handing» (r=0,78) , «200 m crawl» - «50 m ball handing» (r=0,65).

Such indicators of technical skill as «main throw from the place» and «4x25 m

ball handing» essentially influence efficiency of movement of players in water (r at the level of values - 0,71 - 0,90).

The study provided an opportunity to determine the parameters of the level of physical development, technical and special swimming preparedness, which are most interconnected and compliance with which will allow athletes to best realize themselves as a central defender.

So among the most important indicators that can be used as a guide in choosing the game role of the central defender, we can consider such parameters as: height, body weight, hand length, number of pull-ups, «10 jumps», «30 jumps», «100 m crawl», the accuracy of the main throw from the place, «50 m ball handing», «4x25 m ball handing».

Based on the obtained digital material, became possible to develop model characteristics of certain parameters (Table 4).

Table 4

Model characteristics of the most significant preparedness of the structure of special training of central defenders in men's water polo

№	Indicator	Model value
1	Body length, sm	184,1 ±5,69
2	Body weight, sm	81,6±8,04
3	Brush length, sm	21,31±1,57
4	Pull-ups, number	12,5±3,21
5	10 jumps, s	12,03± 0,36
6	30 jumps, s	38,32± 1,9
7	100 m crawl, s	60.76±11,97
8	Main throw from the place, number	3,2±0,79
9	50 m ball handling, s	32,64±0,97
10	4x25 m ball handling, s	78,51±0,96

Comparing the individual characteristics of the indicators of the structure of special preparedness with the model will allow athletes to determine the expediency of the choice of this role, which in turn will provide an opportunity to right build the training process.

Conclusions / Discussion

The results of the study confirm the opinion of many experts that the main components of the structure of special preparedness of qualified water polo players, which determine the effectiveness of their game activities, are physical, technical and special swimming preparedness.

It is determined that the central defenders differ of the significant values of the linear dimensions of the lower extremities and their segments, brush strength, powerful motor actions during the game, fast overcoming of segments of different lengths with and without the ball, long throws.

It was found that defensive players have a close correlation between such indicators of technical and special swimming preparedness as: «10 jumps» - «50 m ball handing» (r=0,84), «30 jumps» - «50 m ball handing» (r=0,84), «100 m crawl» - «50 m ball handing» (r=0,78). «Main throw from a place» and «4x25 m ball handing» are connected with efficiency of movement of players in water at the level of values r– 0,71 - 0,90.

It is proved that among the parameters that allow to choose the role of the central defender, can be used: height, body weight, hand length, number of pull-ups, «10 jumps», «30 jumps», «100 m crawl», the accuracy of the main throw from the places, «50 m ball handing», «4x25 m ball handing». In turn, determining the features of the structure of special preparedness of players of different roles on the basis of a comprehensive analysis of the structure of special preparedness allows you to effectively differentiate the training process in modern water polo.

Prospect of further research is study of the features of the structure of special training of qualified water polo players who perform the functions of midfielders and mobile strikers.

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References

1. Abdukadyrova, Zh. R. (2004), «General and special working capacity of water polo players of various playing roles», Sovremennyi olympyiskyi sport y sport dlia vsekh : materyaly VIII mezhdunar. nauchn. konhr. Almaty, pp. 5 - 6. (in Russ.)

2. Volkov, L. V. (1997), Teoryia sportyvnoho otbora: sposobnosty, odarennost, talant [Sports selection theory: abilities, giftedness, talent]. Kiev, 128 p. (in Russ.)

3. Davydov, V. Ju. (2007), Vodnoe polo: uchebnoe posobie [Water polo: a training manual]. Volgograd, 42 p. (in Russ.)

4. Evpak, N. (2016), «Management of the team's competitive activity in water polo», Sportyvnyi visnyk Prydniprovia, № 2. pp. 61 - 65. (in Russ.)

5. Zemcov, I. F. (2008), «The speed and efficiency of the solutions applied as a criterion of preparedness of water polo players», VII Mezhdunar. nauch. kongr. «Sovremennyj olimpijskij sport i sport dlja vseh», Moscow, Vol. 3, pp. 169-180. (in Russ.)

6. Pylypko, O. A., Poproshaev, A. V. (2001), «Features of the structure of special preparedness of waterpolo players aged 14–15, depending on the play in grole», Pedahohika, psykholohiiata medyko-biolohichni problemy fizychnoho vykhovannia i sportu, № 7, pp. 36 - 40. (in Russ.)

7. Pylypko, O., Pylypko, A. (2019), «Choice of playing roles of the central defenders on the basis of the analysis of the structure of the special preparedness of qualified female water polo players», Slobozhanskyi naukovo-sportyvnyi visnyk, № 1 (69), pp. 37–42. (in Ukr.)

8. Platonov, V. N. (1997), Obshchaia teoryia podhotovky sportsmenov v olympyiskom sporte [General theory of training athletes in Olympic sports]: ucheb. dlia studentov vuzov fyz. vospytanyia y sporta. Kiev, 584 p. (in Russ).

9. Poproshaiev, O. V., Pylypko, O. O. (2005), «Expert system for determining the role of water polo», Sportyvnyi visnyk, № 1, pp. 67-72. (in Ukr.)

10. Rebic'ka, N. (2002), «Prohnozyrovanye sportyvnoho rezultata vaterpolystov na osnove kompleksnoi otsenky ykh podhotovlennosty», Young sports science of Ukraine, Vol. 6, № 2, pp. 206 – 208. (in Ukr.)

11. Rebytskaia, N. A., Zemtsov, Y. F. (2004), «Analysis of the effectiveness of competitive activities of high-class water polo players», Sovremennyi olympyiskyi sport y sport dlia vsekh : materyaly VIII Mezhdunarodnoho nauchnoho konhressa (h. Almaty, 2004.). Almaty, pp. 230–231. (in Russ.)
12. Ryzhak, M. M. (2002), Vodnoe polo [Water polo]. Moscow, 280 p. (in Russ.)
13. Serhiienko, L. P. (2009), Sportyvnyi vidbir: teoriia ta praktyka [Sports view: theory and practice] U 2 kn., Knyha 1: Teoretychni osnovy sportyvnoho vidboru: pidruchnyk. Ternopil, 672 p. (in Ukr.)
14. Shynkaruk, O. A. (2011), Otbor sportsmenov y oryentatsyia ykh podhotovky v protsesse mnoholetneho sovershenstvovanyia (na materyale olympyiskykh vydov sporta) [Selection of athletes and the orientation of their training in the process of long-term improvement (on the material of Olympic sports)]. Kiev, 360 p. (in Russ.)
15. Olga Pilipko, Alina Pilipko, Volodymyr Ashanin (2020), «Choice of game role of the midfielders and movingforwards of players in female water polo», Slobozhanskyi herald of science and sport, Vol. 8, No 2, pp. 40-51. (in Eng.)

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FEATURES OF THE DEVELOPMENT OF THE COORDINATION ABILITIES OF FITNESS ATHLETES AGED 8-9 YEARS

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Purpose: to determine the dynamics of the development of the coordination abilities of fitness athletes aged 8-9 years.

Material and methods: 24 fitness athletes were tested at the beginning and at the end of the study. The 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: the results of a pedagogical study of the development of the coordination abilities of fitness athletes aged 8-9 years indicate a significant increase in the indicators of coordination abilities, which confirm that the use of special complexes of exercises is an effective approach in the educational and training process.

Conclusions: comparison of the dynamics of statistical indicators of the final testing of fitness athletes aged 8-9 years showed an increase in all tested indicators.

Keywords: coordination abilities, athletes, fitness, testing.

Introduction

Like any sport, fitness attracts the young, and even the children's generation of our time, with its simplicity and varied palette of movements, which create a demonstration of different-sized and statically fixed body positions of those involved.

The development of the coordination abilities of 8-9 years old children occupies an important place in the system of technical training of athletes in complex coordination sports, which include fitness. Due to the coordination abilities of athletes of this age, much attention is paid to education and technical training. Its main content is the basic training of the sport, learning the profiling elements [1, 4, 7].

Currently, the development of the coordinating abilities of young athletes in children's fitness is becoming an increasingly urgent problem. In this fitness, in addition to static postures, body positions, characteristic movements are used, performed in dynamics, in revolutions, as well as in changing the angles of posing the athlete's body [5, 6, 13].

Taking this into account, our study on the peculiarities of the development of the coordination abilities of fitness athletes at the age of 8-9 years old is relevant.

Communication of research with scientific or practical tasks, plans, programs. The study was carried out in accordance with the initiative theme of the research work of the Department of Gymnastics, Dance Sports and Choreography of KSAPC: “Theoretical and methodological foundations for the development of the backbone components of physical culture (sport, fitness and recreation) for 2020-20251 (state registration number 0120U101215).

Purpose of the research: to determine the dynamics of the development of coordination abilities of athletes in fitness at the age of 8-9 years.

Objectives of the study:

1. To study the problems of the development of coordination abilities of athletes in fitness at the age of 8-9 years.
2. To determine the content and features of the formation of coordination abilities among fitness athletes at the age of 8-9 years.

Material and Methods of research

The study was conducted during 2020-2021. 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 17 fitness athletes from the control group (8 boys and 9 girls) and 17 fitness athletes from the main group (8 boys and 9 girls) were tested at the beginning and end of the study.

Results of the research

At the beginning of the study, the first testing of the coordination abilities of athletes in fitness at the age of 8-9 years of the control group (CG) and the main group (MG) was carried out, which made it possible to determine their initial level. The test results are presented in Table 1.

Table 1

The results of testing the coordination abilities of fitness athletes at the age of 8-9 years at the beginning of the pedagogical experiment

№ i/o	Test name	$\overline{X}$ ±m		t_p	t_{gr}	P
		CG	MG			
Boys ($n_1+n_2=16$)						
1.	Shuttle run (s)	12,82±0,21	12,6 ±0,18	0,79	2,14	>0,05
2.	Static balance (s)	9,94±0.32	9,9±0,46	0,07	2,14	>0,05
3.	Tossing and catching the ball (number of times)	14,4±0,34	14,8±0,41	0,75	2,14	>0,05
4.	Bouncing the ball off the wall (number of times)	11,4±0,64	10,2±0,41	1,59	2,14	>0,05
5.	Jumping rope (number of times)	11,0±0,91	11,8±0,82	0,65	2,14	>0,05
Girls ($n_1+n_2=18$)						
1.	Shuttle run (s)	14,4±0,34	14,07±0,34	0,69	2,12	>0,05
2.	Static balance (s)	10,25±0,34	10,42 ± 0,3	0,37	2,12	>0,05
3.	Tossing and catching the ball (number of times)	12,57 ± 0,29	12,14 ± 0,54	0,70	2,12	>0,05
4.	Bouncing the ball off the wall (number of times)	9,42±0,46	9,52±0,7	0,12	2,12	>0,05
5.	Jumping rope (number of times)	14,28 ±0,73	13,85±0,86	0,38	2,12	>0,05

During the testing of fitness athletes at the age of 8-9 years of both groups at the beginning of the pedagogical experiment, unreliable results were not determined according to the Student's criterion (p>0,05). This allows us to state that the

development of coordination abilities among athletes of both groups does not have a significant difference..

In the course of the pedagogical experiment, the educational and training process in fitness was carried out in accordance with the curriculum, where the educational and training process of fitness athletes in the control group (CG) was conducted according to the traditional method, and in the study of the development of the coordination abilities of athletes in fitness of the main group (CG) we used sets of exercises that included spatial and dynamic biomechanical characteristics.

During the pedagogical experiment, the dynamics of the development of coordination abilities in the control and main groups was revealed, presented in Tables 2 and 3.

Table 2

Statistical indicators of the development coordination abilities of fitness athletes at the age of 8-9 years from the CG during the pedagogical experiment

№	Test	Results		t_p	t_{gr}	P	IN %
		Initial	Final				
Boys (n=8)							
1	Shuttle run (s)	12,82±0,21	12,36± 0,27	1,34	2,31	> 0,05	3,6
2	Static balance (s)	9,94±0.32	10,26± 0.45	0,58	2,31	> 0,05	3,2
3	Tossing and catching the ball (number of times)	14,4±0,34	15,6 ± 0,75	1,46	2,31	> 0,05	8,3
4	Bouncing the ball from the wall (number of times)	11,4±0,64	12,8± 0,42	1,83	2,31	> 0,05	12,2
5	Jumping rope (number of times)	11,0±0,91	11,59 ±0,79	0,49	2,31	> 0,05	5,4
Girls (n=9)							
1	Shuttle run (s)	14,4±0.34	13,9 ± 0,35	1,02	2,30	> 0,05	3,5
2	Static balance (s)	10,25 ±0,34	11,05 ±0,26	1,87	2,30	> 0,05	7,8
3	Tossing and catching the ball (number of times)	12,57 ±0,29	14,42± 0,81	2,15	2,30	> 0,05	14,7
4	Bouncing the ball from the wall (number of times)	9,42±0,46	11,17 ± 0,7	2,09	2,30	> 0,05	18,6
5	Jumping rope (number of times)	14,28 ±0,73	16,0 ± 0,85	1,54	2,30	> 0,05	12,1

Comparison of the indicators of the initial and final testing of the CG showed an increase in all indicators of the proposed tests. At the same time, considering the

average group changes, it can be noted that the increase in the indicators of the development of coordination abilities among athletes is not uniform. So, the highest percentages were found in boys, where a statistically insignificant increase in indicators was found in bouncing the ball from the wall 8,3 % (t_p=1,46; p>0,05); and tossing and catching the ball 12,2% (t_p=1,83; p>0,05), characterizing the level of orientation in space. Indicators of tests and their percentages are: jumping rope, characterizing the level of development of coordination of movements 5,4% (t_p=0,49; p>0,05); shuttle run, which characterizes the development of spatio-temporal parameters 3,6% (t_p=1,34; p>0,05) and in static equilibrium, which characterizes the level of termination of macroscopic mechanical systems and body movement 3,2% (t_p=0,58; p>0,05) changed in the direction of improving the results, but the indicators were also statistically insignificant. Somewhat better indicators of the dynamics of the development of coordination abilities in girls of the control group.

So, the highest percentages were found in girls, where a statistically insignificant increase in indicators was found in bouncing the ball from the wall 18,6% (t_p=2,09; p>0,05); tossing and catching the ball 14,7 % (t_p=2,15; p>0,05), characterizing the level of orientation in space. Indicators of tests and their percentages are: jumping rope, characterizing the level of development of coordination of movements 12,1% (t_p=1,54; p>0,05); shuttle run, which characterizes the development of spatio-temporal parameters 3,5 % (t_p=1,02; p>0,05) and in static equilibrium, which characterizes the level of termination of macroscopic mechanical systems and body movement 7,8 % (t_p=1,87; p>0,05) changed in the direction of improving the results, but the indicators were also statistically insignificant.

Comparison of indicators of initial and final testing of athletes of the main group showed an increase in all indicators of the proposed tests.

Table 3

Statistical indicators of the development coordination abilities of fitness athletes at the age of 8-9 years from the MG during the pedagogical experiment

№	Test	$\overline{X}$ ±m		t_p	t_{gr}	*P*	IN %
		In the beginning	In the end				
Boys (n=8)							
1	Shuttle run (s)	12,6 ±0,18	11,2 ±0,29	4,10	2,31	<0,01	11,2
2	Static balance (s)	9,9±0,46	11,8±0,38	3,18	2,31	< 0,05	19,1
3	Tossing and catching the ball (number of times)	14,8±0,41	17,8±0,41	5,17	2,31	< 0,001	20,3
4	Bouncing the ball from the wall (number of times)	10,2±0,41	15,2±0,65	6,51	2,31	< 0,001	49,1
5	Jumping rope (number of times)	11,8±0,82	15,4±0,57	3,60	2,31	< 0,01	30,5
Girls (n=9)							
1	Shuttle run (s)	14,07±0,34	12,8±0,26	2,97	2,30	< 0,05	9,1
2	Static balance (s)	10,42 ± 0,3	12,77± 0,35	5,10	2,30	< 0,001	22,5
3	Tossing and catching the ball (number of times)	12,14 ± 0,54	16,42 ± 0,21	7,39	2,30	< 0,001	35,2
4	Bouncing the ball from the wall (number of times)	9,52±0,7	14,28±0,69	4,84	2,30	< 0,01	50,0
5	Jumping rope (number of times)	13,85±0,86	18,85 ±0,42	5,22	2,30	< 0,001	36,1

Considering the middle group configurations, it can be noted that the increase in the indicators of the development of coordination abilities among the athletes of the main group is significantly higher. This confirmation has the results shown as a percentage of their difference. In boys, this is a statistically significant increase in indicators, which was found in the bouncing the ball from the wall 49,1 % (t_p=6,51; p<0,001); and jumping rope (number of times) 30,5% (t_p=3,60; p<0,01), characterizing the level of development of coordination of movements. Indicators of tests and their percentages: tossing and catching the ball (number of times), characterizing the level of orientation in space 20,3% (t_p=5,17; p<0,001); static equilibrium, which characterizes the level of termination of macroscopic mechanical systems and body movement 19,1% (t_p=3,18; p<0,05); shuttle run, which characterizes the development of spatio-temporal parameters 11,2 % (t_p=4,10;

p<0,01). The test indicators and their percentages indicate positive changes in the direction of improving the results, which, according to the Student's criterion, turned out to be statistically significant (p<0,05). As in the control group, and in the main group, girls showed the best results.

So, the highest percentages were found in girls, where a statistically significant increase in indicators was found in the bouncing the ball from the wall 50,0% (t_p=4,84; p<0,01) and tossing and catching the ball 35,2 % (t_p=7,39; p<0,001), characterizing the level of orientation in space. Indicators of tests and their percentages: jumping rope, characterizing the level of development of coordination of movements 36,1% (t_p=5,22; p<0,001); static equilibrium, which characterizes the level of termination of macroscopic mechanical systems and body movement 22,5% (t_p=5,10; p<0,001); shuttle run, which characterizes the development of spatio-temporal parameters 9,1% (t_p=2,97 p<0,05). The test indicators and their percentages indicate positive changes in the direction of improving the results, which, according to the Student's criterion, turned out to be statistically significant. (p<0,05). When comparing the indicators of the development of the coordination abilities of fitness athletes of the main and control groups, the reliability of the results is observed in all test indicators, which is reflected in Fig. 1 and 2.

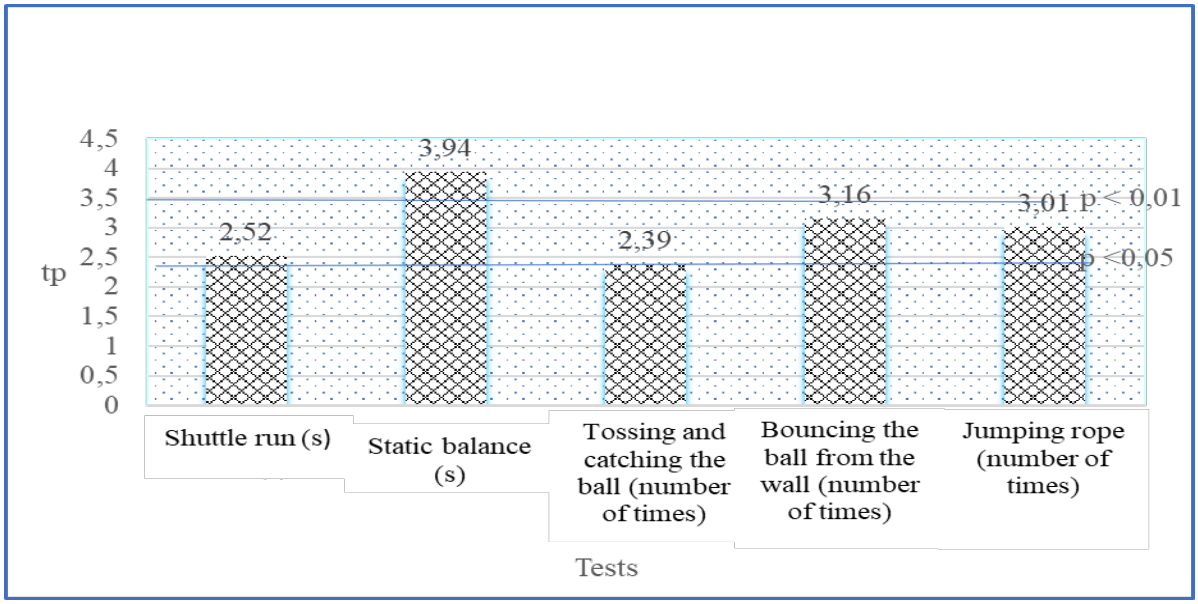

Fig. 1. Reliability of indicators of the development of coordination abilities of fitness athletes (boys) in the main and control groups after a pedagogical experiment

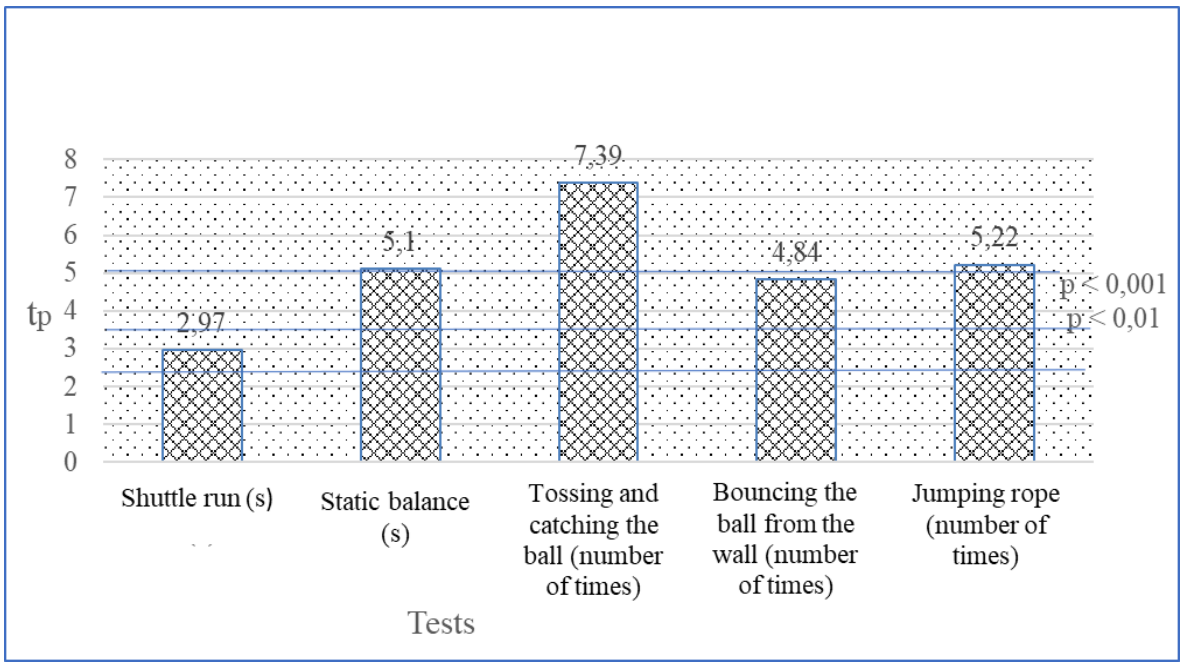

Fig. 2. Reliability of indicators of the development of coordination abilities of fitness athletes (girls) in the main and control groups after a pedagogical experiment

Conclusions / Discussion

The results of the study indicate the relevance of the issues under consideration, where experts in the field of physical culture and sports indicated the need to study approaches to improving the development of physical qualities of young athletes [9, 10, 19]. The study of scientific and methodological literature and informative sources of the Internet [14, 15, 16] gave grounds for generalization and the need to address the issues of the development of coordination abilities of young athletes in fitness. The obtained results of the study confirm the expediency of using a set of exercises with spatial and dynamic biomechanical characteristics in the educational-training process of the main group. The results of the study are shown by the athletes of the main group, in comparison with the results of the control group, the improvement of the pedagogical experiment have statistical significance within the limits of $p<0,05$ and $p<0,01$, which gives grounds to ascertain the significant influence of a complex of exercises with spatial and dynamic biomechanical characteristics on development of the coordination abilities of fitness athletes.

Prospects for further research. Subsequent studies will be devoted to establishing the characteristics of the influence of choreography on the level of

technical readiness of young fitness athletes.

Conflict of interest. The authors state that there is no conflict of interest that may be perceived as prejudicial to the impartiality of a state, public or commercial organization.

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References

1. Atamanyuk, S. I. (2012), «Peculiarities of the training process in aerobic gymnastics within the framework of the fabulous theory of training coordination health», Teoriya i praktyka fizychnoho vykhovannya, No. 2, pp. 86-93. (in Ukr.)

2. Bateeva, N. P., Kyzim, P. N. (2017), Sovershenstvovaniye spetsial'noy fizicheskoy i tekhnicheskoy podgotovki kvalifitsirovannykh sportsmenov v akrobaticheskom rok-n-rolle v godichnom makrotsikle [Improvement of special physical and technical training of qualified athletes in acrobatic rock and roll in a one-year macrocycle]: monograph. Kharkiv: FOP Lvin O.V., 228 p. (in Ukr.)

3. Boloban, V. N. (2013), Regulyatsiya pozy tela sportsmena [Regulation of an athlete's body posture]: monograph. Kiev: Olym. lit., 232 p .(in Ukr.)

4. Volkov, L. V. (2005), «Modern requirements for the professional activity of a coach of children and youth sports», Pedahohika, psykholohiya ta medyko-biolohichni problemy fizychnoho vykhovannya i sportu, No. 12, pp. 33–35. (in Ukr.)

5. Kashuba, V. A. (2003), Biomekhanika osanki [Biomechanics of posture]. Kiyev: Olimpiyskaya literatura, 279 p. (in Ukr.)

6. Kizim, P. M. (2018), Biomekhanika v akrobatychnomu rok-n-roli [Biomechanics in acrobatic rock-n-roll]: navch.-posib. Kharkiv.: FOP Brovin O.V., 130 p. (in Ukr.)

7. Mulik, V. V., Kharchenko, T. P. (2007), «Determination of the level of development of motor qualities among young figure skaters of the group of initial training», Slobozhans′kyy naukovo-sportyvnyy visnyk, No. 12, pp. 100–102. (in Ukr.)

8. Lyakh, V. I. (2006), Koordinatsionnyye sposobnosti: diagnostika i razvitiye [Coordination abilities: diagnosis and development]. Moskva : Divizion, 290 p. (in Russ.)
9. Nazarenko, L. D. (2003), Sredstva i metody razvitiya dvigatel'nykh koordinatsii [Means and methods of development of motor coordination]: monografiya Moskva, 258 p. (in Russ.)
10. Platonov, V. N. (2004), Sistema podgotovki sportsmenov v olimpiyskom sporte. Obshchaya teoriya i yeye prakticheskiye prilozheniya [The system of training athletes in Olympic sports. General theory and its practical applications]: ucheb. trenera vyssh. kvalif. Kiyev : Olimpiyskaya literatura, 808 p. (in Ukr.)
11. Romanenko, V. A. (2005), Diagnostika dvigatel'nykh sposíbnostey [Diagnostics of motor abilities]: uchebnoye posobiye. Donetsk : Izd-vo DonNU, 290 p. (in Ukr.)
12. Sergiyonko, L. P., Chekmarova, N. G., Khadzhinov, V. A. (2012), Psykhomotoryka: kontrol′ ta otsinka rozvytku [Psychomotor: control and assessment of development]: navch. posib. Kharkiv: OVS, 270 p. (in Ukr.)
13. Todorova, V. (2017), «Stan of the aesthetic component of aerobic activity in aerobic gymnastics», Slobozhans′kyy naukovo-sportyvnyy visnyk, No. 1 (57), pp. 106-110. (in Ukr.)
14. Khudoliy, O. M., Ivashchenko, O. V. (2013), «Conceptual approach to the model of the process of creation and development of healthy health in children and children», Teoriya ta metodyka fizychnoho vykhovannya, No. 2, pp. 3–16. (in Ukr.)
15. Mostaert, M, Deconinck, F., Pion, J., Lenoir, M. (2016), «Anthropometry Physical Fitness and Coordination of Young Figure Skaters of Different Levels», International journal of sports medicine, No. 37 (7), pp. 531-538. (in Eng.)
16. Ávila-Carvalho, L., Md. Palomero, L., Lebre, E. (2011), «Body difficulty score (d1) in group rhythmic gymnastics in portimão 2009 world cup series», FGP, Ed. Da Prática à Ciência Artigos do 2 e 3 Congresso de FGP. Lisboa, pp. 105-113. (in Eng.)
17. Čuljak Z., Delaš Kalinski S., Kezić A., Miletić Đ. (2014), «Influence of fundamental movement skills on basic gymnastics skills acquisition», Science of Gymnastics Journal, № 2, pp. 73–82. (in Eng.)

18. Hëkelmann A., Richter K. (2008), «New perspectives for performance analysis in gymnastics, handball and skiing», 5th International Scientific Conference on Kinesiology. Zagreb, Croatia, pp. 10–13. (in Eng.)
19. Law M. P., Cote J., Ericsson K. A. (2008), «Characteristics of expert development in rhythmic gymnastics:A retrospective study», International Journal of Sport and Exercise Psychology, Vol. 5(1), pp. 82–103. (in Eng.)
20. Todorova V. (2017), «Choreographic training optimization of female gymnasts aged 8–11 years in aerobic gymnastics», Слобожанський науково-спортивний вісник, № 2(58), С. 64–68. (in Eng.)

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BIOMECHANICAL ANALYSIS OF MOTIONAL ACTIONS OF ATHLETES ENGAGED IN SHORT TRACK SPEED SKATING DURING THE TURNING PHASE

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Purpose: development of a model for theoretical analysis and assessment of optimal biomechanical characteristics in the turn phase of short track skating athletes using existing biomechanical ergogenic devices and information technologies in the training process.

Material and methods: theoretical analysis of scientific and methodological literature, analysis of web resources, pedagogical observation, video filming, biomechanical analysis of motor actions. The test group consisted of 10 young short trackers 9-12 years old and 5 short trackers aged 18-24 years, who practice short track speed at least three times a week (from 1 year old, for young athletes) and regular trainings five times a week (about 6-10 years, for adult athletes).

Results: the paper theoretically analyzes the characteristics of the technique of passing the turning phase of short track speed skating athletes by means of biomechanical analysis. By calculation, the theoretical dependences of the indicators of the passage of the turning phase were determined: speed, the angle of inclination

of the athlete's body in the turn, the position of the general center of mass of the body and their relationship. The main mistakes of the technique of motor actions fulfillment of beginner athletes in the turning phase are highlighted.

Conclusions: these theoretical studies confirm the feasibility of using special devices to create conditions that simulate the real situation of an athlete passing a short track turn on one skate, and the coach can control the correct execution of movements by novice athletes from the point of view of biomechanics. The use of special elastic bands as ergogenic means for improving the motor actions of short track speed skating athletes is grounded. The ways of improving the biomechanical indicators, which the athlete is able to implement in practice, are indicated.

Keywords: biomechanics, short track, turn phase, technical training of athletes, analysis of motor actions.

Introduction

Short track is especially popular among the winter Olympic sports and is a promising discipline for Ukraine. Unfortunately, today foreign short track schools are in great competition for Ukrainian athletes. This prompts the search for means to increase the effectiveness of the formation of sports and technical skills of our athletes.

Evaluative studies of sports results in short track (Kashuba V. and Litvinenko Y. (2008) [5], Kugaevsky S. and Bleshunova K. (2010) [4]) indicate that an increase in the effectiveness of training athletes by increasing the volume and the intensity of the training load does not guarantee a dramatic improvement in competitive results. In addition, it is very difficult to work on their increase, especially in the technique of the short trackers' motor actions fulfillment, which are closely related to the quality and temperature conditions of the ice cover.

In addition, Ashanin V.S., Druz V.A. & et.al (2012) [1]; Fintelman, D.M. (2010) [14] indicate that it should be borne in mind the desire of athletes to improve their results by eliminating the discrepancy between technical readiness and lag in the

development of physical condition, as well as due to impaired muscle coordination.

Thus, the question of searching for modern effective methodological measures to build a system of sports training of short trackers, increasing the technique of motor actions fulfillment, is a priority direction of the training process improvement. The research of the authors in this direction [8, 10] substantiates the possibility of using information technologies in organizing the training process among athletes.

Correctly organized training, both in short track speed skating and in other sports [9, 17-19], is the most effective pedagogical tool that helps to increase sports performance in general. Coaches, together with biomechanics specialists, develop and implement in the training process innovative approaches to improve the physical level of athletes' perfection. This, as the most accessible, includes the improvement of the physical condition of an athlete with the help of special simulators and general physical training.

Mastering and using the technical skills and techniques of short track speed skating is a very complex step-by-step algorithm. From a biomechanical point of view, this requires special approaches to control the process of formation of special motor skills; improvement of the coordinated geometry of the athlete's movements; creation for this, as it is given in the works of Gamaliy V.V. (2013) [3]; Ratova I.P., Popova G.I. & et.al (2007) [7], Laputina A.M. (2005) [2], models of biokinematic or biodynamic interaction of a human biolac, as an object of research and mathematical modeling, taking into account the mechanical factors of interactions between the human body and simulators.

The use of special biomechanical ergogenic means in sports is based not only on knowledge of the fundamental laws of physics, but also on the knowledge of modern technologies of sports training [6, 11]. Thus, improving the performance of athletes presupposes the simultaneous use of knowledge of the laws of physics, taking into account the biomechanical laws of the human motor system and the technical and tactical features of the competitive system and training activity.

Practice shows that simulators as mechanical devices with a controlled degree of freedom help in the process of training to simulate certain conditions for the future

real activity of athletes. They allow directed transformation of the energy of the external environment in such a way that it acquires a useful form necessary for utilization by the body. From a biomechanical point of view, it is most expedient to single out such important fragments of the systems of mastering and improving sports movements as geometric, biokinematic, biodynamic, coordination, informational and some other structures [15].

Purpose of the study is to develop a model for theoretical analysis and assessment of the optimal biomechanical characteristics of the turn phase of short track athletes using existing biomechanical ergogenic means and information technologies in the training process.

Objectives of the study:

1. To analyze the special literature, existing biomechanical technologies and ergogenic means in the preparation of short track athletes.
2. Develop a model to determine the system of forces acting on the general center of mass of the athlete's body when entering a turn. To determine the influence of the main biomechanical factors of the successful fulfillment of motional actions on the basis of the position of the center of mass, the angle of inclination of the athlete's body, etc. during the turning phase.
3. Make recommendations on the reasonable use of biomechanical ergogenic means and information technologies to improve the quality of the training process of short trackers.

Material and Methods of research

Research methods: theoretical analysis of scientific and methodological literature, analysis of Internet resources, pedagogical observation, video filming, biomechanical analysis of motor characteristics. The test group consisted of 10 young short trackers 9-12 years old and 5 short trackers aged 18-24 years old, who go in for short track speed skating at the Youth Sports School of the Olympic Reserve in Kharkov and have at least three workouts per week (from 1 year old, for young athletes) and regular sessions five times a week (for 6-10 years for adult athletes).

Results of the research

Since the attention of short track coaches is focused on improving the running technique of athletes when cornering, the theoretical model of the technique of movements allows them to highlight the characteristics of the trajectory of the athlete's body depending on the speed of the general center of inertia of body mass, the angle of inclination of the *AB* line to the support line on the ice, the height of the center of mass and the radius of the entrance to the turn (Fig. 1)

Let us consider in more detail some of the features in the running technique of athletes in short track speed and strength, which an athlete needs to control when performing movements to maintain balance on the trajectory when turning.

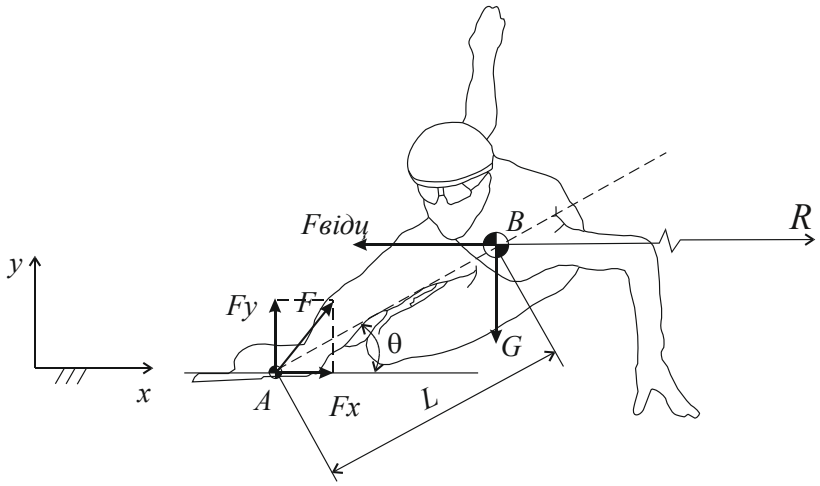

Fig. 1 The system of forces when cornering in a short track,

where – is the horizontal force $\vec{F}_x$ – the result of interaction between ice and skates; vertical force $\vec{F}_y$ – support reaction as a result of the ice providing resistance to the athlete; force of gravity $\vec{G} = m\vec{g}$; centrifugal force $\vec{F}_{\text{відц}}$ (the inertial force arising from a change in speed or direction of movement tries to displace the athlete in the direction opposite to the center of the turn when cornering); A - point of resistance; B - general center of mass of body mass (GCBM)

In short track skating, all attention is focused on the turns, during which the athlete needs to balance the centrifugal force with the gravity of his body. The combined action of centrifugal forces and body weight significantly increases the load on the muscles of the lower extremities. Entering a turn, the athlete tries to sit down. At the exit from the turn, centrifugal force acts, which the athlete must balance. Athletes on short track of low qualifications stand up, which reduces the speed of movement, and more qualified athletes change the angle of the torso to the

ice to 25-30°. In doing so, the athlete extends his right arm and bends over a corner to counter centrifugal force. To maintain balance, the left hand touches the ice, and the athlete enters the turn on one leg. These motor actions allow to reduce the effect of the buoyancy force, and the time worked out between the fourth and sixth chips leads to the addition of forces (centrifugal and gravity) and contributes to further gaining speed.

Coaches always devote a lot of time to practicing the correct rotational motor actions of athletes, improving the technique of cornering. For a positive use of centrifugal force and entry into a turn at high speed, it is necessary to make the rolling time on one skate as long as possible in this section. This affects the overall speed of passing the distance due to the longer application of force in the support during repulsion.

Consider the physical aspect of this problem with the construction of special equations for this. Figure 1 shows the position of the athlete's body on the short track in a turn on one leg and shows the forces acting on the athlete's GCBM while moving in the turn.

Vector sum of two components $\vec{F}_x$ and $\vec{F}_y$– it is a total force $\vec{F}$, arising from the contact of the skate and ice. The vertical component of the contact force balances the force of gravity $\vec{G}$, and the horizontal component of the contact force pushes the person towards the center of the circle and opposes the centrifugal force depending on the mass m and speed $\vec{V}$ athlete's movement.

As a first approximation, let us consider the equilibrium equation for the center of mass of an athlete in a static state. Let's make some assumptions:

1) in the vertical direction, the general center of mass of the body has no acceleration;

2) equilibrium equation is written for the "instantaneous" position of the athlete's general center of mass.

The balance system for translational and rotational movements is presented as:

$$\begin{cases} \sum X = 0; \quad F_x - F_{\text{відц}} = 0 \\ \sum Y = 0; \quad F_y - G = 0 \\ \sum M_B = 0; F_x \cdot L \sin\theta - F_y \cdot L \cos\theta = 0 \end{cases}, \tag{1}$$

where L - the distance between point *A* and point *B*, θ- the angle of "tilt" of the center of mass, measured between the line through points *A* and *B* and the horizontal line of the roller.

The centrifugal force is calculated using the formula:

$$F_{\text{відц}} = m\ddot{x}, \tag{2}$$

where $\ddot{x} = a_{\text{відц}}$ – the acceleration of the GCBM located in the horizontal plane along the height x, it can be calculated by the formula:

$$a_{\text{відц}} = \frac{V^2}{R}, \tag{3}$$

where V – the speed of the athlete's GCBM, it is directed along the tangent to the trajectory of movement; *R* – the radius of curvature of the trajectory. Substituting this equation into the previous one, we get an expression for the centrifugal force

$$F_{\text{відц}} = \frac{mV^2}{R}. \tag{4}$$

Centrifugal force $F_{\text{відц}}$, as can be seen from expression (4), it is inversely proportional to the turning radius and directly proportional to the square of the speed of movement.

In Figure 2 shows the calculated values of the centrifugal force of an athlete with a mass of kg depending on the radius of the turn for different values of the speed of movement (V=20 m·s^{-1}, 30 m·s^{-1}, m·s^{-1}).

An analysis of the comparative graphical characteristics of the magnitude of the centrifugal force (Fig. 2) demonstrates how, with an increase in the turning radius, the action of the force $F_{\text{відц}}$ per athlete decreases. But the speed of movement on a corner changes the magnitude of the centrifugal force in a quadratic relationship: if the speed is increased by 2 times, the action of the lateral force will increase by 4 times.

It is natural to slow down for safe cornering, but there is a risk of leaving your good position in the distance. Therefore, the main task when passing the turning phase with your motor actions is to resist the action of the lateral force $F_{відц}$, that is, repulsion to the board. Experienced athletes maintain their trajectory and do not change its radius during the turn phase, which does not allow competitors to take a position that follows the optimal trajectory and is the best for maintaining speed and further successful passing the distance.

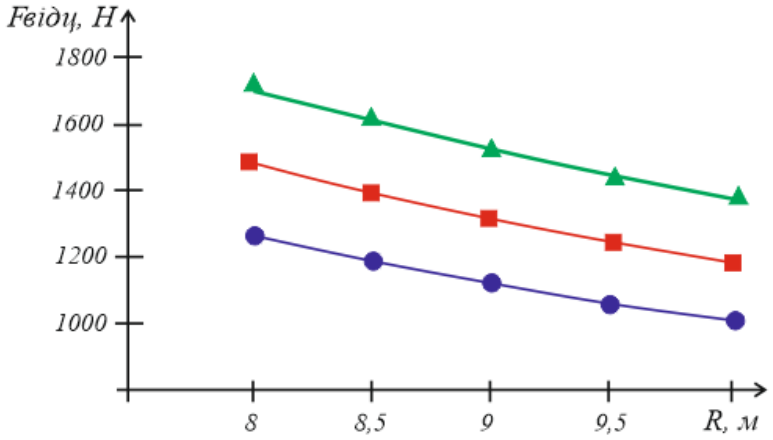

Fig. 2 Dependence of the centrifugal force of inertia on the radius of the trajectory of an athlete with a mass $m = 70$ kg for different speed values V: green – 20 m·s^{-1}, red – 30 m·s^{-1}, blue – 40 m·s^{-1}

In Figure 3 shows a series of calculated curves for various values of the center of mass of the body of athletes (m = 40 kg, 50 kg, 60 kg), characterizing the dependence of the magnitude of the centrifugal force on the radius of passage of the turn at a constant speed of movement 20 m·s^{-1}.

Analysis of comparative graphical characteristics of the quantity $F_{відц}$ shows that an increase in mass also leads to an increase in centrifugal forces in a corner and decreases with an increase in the radius of a corner R.

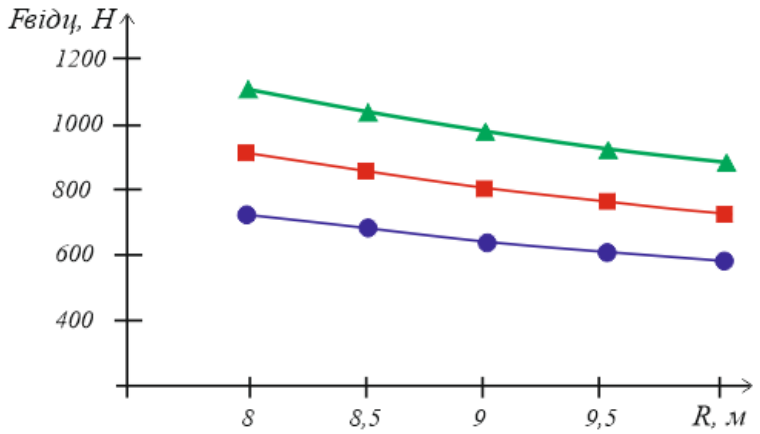

Fig. 3 Dependence of the centrifugal force of inertia on the mass of the athlete's CMR at the speed of movement $V = 20$ m / s for different values m: green - 60 kg, red - 50 kg, blue - 40 kg

With skillful use of the overall center of mass, the athlete can use this force in conjunction with gravity and lean angle θ to keep the leading position at a distance. To do this, you need to skillfully manage your center of mass during dynamic movement on the roller, especially in the turning phase. In addition, you should practice the ability to maintain the angle of inclination in the turn with a "low landing", that is, with a low location of the general center of mass of the body (Fig. 4).

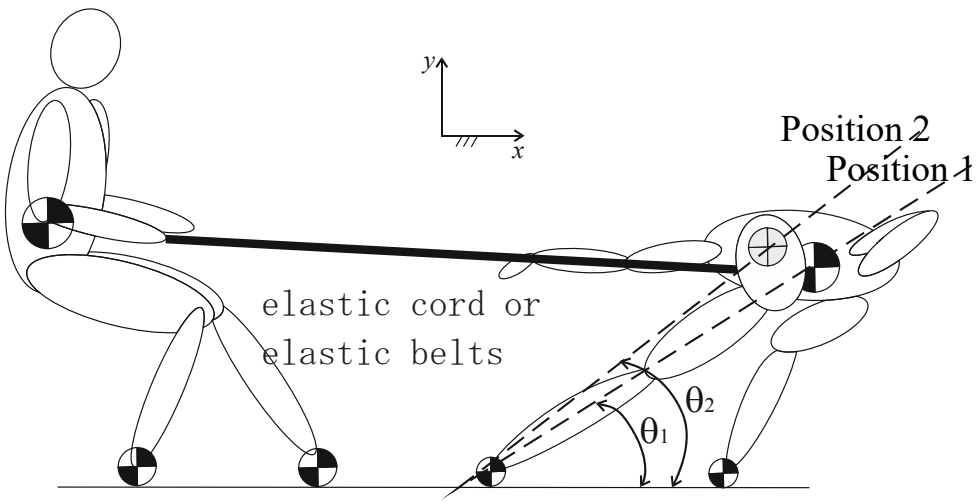

Fig. 4 Schematic representation of the training process with special tools for practicing correct biomechanical movements in a turn

Beginner athletes cannot achieve the required degree of "incline" (position 2, Fig. 4), because the effect of self-protection from falling is triggered, which prevents them from making the necessary incline to the center of the trajectory of movement. Therefore, in the short track, when practicing the technique of performing the turning phase, special training aids are used, which simultaneously play the role of an insurance "lounge" (Fig. 4). These include an elastic cord or elastic belts. The common center of mass of the partner's body is used as inertial parts.

A short track trainer, when working with athletes on the technique of cornering at low speeds (on ice or on land), uses such aids. Its task is to correct the position of the athlete's legs and body for the formation of correct motor actions and the ability to control the location of his center of mass and biomechanical circuits. It should be emphasized that the position of the center of mass of the body of each athlete is different according to his anatomical and morphological data, as well as the initial values of the entry speed into the turn.

Conclusions / Discussion

The study confirmed the data of the authors Eline van der Kruk, Marco M. Reijne, Bjorn de Laat & DirkJan (HJ) Veeger (2019) [12] regarding the biomechanical characteristics of the turning phase, which are typical for the world's leading athletes. Analyzing the technique of cornering in a short track, which depends on the radius of the athlete's trajectory. We have confirmed the results of [13, 16] and supplemented with our own calculations the dependence of the centrifugal force of inertia on the mass and radius of the trajectory.

The study examines the possible location of the general center of mass of the athlete's body using special tools that help to work out the optimal options for the trajectory of movement in a turn. The use of similar means and technology is substantiated in works [11, 14, 20] and is generally accepted in world practice. Taking into account the individual technical characteristics of cornering in the short track of novice athletes has become its own legacy to the generally accepted methodology.

In the literary sources of the Ukrainian professional editions in the field of sports, there is practically no information on the study of the biomechanical characteristics of the short track running technique, especially in the turning phase.

The analysis of videos and photographs taken at competitions and short track trainings showed that in order to ensure a high result, an athlete needs to be able to perform high-quality motor actions in the turning phase. To do this, it is necessary to take into account a number of multiply connected factors that ensure the maximum speed of passing the distance.

These factors, mainly, include biomechanical characteristics that an athlete can realize, namely: the speed of the run, the radius of the athlete's entry into the turn, the height of the athlete's general center of inertia at the time of the turn, etc.

Biomechanical equations for the dependence of centrifugal forces on the angle of inclination of the body and the radius of the trajectory of movement of athletes along the short track are given, as well as the visualization of the theoretical understanding of the relationship of individual elements of movement, which makes it possible to model various situations and determine the optimal values of the kinematic characteristics of the movement of an athlete.

Based on the data of theoretical studies, with the help of special simulators, it is possible to create conditions that simulate in space the real situation of an athlete passing a short track turn on one skate, and the coach will be allowed to control all biomechanical characteristics of the correct performance of competitive movements. In addition, it is possible to correct movements directly during training..

Thus, training exercises with biomechanical aids form in athletes muscle memory to perform the correct motor action when passing through the turning phase at high speeds during the competition, and the feeling of the correct location of the general center of body mass in the rolling position on one leg is recorded. This helps to develop the skill of increasing the rolling time on one skate as long as possible on this section in order to positively use the centrifugal force and the sharp entry into the turn. In turn, this affects the speed of passing the distance due to a longer application of force in the support during repulsion.

With the help of the above simulators, conditions are created that simulate in space the position of the rolling state in the turn phase, and it is convenient for the coach to control all biomechanical characteristics that characterize the correct position of the athlete's center of mass when entering the turn.

The introduction of an arsenal of biomechanical ergogenic means into the practice of the training process on a short track opens up opportunities for improving the technical training of athletes in an entry-level short track and improving the training of highly qualified athletes.

Prospects for further research will focus on the development of biomechanical models for the implementation of other technical elements in the short track, based on computer modeling and information technology.

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References

1. Ashanin, V. S., Druz', V. A., Zadorozhnaya, E. A., Pyatisotskaya, S. S., Litvinenko, A. N. (2012), « Theoretical foundations for constructing an assessment of the physical development and physical health of the surveyed contingent», Slobozhans′kyy naukovo-sportyvnyy visnyk, No. 2, pp. 131-137. (in Russ.).

2. Biomekhanika sportu [Biomechanics of sport] (2005), navchal′nyy posibnyk dlya studentiv vyshchykh navchall′nykh khakladiv z fizychnoyi kul′tury ta sportu / edited by Laputin.A.M, Kyiv: Olympic Literature, 319 p. (in Ukr.).

3. Gamaliy, V. V. (2013), Teoretiko-metodicheskiye osnovy modelirovaniya tekhniki dvigatel'nykh deystviy v sporte [Theoretical and methodological foundations of modeling the technique of motional actions in sports], Kiev: Poligrafservis, 300 p. (in Russ.).

4. Kugaevsky, S. O., Bleshchunova, K. M. (2010), «Priorytetni napryamy udoskonalennya trenuval′noho protsesu ukrayins′kykh short-trekovykiv vysokoyi kvalifikatsiyi u makrotsyklakh pidhotovky», Teoriya i metodyka fizychnoho vykhovannya i sportu, №4, pp. 20-25. (in Russ.).
5. Litvinenko, Yu. V., Kashuba, V. A. (2008), «Biomekhanicheskiy analiz tekhniki dvigatel'nykh deystviy sportsmenov razlichnoy kvalifikatsii, spetsializiruyushchikhsya v short-treke», Nauka v olimpiyskom sporte, No. 1, pp. 94-101. (in Russ.).
6. Meleshko, V. I. (2010), Erhohenni ta erholitychni zasoby sportyvnoho trenuvannya: navchal′nyy posibnyk [Ergogenic and ergolytic aids of sports training: a textbook]. Dnipropetrovsk: DDIFKiS, 124 p. (in Ukr.).
7. Ratov, I. P., Popov, G. I., Longinov, A. A., Shmonin, B. V. (2007), Biomekhanicheskiye tekhnologii podgotovki sportsmenov [Biomechanical technologies of athletes training]. M .: Physical culture and sport, 120 p. (in Russ.).
8. Filenko, L. V. (2017), «Alhorytmichni osnovy pobudovy navchal′no-trenuval′noho protsesu studentiv-sport•smeniv iz vykorystannyam informatsiynykh tekhnolohiy», Visnyk Prykarpats′koho universytetu. Seriya: Fizychna kul′tura, Issue 27-28, pp. 318-323. (in Ukr.).
9. Filenko, L. V., Nesen, O. O. (2018), Informatyzatsiya pidhotovky studentiv-handbolistiv zasobamy mul′tymediynoyi komp″yuternoyi prohramy «Handbol» [Informatization of training of handball students by means of the multimedia computer program "Handball"], Sportyvni ihry, №1 (7), pp. 54- 61. (in Ukr.).
10. Filenko, L. V. (2016), Komp″yuterni navchal′ni ta kontrolyuyuchi prohramy u fizychnomu ykhovanni ta sporti [Computer training and control programs in physical education and sports], Naukovyy chasopys. Seriya 15: Naukovo-pedahohichni problemy fizychnoyi kul′tury (fizychna kul′tura i sport), Issue 10 (80) 16, pp. 139-145. (in Ukr.).
11. Platonov, V. N., Bulatova, M. M., Kashuba, V. A. (2006), «Biomechanical ergogenic means in modern sport», Stiinta sportului. Academia Romana, Bucuresti, No. 53, pp. 19-49. (in Eng.).

12. Eline van der Kruk, Marco M. Reijne, Bjorn de Laat & DirkJan (H. E. J.) Veeger (2019), «Push-off forces in elite short-track speed skating», Sports Biomechanics, Vol. 18 No. 5, pp. 527-538. (in Eng.).
13. Felser, S., Behrens, M., Fischer, S., Heise, S., Bäumler, M., Salomon, R., & Bruhn, S. (2016), «Relationship between strength qualities and short track speed skating performance in young athletes», Scandinavian Journal of Medicine and Science in Sports, Vol. 26, pp. 165–171. (in Eng.).
14. Fintelman, D. M. (2010), Literature study: Biomechanical models for speed skating, Technical University Delft. (in Eng.).
15. Lanka, Ya. Ye., Gamaliy, V. V, Habinets, T. O. (2017), «Biomechanical substantiation of mechanical impulse transfer mechanisms in the "athlete – sports equipment" system when performing moving actions in sports», Slobozhanskyi herald of science and sport, №3 (59), pp. 29-34. (in Eng.).
16. Lozowski, E., Szilder, K., Maw, S. (2013), «A model of ice friction for a speed skate blade», Sports Engineering, Vol. 16, Issue. 4, pp. 239–253. (in Eng.).
17. Pasko, V., Rovniy, A., Nesen, O., Ashanin, V., Filenko, L., Okun, D., Shevchenko, O., Dzhym, V., Pilipko, O. (2019), «Efficiency of performing rugby's technical elements depending on the speed and strength quality level of 16-18-year-old rugby players», Journal of Physical Education and Sport, No. 19(1), pp. 546-551. (in Eng.).
18. Rovniy, A., Pasko, V., Karpets, L., Nesen, O., Ashanin, V., Filenko, L., Pomeshchikova, I., Mukha, V., Korsun, S., Shaposhnikova, I. (2018), «Special aspects of preparation of student`s teams for competitions in Rugby», Research Journal of Pharmaceutical, Biological and Chemical Sciences, No. 9(4), pp. 1402-1413. (in Eng.).
19. Rovniy, A., Pasko, V., Nesen, O., Tsos, A., Ashanin, V., Filenko, L., Karpets, L., Goncharenko, V. (2018), «Development of coordination abilities as the foundations of technical preparedness of rugby players 16-17 years of age», Journal of Physical Education and Sport, No. 18(4), pp. 1831-1838. (in Eng.).

20. Yuki, M., Ae, M., Fujii, N. (1996), ドケトの ド反 [Blade reaction forces in speed skating], Society of Biomechanisms Japan (SOBIM), No. 13, pp. 41–51. (in Japan.).

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ACTIVITIES OF THE STATE INSTITUTE OF PHYSICAL CULTURE OF UKRAINE AND THE UKRAINIAN RESEARCH INSTITUTE OF PHYSICAL CULTURE IN THE 30-40 OF THE XX CENTURY

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Purpose: summarize information on the activities of the State Institute of Physical Culture of Ukraine and the Ukrainian Research Institute of Physical Culture for the development of education and science in the field of physical culture and sports in the Ukrainian Socialist Soviet Republic.

Material and methods: the research material was scientific literature, which contains information on the issue under study. Research methods: analysis and generalization of scientific literature data, historical-systemic, logical, problem-search.

Results: it was determined that SICU began its activities in difficult conditions of the formation of the statehood of the republic. The educational institution was engaged in the preparation of teachers-trainers, teachers-methodologists in physical education for educational institutions, organizational and methodological workers. Among the teachers of the institute were experienced practitioners who contributed to the development of high-performance sports and sports science. It was established that UNSIPC was created on the basis of the research department of the Central

House of Physical Culture in Kharkov. In the structure of the research institute, five functional departments worked and collections of scientific works were published.

Conclusions: the institute has made a significant contribution to the development of the domestic system of physical education due to: the presence of practitioners, experienced teaching staff; training of qualified specialists, high-class athletes. The activity of the Ukrainian Scientific Research Institute of Physical Culture was important for the republic. It was in the 30s of the XX century that the foundation was laid for the further development of domestic sports science.

Keywords: Institute of Physical Culture, Research Institute of Physical Culture, sports education, sports science.

Introduction

The formation and development of sports education and science, the release of periodical sports publications in Ukraine took place during the formation of the statehood of the republic with the capital in the city of Kharkov. The study of this issue is devoted to the work of many scientists, who present both well-known and little-known facts.

The subject of the study by Y. Timoshenko (2011) was the system of training teachers in the field of physical culture in the 1920s-1930s, the author comprehensively considered the prerequisites for the formation of the system of physical education.

Research by G. Griban (2012) is devoted to the study and analysis of trends in the development of the methodological system of physical education in Ukraine in the XX century. In particular, it is noted that in Eastern Ukraine in the 20-39-ies of the XX century, the scientific foundations of physical education and the theoretical and methodological foundations of the Ukrainian physical culture and sports movement were created, which left a significant legacy for the formation of a modern methodological system of physical education. The formation of models of the methodological system of physical education was due to a number of factors: socio-

historical conditions, the level of development of the theory and methodology of physical education, the level of development of higher pedagogical education in the country, the level of development of physical culture work among youth and the development of sports, the availability of scientific and methodological publications on physical education

As noted by G. Savchenko, E. Khomenko (2013), at the turn of the 20-30s, in the context of political and socio-economic changes, which were taken by the top party and Soviet leadership, physical culture played the role of an important component of state policy, was one of the means of increasing the efficiency of labor, political education, military training and health improvement of the population.

The peculiarities of the formation and development of institutions of higher physical education in Ukraine in the twentieth century are traced in the work of A.Yu. Agippo (2020), W.M. Protsenko (2013, 2020). The study found that among the factors influencing the creation of specialized physical education universities in the twentieth century, political and defense are dominant..

The question of the formation of the scientific and methodological foundations of the Soviet system of physical education and sports in the period 1930-1941. considered in the tutorial by V.A. Verbitsky (2014) "History of physical culture and sports in Ukraine". The authors note that the scientific approach to the construction of the training process has led to the emergence of new effective methods of training athletes and techniques for performing sports elements, a sharp qualitative increase in the results of athletes.

Purpose of the study is to summarize information on the activities of the State Institute of Physical Culture of Ukraine and the Ukrainian Research Institute of Physical Culture for the development of education and science in the field of physical culture and sports in the Ukrainian Socialist Soviet Republic.

Material and Methods of research

The research material was scientific literature, which provides information on the issue under study. Research methods: analysis and generalization of scientific literature data, historical-systemic, logical, problem-search.

Results of the research

A number of *prerequisites* can be identified for the opening of the State Institute of Physical Culture of Ukraine. The first two departments of physical culture in the republic were created - in 1925 at the Kharkov Institute of Public Education (KhIPE) and in 1928-1929 at the Kharkov Medical Institute. Doctor Blyakh Vladimir Abramovich was appointed the head of both departments. At the same time V.A. Blyakh taught at the All-Ukrainian courses of physical culture in 1925-1926 [15].

The need to train specialists in physical culture and sports prompted the adoption of the Decree of the Council of People's Commissars of the USSR in 1929, thanks to which physical education was introduced in all universities of the country as a compulsory discipline. Departments of physical culture have been created at the Kharkov, Kiev, Odessa institutes of public education.

Courses for the training of teachers of physical education in schools begin to operate as a faculty at the Kharkov and Kiev institutes of public education, and courses without autonomous rights worked at the Odessa and Artyomovsk institutes [8].

Historical reference. On May 20, 1930, at a meeting of the board of the People's Commissariat of Education of the Ukrainian SSR, it was decided to establish the State Institute of Physical Culture of Ukraine in the city of Kharkov, the capital of the republic. The institute was created to train physical education teachers for educational institutions and organizers-methodologists of physical education [8, 16].

In 1930, the institute was called the All-Ukrainian Institute of Physical Culture, and after 1935 - the State Institute of Physical Culture of Ukraine [17].

In the period 1930-1933. SIPCU was located on the street Svobodnaya Akademia (Universitetskaya), 25. Previously, the house housed a library, an observatory, a university house church and an assembly hall [10].

In 1934, SIPCU transferred the building on Tevelev Square (Constitution), 18, where the Azov-Don Bank was previously located [9].

The dates are important for the institute. October 1, 1930 - the beginning of training sessions at the State Institute of Physical Culture of Ukraine. After the entrance exams, 78 people were enrolled in the first year [10].

In 1930-1931. SIFKU was subordinated to the People's Commissariat of Education of the RSFSR, and since 1932 it was communicated to the All-Ukrainian Supreme Council of Physical Culture, which contributed to the improvement of its material and technical base [8].

Until 1946 the institute remained the only higher educational institution for training specialists in physical education in the Ukrainian SSR and one of the three main sports universities in the USSR.

Konstantin Pavell (from the Kharkov Institute of Public Education) became the first director of SIPCU, and Nikolai Fil became his deputy for educational, methodological and scientific work. Among the first teachers of SIFKU were experienced practicing specialists - Ivan Brazhnik (gymnastics), Stepan Romanenko (sports games), Vladimir Bedunkevich (wrestling, weightlifting, skiing, athletics), Peter Zakovorot (fencing, hand-to-hand combat), Nikolai Krotov (football), Nikolay Fil (theory and methodology of physical education, history of physical culture) and others [9, 11].

From the institutes of physical culture that were already operating at that time in Moscow and Leningrad, moved to work at the SIPCU: Petr Sobenko (artistic gymnastics), Mikhail Romanenko (boxing), Zosima Sinitsky and Nikolai Vystavkin (athletics), Vadim Andrievsky (fencing), Alexandra Semenova (rhythmic gymnastics) and others [11].

Among the specialists in sports disciplines of the first cadre, there was not a single certified one. However, they were all expert practitioners who had special knowledge and athletic achievements. And it is these qualities of theirs that determined the following history of the university, focused on sports of the highest achievements, the development of sports science and the training of coaches [11].

The teaching staff of SIPCU was replenished with its best graduates, including Valentina Zinchenko, Nikolai Tepper, Dmitry Obbarius, Alexander Mishakov, Ivan

Vrzhesnevsky, Evgeny Ivakhin and others, who largely determined the development of sports and sports science over the next decades [11].

In 1933, the first departments of general theoretical disciplines were created, which were headed by Academician V. Vorobiev, professors P. Rubinstein, V. Blyakh, associate professors M. Fil, K. Ivanov, M. Teslenko, M. Gorkin [17].

In 1934, according to the resolution of the Supreme Council of Physical Culture, three faculties were created: organizational and methodological, sports and technical, and military. Specialization appeared, sports and pedagogical disciplines became the main ones.

The organizational and methodological faculty had two departments: preschool-school, which trained teachers-methodologists of higher qualifications in physical education and production and embroidery - trained organizational and methodological workers, teachers-methodologists for higher educational institutions [17].

The sports and technical faculty had seven departments: gymnastics, athletics, defense and attack, water sports, winter sports, shooting, sports games. The main profile of the faculty is the training of highly qualified teachers-trainers in certain sports.

Also in 1934, a school of trainers was opened at the State Institute of Physical Culture, which in 1936 was reformed into the Higher School of Trainers.

In 1935, an externship was opened with the purpose of teaching teachers who had a lot of practical experience, but did not have a special physical education.

In 1937 a group of leading experts was repressed, including V. Bedunkevich, N. Butakov, O. Kontsevich, V. Blyakh and others.

In May 1940, the first scientific conference of the State Institute of Physical Culture was held, on the basis of which the collection was published.

For the period 1936-1941. teachers of the institute and graduate students completed 84 works published as scientific, methodological and teaching aids.

Information on the quantitative composition of the student body and faculty for individual academic years is presented in Table 1 [2, 8, 17].

Table 1

The total number of the student body and the teaching staff of the State Institute of Physical Culture of Ukraine (1930/1931 - 1940/1941 academic years)

Total number	Academic year		
	1930/1931	1935/1936	1940/1941
Students (number of persons)	124	1004	1031
Teaching staff (number of persons)	27	86	107

In just ten years of functioning of the State Institute of Physical Culture of Ukraine in the city of Kharkov, the number of students has increased eightfold, and the teaching staff almost fourfold.

On March 24, 1944, a resolution was adopted, which indicated the decision to transfer SIPCU from Kharkov to Kiev.

Summarizing the activities of the SIPCU in the 30s [7], one can *single out the problems that hindered the activities of the institute*:

- lack of premises necessary for classes, which disrupted the planning of the educational process and its quality, lack of equipment, funds in the work of the institute. So, rented premises were scattered across 15 places in Kharkov, classes were held in two shifts, it was necessary to conduct joint lectures with a large number of students;
- lack of a hostel for students and normal living conditions;
- the influence of the instructions of the Supreme Council of Physical Culture of the USSR on the preparation of students in the direction of militarization.

It is necessary to highlight the *features of training* inherent in that time. Students had to master, starting from the 3rd year, sports technique in 1-2 kinds of sports (preferably winter and summer) and after graduation from the institute to pass an exam not lower than the II grade. Fulfillment of the standards of the GTO complex of the II degree was obligatory for all students, but it had to be mastered outside the classroom. The students of the institute had to participate in all competitions of the calendar by a separate team [17].

Activities of the Ukrainian Research Institute of Physical Culture. The Central House of FC in Kharkov was opened in 1925 at the initiative of Vladimir Abramovich Blakh. It was the first House of Physical Culture in Ukraine, which trained public organizers – physical culture instructors to work with the working population. It was located on Maryinskaya Street, 14.

In the publication of A. Butsenko (1928) "The Five Years of Soviet Physical Education in Ukraine" it is noted: "In Ukraine there are 12 physical education houses at the district councils of physical education and one Central House of Physical Culture in Kharkov, where in 1928 a research department of physical culture began to exist. These houses carry out research work in the field of physical education".

In the structure of the Central House of Physical Culture (CHPC) begin to operate offices: somatic, anthropometric, corrective gymnastics, later - the office of motility, psychotechnical, radiological, gynecological and others, organized a physiological laboratory. Since 1926 in the Kharkov CHPC course training of "physicians" is adjusted [4].

According to O.M. Vaceba (2003), it was this department that turned in 1931 into the Ukrainian Research Institute of Physical Culture. The first director of the institution was Vladimir Blyakh (the All-Union institution - the Central Scientific Research Institute of Physical Culture in Moscow was created only in 1933).

At the Research Institute of Physical Culture, postgraduate studies were opened, with a period of 3 years of study, as well as its branches in Odessa, with a fairly wide range of research problems, in which the leading place was given to the study of the problems of sports training and the clinical and biological aspects of physical education and sports. The opening of postgraduate studies has become an important incentive to popularize sports science, intensify scientific research, and train highly qualified specialists [11].

The report on the development of the physical culture movement in Ukraine indicates that the immediate task of the research institute and its branches is to introduce physical culture into production processes, health institutions, rural physical education circles, schools and in every possible way popularize their work

among the broad masses of athletes and workers [2]. Branches of the research institute were opened in Odessa – 1931, Kiev – 1932, Dnepropetrovsk – 1934 [4].

In the 1930s, the Ukrainian Research Institute of Physical Culture introduced the following functional subdivisions: the sector of physical education in production, the medical and preventive sector, the military sector, the sector of educational institutions, the clinical and physiological department with an office and a laboratory. Much attention in the work of the research institute was paid to physiotherapy exercises.

Final conferences of the Research Institute of Physical Culture were held annually.

During the period of work of the research institute until 1939, 11 collections of scientific works were published. The topics of most of the collections were related to the problems of mass physical culture, professionally applied physical training of the population.

Collections of scientific papers were published under the editorship of Dr. V.A. Blyakh. He also supervised most scientific projects. By the way, perhaps, with his personal participation (as an author or editor), about 10 percent of all books published in Ukraine in the 1920s and 1930s of the last century appeared [4]. In addition, Vladimir Blyakh was the editor and author of the sports magazines "Bulletin of Physical Culture" (1922-1929), "Sport" (1922-1938), "Sports List" (1922) [7, 14].

Conclusions / Discussion

The State Institute of Physical Culture of Ukraine made a significant contribution to the development of the domestic system of physical education thanks to the presence of practitioners, experienced teaching staff; training of qualified specialists, high-class athletes The activity of the Ukrainian Scientific Research Institute of Physical Culture was significant for the republic. It was in the 30s of the XX century that the foundation was laid for the further development of domestic sports science.

Prospects for further research are related to the generalization of reports of scientific works of the Ukrainian Scientific Research Institute of Physical Culture, the study of the activities of prominent figures of Ukrainian sports science.

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References

1. Azhyppo, O. Yu., Protsenko, U. M., (2020), «Historical aspects of higher education in physical education in Ukraine (20-70 years of XX century)», Innovatsiyna pedahohika, Vypusk 24, Tom 1, pp. 9-13. (in Ukr.)
2. Blyakh, V. A., Pryvis, S. L., (1935), Fizkul′turnyy rukh na Ukrayini do KHIII vseukrayins′koho z'yizdu rad [Physical culture movement in Ukraine before the XIII All-Ukrainian Congress of Soviets]. K., 32 p. (in Ukr.)
3. Butsenko, A. (1928), V-richchya Radyans′koyi fizkul′tury na Ukrayini [V-anniversary of Soviet physical culture in Ukraine]. Kharkiv: Visnyk fizychnoyi kul′tury, 40 p. (in Ukr.)
4. Vatseba, O. (2003), «Activities of the Ukrainian Research Institute of Physical Culture (1931-1939) as a scientific and organizational basis for the formation and development of the State Research Institute of Physical Culture and Sports in modern Ukraine», Aktual′ni problemy fizychnoyi kul′tury i sportu, №1, pp. 39-45. (in Ukr.)
5. Verbyts′kyy, V. A. (2014), Istoriya fizychnoyi kul′tury ta sportu v Ukrayini [History of physical culture and sports in Ukraine]: navchal′nyy posibnyk. Mykolayiv, CHDU im. Petra Mohyly, 340 p. (in Ukr.).
6. Hryban, H. P. (2012), «Trends in the development of the methodological system of physical education of students in educational practice in the twentieth century», Pedahohika, psykholohiya ta medyko-biolohichni problemy fizychnoho vykhovannya i sportu, №8, pp. 30-33. (in Ukr.)

7. Grot, Yu. (2015), Etot nepostezhimyy Blyakh [This inconceivable Blach].URL:https://volleykharkiv.ucoz.ua/publ/ehtot_nepostizhimyj_bljakh/2-1-0-53 (in Russ.)
8. Litopys Natsional′noho universytetu fizychnoho vykhovannya i sportu Ukrayiny (2005) [Chronicle of the National University of Physical Education and Sport of Ukraine]. Kyyiv: Olimpiys′ka literatura, pp. 8-17. (in Ukr.)
9. Oleynik, N. A., Grot, Yu. I. (2002), Istoriya fizicheskoy kul'tury i sporta na Khar'kovshchine [History of physical culture and sports in the Kharkiv region]. T.1. Khar'kov: KHDAFK, pp. 65, 102-103, 115-117. 9 (in Russ.)
10. Platonov, V. N., (1990), Kiyevskiy infizkul't: gody i lyudi [Kiev infizcult: years and people]. Kiyev: Zdorov'ye, 215 p. (in Russ.)
11. Platonov, V. (2020), «Sports science of Ukraine: pages of history», Nauka v olimpiyskom sporte, pp. 4-47. DOI:10.32652/olympic2020.3_1 (in Russ.)
12. Protsenko, U. M. (2013), «Formation of a system of training for physical education and sports in Ukraine in the second half of XX century», Nauk. zap. Nats. ped. un-tu imeni M. P. Drahomanova, Kyyiv: NPU im. M.P. Drahomanova, Vyp. 111, C. 133 –140. (in Ukr.)
13. Savchenko, H., Khomenko, Ye. (2013), « Restructuring of the system of physical culture in the USSR in the late 1920's - early 1930's», Etnichna istoriya narodiv Yevropy, Vypusk 39, pp. 134-139. (in Ukr.)
14. Sazonova, Yu. (2018), «Journal" Bulletin of Physical Culture "(1922-1929) as an epoch-making phenomenon in the history of Kharkiv sports journalism», Visnyk knyzhkovoyi palaty, №10, pp. 41-46. (in Ukr.)
15. Sazonova, Yu. O., (2020), Sports journalism of Ukraine: leading personalities and main newspaper and magazine publications (XIX-XXI centuries): monohrafiya. Mykolayiv: CHNU im. Petra Mohyly, 256 p. (in Ukr.).
16. Solov'yev, V. O., Sidorov, V. I. (2013), Pervaya stolitsa respubliki: Istoriko-publitsisticheskiy ocherk [The first capital of the republic: Historical and journalistic sketch]. Khar'kov, 116 p. (in Russ.)
17. Tymoshenko, Yu. (2011), «Formation of the system of pedagogical training in the

field of physical culture», Fizychne vykhovannya, sport i kul′tura zdorov″ya u suchasnomu suspil′stvi, №2 (14), pp. 8-15. (in Ukr.)

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INFLUENCE OF NORDIC WALKING ON THE PHYSICAL CONDITION OF NTU "KHPI" STUDENTS

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Purpose: to determine the impact of Nordic walking on the physical condition of students in the process of educational and health activities.

Material and methods: analysis of scientific and methodological literature and regulations on the organization of physical education at the Department of Physical Education at NTU "KhPI" , express assessment of the physical condition of students by V.I Belov [1], student survey. The surveyed group consisted of 45 students of NTU "KhPI" humanities specialties of the Faculty of Social and Humanitarian Technologies, which belong to the main medical group.

Results: the article analyzes the main forms of organization of educational and health activities of the discipline of physical education, determines the level of physical condition of female students before and after Nordic walking. Analyzing the results of the primary indicators of physical condition, the students were asked to practice Nordic walking to improve their physical condition. Classes were held for 10 weeks 3 times a week, where each week had its own focus. According to the results of the study, recommendations were given for the introduction of Nordic walking in the discipline of "Physical Education" NTU "KhPI".

Conclusions: physical condition testing. Therefore, it is possible to propose to introduce Nordic walking into the educational process of the discipline of physical

education.

Keywords: female students, Nordic walking, physical condition, physical education, influence.

Introduction

Student life consists of many areas and activities. One of the directions of the student educational process is the recovery of students. The discipline "Physical Education" is responsible for this direction in higher education institutions. Forms of organization of the discipline of physical education in higher education institutions are different: sectional, professionally-oriented, traditional, individual. But each of them is aimed at teaching students the basics of using physical activity to lead a healthy lifestyle and improve physical fitness. Each form of physical education includes a list of appropriate means of educational and recreational activities for students. Problems of reforms in the system of physical education of higher education institutions were considered by scientists Krutsevich T., Malakhova J. The following scientists Petrenko NV, Gavrilova, NM were engaged in the introduction of new technologies of training in the system of discipline of the physical education. , Lamfon, GN considered the features of physical activity in students before admission and during training. Podsiadło Szymon, Agnieszka Skiba, Anna Kałuża, Bartłomiej Ptaszek, Joanna Stożek, Amadeusz Skiba, and Anna Marchewka studied the influence of Nordic walking on the body of elderly women in the elderly, Jakub Kortas. Scientists such as Marcus Tschentscher, David Niederseer, Josef Niebauer have studied the influence of Nordic walking and its comparison with simple walking and jogging. But Nordic walking as a means of educational and recreational activities of students in the learning process is not considered enough. Therefore, it is important to consider such an issue as the introduction of Nordic walking in the educational process of physical education of student youth. The study will determine the possibility of adding Scandinavian walking to the means of educational and recreational activities of student youth.

The purpose of the work is to determine the influence of Nordic walking on the physical condition of students in the process of educational and health activities.

Tasks of work:

1. To analyze the form of organization of the discipline of physical education at NTU "KhPI".

2. To determine the level of the physical condition of students of NTU "KhPI" before and after Nordic walking.

3. Provide recommendations for the introduction of Nordic walking in the educational and recreational activities of the discipline of physical education.

Material and Methods of research

Analysis of scientific and methodical literature and provisions on the organization of physical education at the Department of Physical Education at NTU "KhPI", methods of mathematical statistics, express assessment of the physical condition of students by V.I. Belov [1], student survey. The study involved 45 students of NTU "KhPI" humanities, which belong to the main medical group.

Results of the research

Analyzing the provisions on physical education at NTU "KhPI" at the Department of Physical Education, it was determined that the form of organization of the discipline of physical education is traditional. This form means that physical education is a compulsory discipline with classroom hours and summarizing at the end of each semester assessment, in the form of credit and inclusion of the discipline in the schedule of students. The discipline of physical education belongs to the general block of disciplines in the curricula of all specialties of NTU "KhPI" and meets the needs of general competence to use different types and forms of physical activity for active recreation and healthy living. Educational and recreational activities include theoretical and practical classes, as evidenced by the curriculum of physical education.

In the block of the theoretical component of physical education - knowledge on the safety of physical education, the basics of a healthy lifestyle, hygienic norms of the body are formed. Forms of theoretical classes on physical education at NTU

"KhPI" at the Department of Physical Education - are lectures, participation in scientific conferences, seminars.

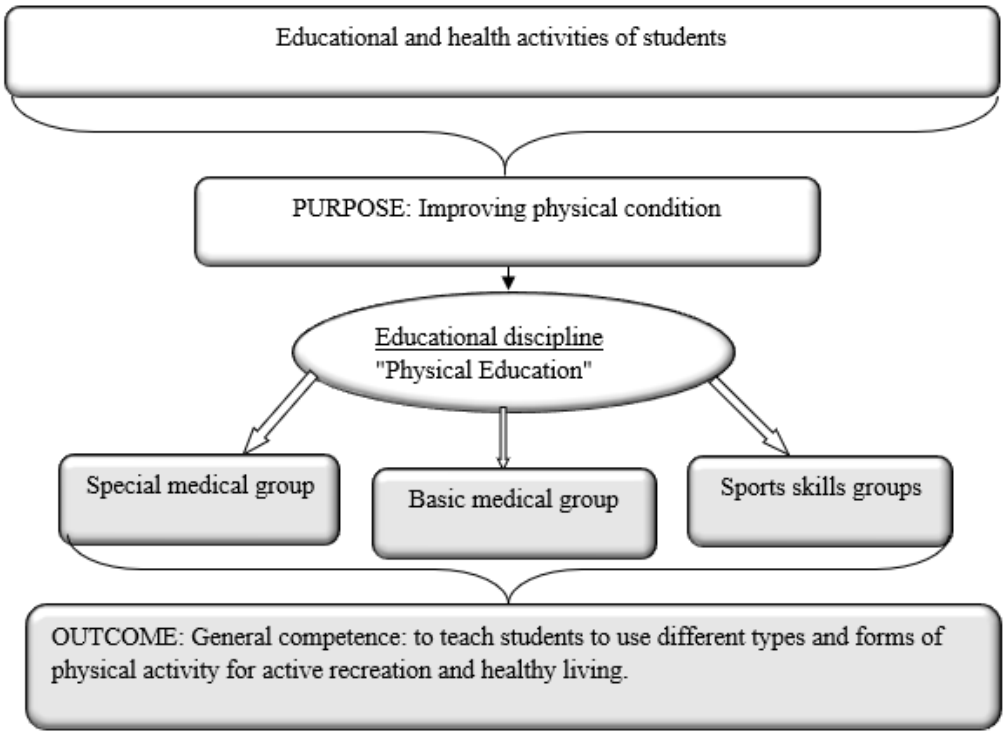

Fig. 1 Direction of educational and health activities of students

In the section of practical classes, students are engaged in professional and applied physical training, participate in competitions of various qualifications. Students attending physical education classes are assigned to the appropriate direction, from different types of physical activity. The Department of Physical Education of NTU "KhPI" has a wide range of sports, namely: athletics, basketball, football, volleyball, tennis and table tennis, badminton, swimming, aerobics, weightlifting, weightlifting, sambo, tourism, climbing, gymnastics, free and Greco-Roman wrestling. Each type of physical activity in physical education at NTU "KhPI" has its own history of implementation, work program, and syllabus, so the student has the opportunity to be acquainted with the purpose, objectives, requirements, and competencies that form this discipline.

Further development of physical culture and sports, increasing the need for young people to new types of physical activity requires the introduction of new forms of physical education in the educational process, especially, it is relevant to health

types. To determine the importance of the introduction of Nordic walking in the educational process, our study was conducted. Its influence on the physical condition of students was analyzed.

To determine the level of the physical condition of students, V.I. Belov conducted an express assessment of the physical condition of students. The level of physical condition was determined by the number of points scored by dividing them by 9. Express assessment included indicators: heart rate at rest (1 min.), Blood pressure at rest, (mm.rt.st.), VL by body weight (ml * kg $^{-1}$), experience exercise at least twice a week for 30 minutes. and more, running 2 km, (min., s.), long jump (see), lifting the torso from a supine position, hands behind his head (women) times, the number of colds during the year (times), number of chronic diseases of internal organs (times).

Analyzing the obtained data with the criteria for assessing the level of physical condition, it was determined that 2 (4%) female students scored 5 or more points and corresponds to a very high level of physical condition, 4 (9%) female students scored in the range of 4,0 – 4,9 that corresponds to a high level of physical condition, 14 (31%) female students scored in the range of 3,0-3,9, which corresponds to the average level of the physical condition of female students, 20 (45%) female students scored in the range of 2,0-2,9 having a low level of physical condition, 5 (11%) students showed results corresponding to 1,0-1,9 is an indicator of a very low level of physical condition.

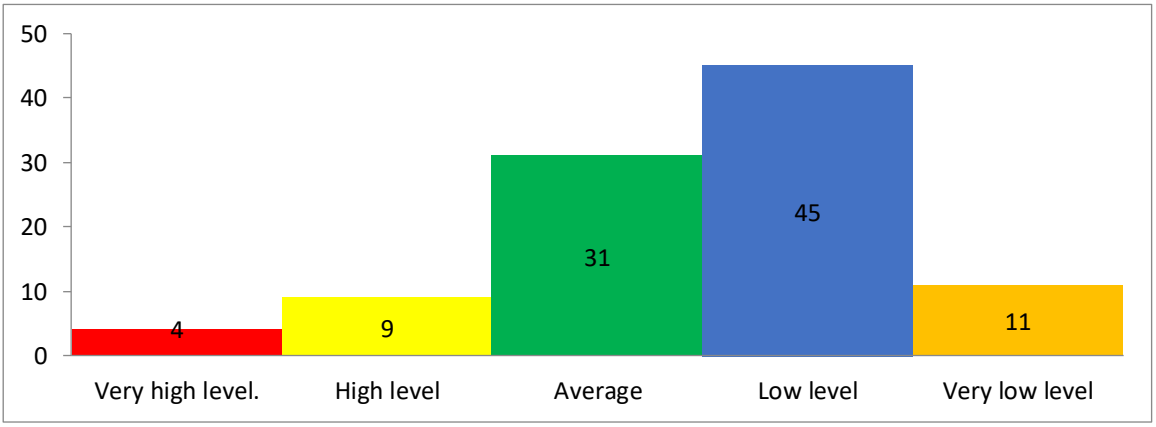

Fig. 2 The level of the physical condition of female students as a percentage of attendance at Nordic walking classes

Analyzing the results of assessing the level of the physical condition of students in the majority of female students who participated in the study, the average and low level of physical condition, which indicates that the student has a low level of health and physical activity. Physical condition as an indicator of student health was considered by the authors Pavlenko I.O., Vorona, V., Kylik, N., Lytvynenko, V., Ratov, A., Lazorenko. Therefore, we can say that students lack physical activity in the curriculum, which suggests that it is necessary to propose and introduce new forms of physical activity for physical education classes for students.

To improve their physical condition, the students were asked to attend 10 Nordic walking classes 3 times a week. Every 2 weeks, students were asked to increase the pace of walking. At the beginning of the classes, students were provided with theoretical knowledge of safety in Nordic walking lessons and exercises were presented, the task of which was to find a comfortable step length for each student and to catch a comfortable rhythm of walking.

The following tasks were proposed:

- Start with walking on the spot, increasing activity, then move on to vigorous walking forward. The purpose of walking is to achieve wide and free movements.

- Perform an exercise for proper foot function. Stand on the sock, gently roll the foot on the heel. Perform the exercise in reverse order.

- Put the sticks near the foot, try to move the center of gravity forward, along with the repulsion of the stick.

- Perform freehand movements back and forth with sticks, standing still.

- Learn to properly adjust the amount of the sling. For this purpose, it is necessary to take sticks in hands and to check the fastening of a sling, to take away hands one by one back, and to feel opening palms that the stick does not slip out.

- Perform active walking with sticks, while keeping them only lowered down and pulling on the ground.

- Short and wide movements. Take the sticks in the middle, and walk until the correct movement of the hands and coordinated work of the arms and legs.

- Take only one stick and walk with it, focusing on the place of the stick (changing hands).

Classes for 1-4 weeks were conducted in a preparatory mode, at a slow pace in the range of 50-60% of the maximum heart rate. Heart rate at rest does not exceed 90 beats per minute.

Classes for 5-8 weeks in training mode, aimed at improving the functional state of the cardiovascular system, as well as increasing the physical load on the body of students by increasing the duration of classes. In this mode, the functional heart rate of students should not exceed 80 beats per minute at rest.

Classes of 9-10 weeks are held in sports mode, which is most pronounced in terms of duration and intensity of exercise and training effect on the body of students. In this mode, the use of short-term accelerations that occupy 75-80% of the threshold heart rate is allowed. Walking in sports mode is allowed for students whose heart rate at rest ranged from 60 to 80 beats per minute. Students who did not meet such indicators were engaged in the second mode. After attending classes, students were asked to conduct a repeat rapid assessment of their physical condition. Analyzing the results of the repeated express assessment, students had the following indicators: 2 (4%) female students scored 5 or more points and correspond to a very high level of physical condition, 5 (12%) female students scored points between 4.0 - 4.9 which corresponds to a high level of physical condition, 21 (47%) female students scored in the range of 3.0-3.9, which corresponds to the average level of the physical condition of female students, 15 (33%) female students scored in the range of 2.0-2.9, having a low level of physical condition, 2 (4%) students showed results corresponding to 1.0-1.9 is an indicator of a very low level of physical condition.

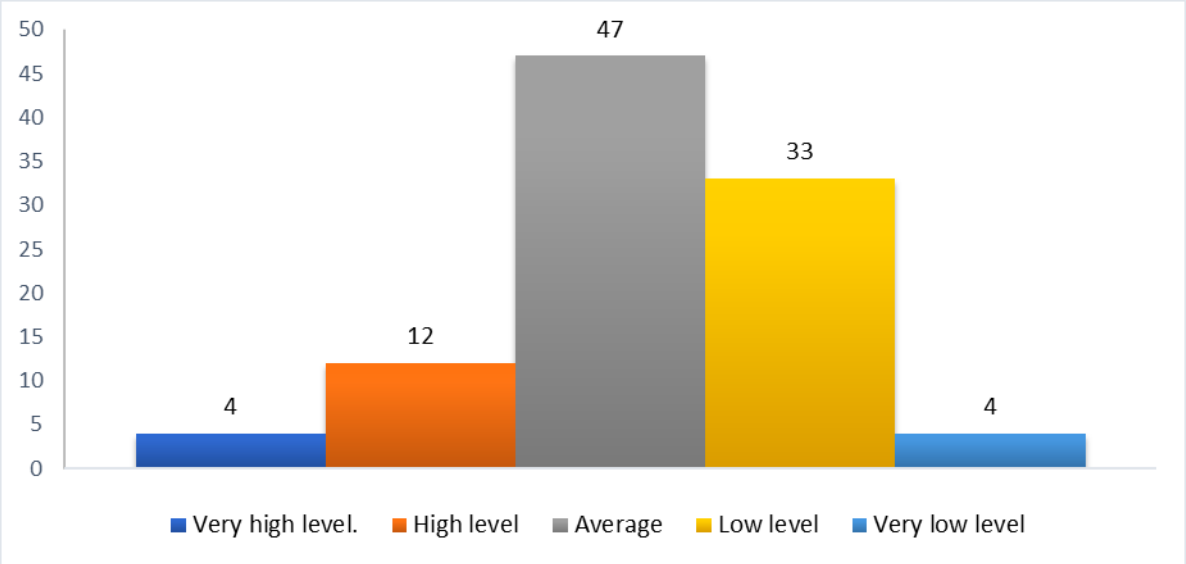

Fig. 3 The level of the physical condition of female students as a percentage after attending Nordic walking classes.

According to the indicators of re-testing, we can say that Nordic walking, as a form of health activity of students is suitable for students in the process of physical education. Therefore, for the introduction of Nordic walking in the educational and health program of the educational component "Physical Education" the following recommendations are proposed:

- Conduct introductory classes in Nordic walking.

- Conduct a course of lectures on the impact of Nordic walking on student health and the basics of performing technical elements in Nordic walking.

- Introduce Nordic walking to the list of types of physical activity of the Department of Physical Education in the distribution of students in sections.

- To develop a curriculum in Nordic walking for students of the main medical group, the purpose of which will be the formation of knowledge, skills, and abilities to use Nordic walking as a healthy activity of students in the process of physical education.

- Develop a video lesson on Nordic walking to learn the technical elements of walking with sticks.

Conclusions / Discussion

During the analysis of the documentation, it was determined that the main form of organization of the discipline "Physical Education" at NTU "KhPI" is a traditional form.

Analysis of the results of retesting allowed to determine the level of the physical condition of students of humanities NTU "KhPI" Faculty of Social Sciences and Humanities: 4% of students have a high level of physical condition, 12% of students have a high level of physical condition, 47% of students have an average level of physical condition, 33% of female students have a low level of physical condition, 4% of female students showed results that correspond to indicators of a very low level of physical condition. Data from re-testing the level of the physical condition of female students show that Nordic walking can be included in the educational process of physical education in the Free Economic Zone. Therefore, recommendations were proposed for the introduction of Nordic walking in the educational and recreational activities of the educational component "Physical Education".

Prospects for further research: Further research will be aimed at developing a program of Nordic walking in the process of physical education of students according to their level of physical condition.

Conflict of interest. The authors state that no conflict of interest could be perceived as damaging the impartiality of the article.

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References

1. Krutsevych, T. Yu., Vorobiov, M. I. and Bezverkhnia, H. V. (2011), Kontrol u fizychnomu vykhovanni ditei, pidlitkiv i molodi [Control in physical education of children, adolescents and young people]: navchalnyi posibnyk. Kyiv: Olimpiiska literatura, 224 p. (in Ukr.)

2. Krutsevych, T., Malakhova, Zh. (2020), «Problems of reforming the system of physical education in the field of education», Sportyvnyi visnyk Prydniprovia, №1, pp. 268-277 (in Ukr.)
3. Pavlenko, I. O. (2016), «Physical mill yak indicator of health of students», Zbirnyk naukovykh statei II Vseukrainskoi naukovo-praktychnoi konferentsii «Aktualni problemy fizychnoho vykhovannia riznykh verstv naselennia». Kharkiv. pp. 135-139 (in Ukr.)
4. Petrenko, N. V. (2015), Optymizatsiia fizychnoi ta rozumovoi pratsezdatnosti studentiv ekonomichnykh spetsialnostei zasobamy akvafitnesu [Optimization of the physical and professionalism of students in economics specialties for aquafitness]: avtoref. dys. . kand. nauk z fiz. vykh. ta sportu: spets. 24.00.02. Kyiv, 20 p. (in Ukr.)
5. Havrylova, N. M. (2017), «Fitness is a very special kind of student's activity», Materiały XIII Międzynarodowej naukowi-praktycznej konferencji «Nauka i inowacja - 2017». Przemyśl : Nauka i studia, Volume 4. pp. 62–64. (in Ukr.)
6. Podsiadło Szymon, Agnieszka Skiba, Anna Kałuża, Bartłomiej Ptaszek, Joanna Stożek, Amadeusz Skiba, and Anna Marchewka (2021), «Influence of Nordic Walking Training on Vitamin D Level in the Blood and Quality of Life among Women Aged 65–74», Healthcare 9, №.9: p. 1146. https://doi.org/10.3390/healthcare9091146 (in Eng.)
7. Marcus Tschentscher, David Niederseer, Josef Niebauer (2013), «Health Benefits of Nordic Walking A Systematic Review», American Journal of Preventive Medicine, No. 44(1), pp. 76-84 DOI:10.1016/j.amepre.2012.09.043 (in Eng.)
8. Zbigniew Ossowski, Katarzyna Prusik, Krzysztof Prusik, Jakub Kortas (2015), «Nordic Walking Training and Physical Fitness in Elderly Women», Polish Journal of Sport and Tourism, No. 21(4) DOI:10.1515/pjst-2015-0006 (in Eng.)
9. Alkhateeb S. A., Alkhameesi N. F., Lamfon G. N., Khawandanh S. Z., Kurdi L. K., Faran M. Y., Khoja A. A., Bukhari L. M., Aljahdali H. R., Ashour N. A., Bagasi H. T., Delli R. A., Khoja O. A. and Safdar O. Y. (2019), Pattern of physical exercise practice among university students in the Kingdom of Saudi Arabia (before

beginning and during college): a cross-sectional study. BMC Public Health 19, p. 1716. https://doi.org/10.1186/s12889-019-8093-2 (in Eng.)

10. Vorona V., Kylik N., Lytvynenko V., Ratov A., Lazorenko S. (2019), «The Level of Physical Condition of Students of Different Faculties of Pedagogical University», International Journal of Applied Exercise Physiology, No. 8(3), pp. 153-158. http://www.ijaep.com/index.php/IJAE/article/view/503 (in Eng.)

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PECULIARITIES OF THE ACTIVITY OF FITNESS CLUBS IN CONDITIONS OF QUARANTINE RESTRICTIONS

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Purpose: to determine the peculiarities of the activities of fitness clubs in conditions of quarantine restrictions.

Material and methods: during the implementation of the set goals, the following research methods were used: analysis of literary sources, organizational analysis, questionnaires, methods of marketing analysis (PEST analysis), media research of the Internet audience (Opinion Software Media), methods of mathematical statistics. The study was conducted on the basis of 3 fitness clubs in Kharkov (Pheromone, Malibu, Safari). The survey was attended by managers, administration and trainers of fitness clubs - 57 people. The method of marketing analysis (PEST analysis) was used to analyze the degree of influence of macroenvironmental factors on the efficiency of the functioning of fitness clubs. The study involved 22 people with appropriate qualifications and access to information.

Results: the main factors of the marketing environment influencing the activities of fitness clubs were identified; disclosed the content of the target guidelines for the use of social networks when choosing a fitness club; the reasons for

the interaction of users with the pages of fitness clubs in social networks and with official sites have been determined.

Conclusions: changes that have occurred in the external environment of fitness clubs over the past two years have led to a reorientation of their professional activities. The epidemiological situation forces fitness clubs to look for new forms of training in order to make a profit. The introduction of quarantine restrictions served as an impetus for the expansion of the socio-economic areas of work of fitness clubs on the Internet. This area is actively developing, despite the economic crises and various external and internal obstacles. Based on the results of the study, the features of the activity of fitness clubs in conditions of quarantine restrictions have been determined. The study of the marketing environment of fitness clubs determined a high degree of influence of demographic factors - the state of health of the population and the epidemiological situation in the country and the city (105 points). It is estimated that 42% of users use social media to express their opinions and 39% turn to online sources to read reviews of sports products, fitness services or fitness clubs. Fitness clubs most actively use Internet technologies to receive banking and financial services (87,7%) and interact with consumers (81,6%).

Keywords: fitness club, Internet, Internet marketing, quarantine restrictions.

Introduction

Modern conditions for the functioning of fitness clubs contribute to the widespread use of the worldwide Internet in their own professional activities. It penetrates into all areas of activity of fitness clubs: recruiting, working with the target segment of the consumer, training and increasing the coaching staff, communication, training, advertising. Effective use of the Internet resource speeds up communication and promotes the search for the target audience, as well as the distribution of their services. In general, on-line activities are becoming increasingly important for the economic development of fitness clubs.

The introduction of on-line work completely changes the style of doing business and can significantly reduce the costs of fitness clubs. Leaders need to develop a new direction, such as online marketing, i.e. develop new plans, strategies, organize and monitor ongoing financial and organizational and managerial activities in order to constantly identify the real and potential consumer of the fitness club. Modern conditions require the use and adaptation of new formats for the functioning of fitness clubs, namely: on-line consultations, marathons, webinars, blogging, Frequently Asked Questions (FAQ - frequently asked questions), SMM (social media marketing - promotion in social) networks), SMO (social media optimization - website optimization for social networks), display advertising, etc.

Scientific works on organizational and managerial activities of fitness clubs (S.A. Stadnik, 2018, 2019; Yu.A. Leonova, A.S. Bondar, 2020) were of scientific interest for the study; features of the use of marketing communications and mass media in the popularization of mass sports and physical culture and health-improving activities (L.Ya. Zatsna, 2013; A.V. Zinyuk, 2013) [1; 2; 3; 5]. The use of marketing in organizational and managerial activities was studied by Damodaran A. (2016), Crouhy M., Galai D., Mark R. (2020), Crouhy M., Galai D., Mark R. (2020) and features of the use of Internet marketing when building a fitness club strategy [4, 8, 9, 10].

Connection of work with scientific programs, plans, topics. The scientific research was carried out in accordance with the theme of the research work of the Department of Physical Culture Management "Strategic management of the development of physical culture and sports" (state registration number: 012U101012).

Purpose of the study is to determine the features of the activity of fitness clubs in conditions of quarantine restrictions.

Material and Methods of research

In the course of implementing the set goals, the following research methods were used: analysis of literature sources, organizational analysis, questionnaires, marketing analysis methods (PEST analysis), media research of the Internet audience

(Opinion Software Media), organizational modeling, methods of mathematical statistics. The study was conducted on the basis of 3 fitness clubs in Kharkov (Pheromone, Malibu, Safari). The survey was attended by managers, administration and trainers of fitness clubs - 57 people. The method of marketing analysis (PEST analysis) was used to analyze the degree of influence of macroenvironmental factors on the effectiveness of the functioning of fitness clubs; 22 people with the appropriate qualifications and access to information took part in the study.

Using the methods of marketing analysis, the degree of influence of macroenvironmental factors, namely quarantine restrictions, on the activities of fitness clubs was investigated. The research of the interests of potential and real consumers was carried out using media research of the Internet audience of Ukraine (Opinion Software Media), based on a user-centric approach. This method analyzes the attendance of web resources and the socio-demographic profile of visitors. The research is based on the work of a permanent representative panel of Internet users on home and work computers.

Results of the research

To analyze the marketing environment for the activities of fitness clubs in Kharkov, the marketing method PEST analysis was used (Table 1).

Table 1

General characteristics of the influence of macroenvironment factors on the activities of fitness clubs in Kharkov (n=22)

№	Factors	Sum Σ	$\overline{X} \pm m$	%	Place
1.	Changes in the legal framework and quarantine restrictions	99	4,47 ± 0,27	89,3	2
2.	Financial support of the fitness club	93	4,20 ± 0,24	84,0	3
3.	Use of advertising and social media marketing (SMM)	90	4,07 ± 0,18	81,3	4
4.	The state of health of the population and the epidemiological situation in the country and the city	105	4,73 ± 0,15	94,6	1
5.	Using the latest techniques and developments in the training process	85	3,87 ± 0,16	77,3	5
$\sum_{i=1}^{n} x_{i\max} = 110$ $\sum_{i=1}^{n} x_{i\min} = 22$					

According to Table 1, it can be seen that demographic factors - the state of health of the population and the epidemiological situation in the country and the city (105 points) - have a high degree of influence on the activities of fitness clubs. The epidemiological situation that has developed today makes physical culture and sports organizations look for new forms of conducting classes and making a profit. The introduction of quarantine restrictions gave impetus to the expansion of the socio-economic areas of the work of the World Wide Web. The next factor influencing the activity of the fitness club is changes in the legislative framework and quarantine restrictions (99 points). In accordance with the Decree of the Ministry of Health of Ukraine No. 33 dated 02.06.2020 "Temporary recommendations on the organization of anti-epidemic measures in some physical culture and sports institutions for the period of quarantine due to the spread of coronavirus disease (COVID-19)", the activities of fitness clubs depending on from the epidemiological level is limited by the appropriate conditions. Within the limits of the yellow level, it is prohibited to: hold mass events with the participation of more than 1 person per 4 square meters of the building or territory; occupancy of gyms and fitness centers no more than 1 person per 10 sq. meters. The red level of epidemiological safety implies a number of restrictions, in particular, it is prohibited: the work of gyms, swimming pools and fitness centers; holding mass events, except for official sports events and matches of team playing sports without spectators [6]. These quarantine restrictions reduce the efficiency of fitness clubs and require a reorientation of their professional activities in a new format, namely the activation of the Internet.

An important tool for internet marketing is the creation and development of your own website and the promotion of a fitness club on social networks. Creation of your own website, from the point of view of internet marketing, should go through the following stages:

1) defining the functions and tasks of the site;
2) studying the target audience;
3) studying the structure of the site;

4) design and style of the site (graphic presentation of the site, which must be effective and effective);

5) determination of the navigation model, which should provide ease of access to the information component of the site;

6) content and support (information available on the site);

7) definition with hosting (this is the place where the site will be physically hosted) [1, 2].

According to the results of a study by the Ukrainian internet association and media research of the Internet audience (Opinion Software Media) [11], in 2021 the population of Ukraine most often turned to the Google search engine – 85%. The most popular social networks among the population are facebook.com (50%) and instagram.com (27%) (Fig. 1.). Focusing on research data, creating your own personal pages is an integral part of work in conditions of on-line and quarantine restrictions.

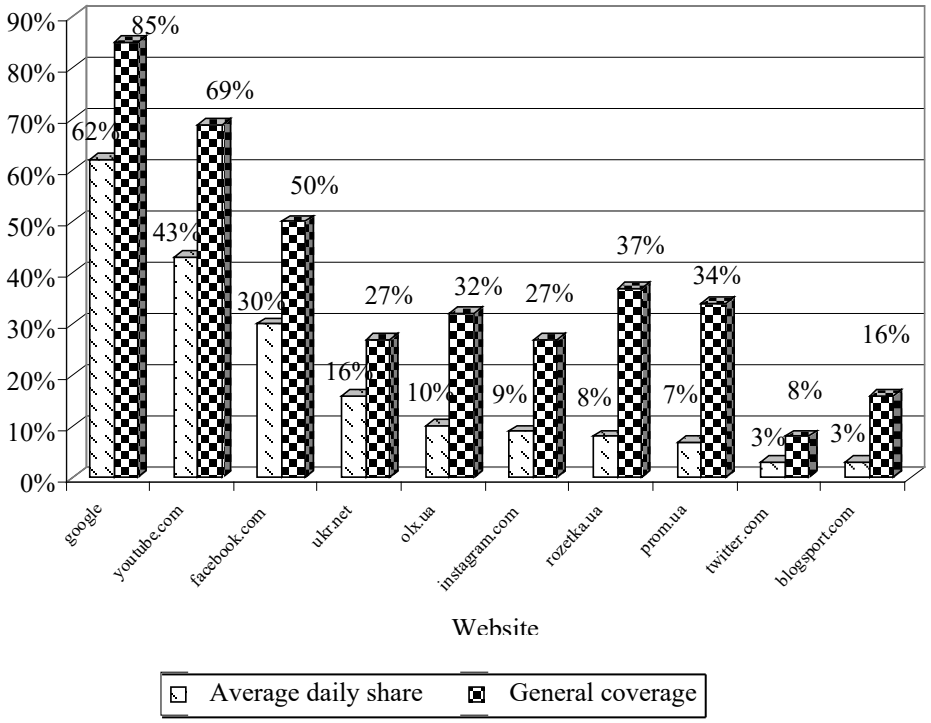

Fig. 1 Top 10 sites in Ukraine in terms of frequency of visits, according to the results of a study by the Ukrainian internet association and media research of the Internet audience (Opinion Software Media) [11]

According to the results of the analysis of the macroenvironment, employees of fitness clubs determine the use of advertising and marketing in the social network (SMM) as one of the factors that have a high degree of influence on further activities. Among the reasons for using social networks, "communication with friends and family" undoubtedly dominates, that is, the processes of socialization of society are deepening. At the same time, the circle of "friends" is constantly expanding due to the network itself (Fig. 2).

However, a study of social media marketing communications found that 42% of users use social media to express their opinions; 39% of users – read reviews of sporting goods, fitness and sports services or fitness clubs; 23% – to get acquainted with the activities of fitness clubs, the services they provide with a pricing policy and subscriptions. This indicates that the influence of social networks on the consumer behavior of users is significantly increasing, which means that fitness clubs should use relevant means of interacting with their audience on these Internet platforms.

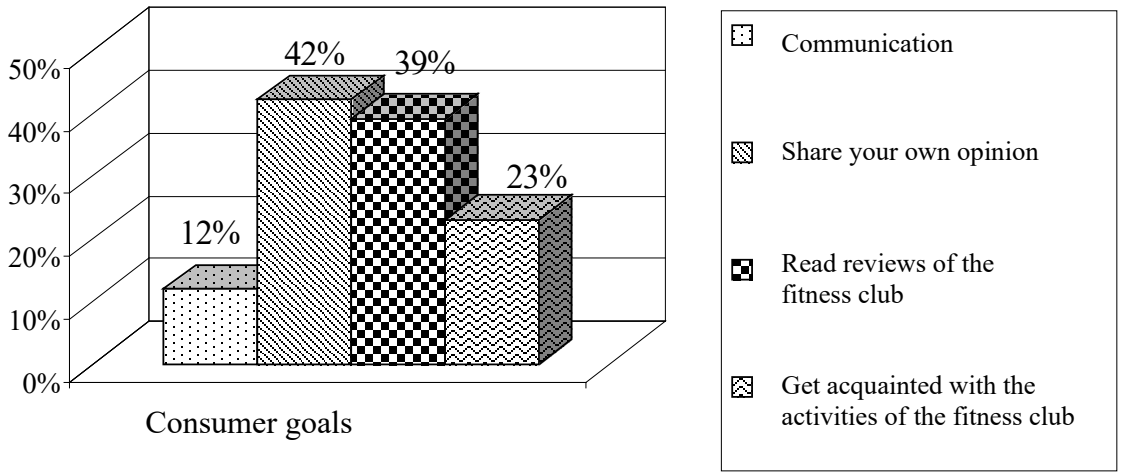

Fig. 2 Targets for the use of social networks, based on the results of our own research

Social networks can solve such communication tasks as raising awareness of the target audience, introducing new positioning, promoting individual promotional offers, incentivizing purchases, interactive communication with the audience within complex communication projects. As noted above, about a quarter of users interact

with a fitness club on social media. Let us consider in more detail the reasons for this interaction (Fig. 3).

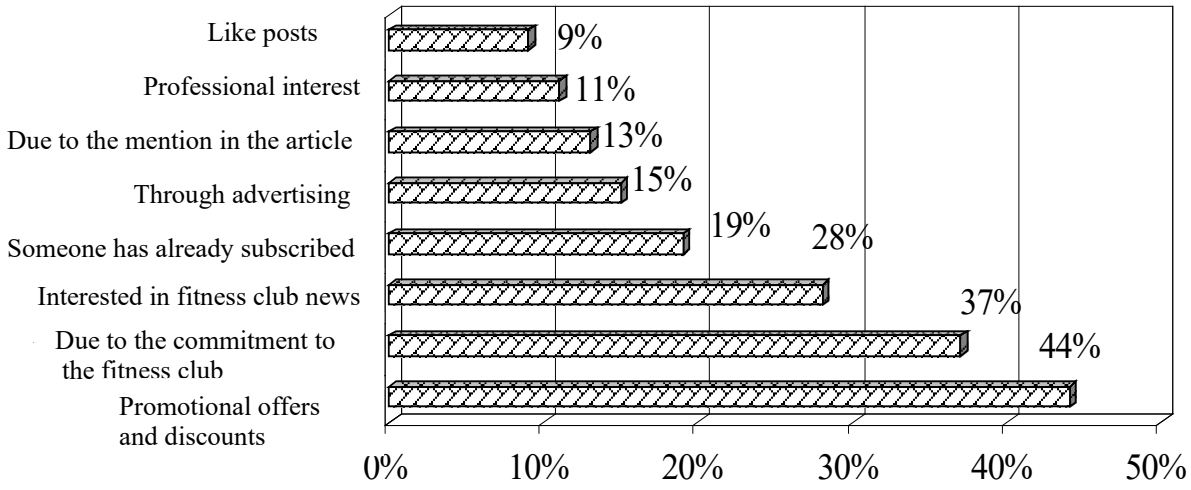

Fig. 3. Reasons for user interaction with the pages of fitness clubs in social networks

The results of the survey indicate that the majority of consumers (44%) visit the personal pages of fitness clubs on social networks to find discounts and promotional offers. This reason requires the focus of the heads of fitness clubs on the formation of the range of on-line information products and services of fitness clubs. On-line activities of fitness clubs should be carried out taking into account such basic criteria:

1) the quality of sports products and physical culture and sports services. The main goal of marketing is to meet needs and build long-term relationships with them, and the provision of quality products and services is one of the most important factors in achieving this goal. The desired result of quality confirmation is approving reviews or user comments on the fitness club page in social networks, or on the website in the interface options provided for this;

2) reliable information about sports products and physical culture and sports services. The site of the fitness club should post comments on the benefits of using

certain sports products or services, as a means of increasing their social value. At the same time, it is important to provide information that corresponds to reality, since the discrepancy between the level of consumer expectations leads to a significant decrease in their contingent;

3) an attractive image of a fitness club in the on-line environment is closely related to the quality and comfort of remote service. In this regard, the task of the fitness club is to form its own style, which is based on the tasks of ensuring full and prompt satisfaction of the information needs of consumers of physical culture and sports services;

4) monitoring the correspondence of the assortment of on-line products and services of fitness clubs to the information needs of users on the basis of systemic marketing research, continuous expansion of the technical capabilities of on-line services through the website of the fitness club;

5) proper design of the website of the fitness club and the information products and physical culture and sports services posted on it, which are perceived primarily visually through reading information from the screen or multimedia;

6) website content updating. Information posted on sites tends to become outdated, so you need to constantly monitor its relevance and promptly update the content if necessary [4, 5].

The analysis of the websites of popular fitness clubs in Kharkov showed that the leaders have already begun to implement the specified components of Internet marketing. It should be noted that fitness clubs are actively modernizing their websites, expanding the range of on-line products and services, constantly striving to achieve the site's compliance with the requirements of search engines, which allows them to occupy leading positions in the results of information search by users. However, there are certain drawbacks that can negatively affect the degree of user satisfaction, namely: a rather complex structure of sites, which, firstly, reduces the ease of navigation, and secondly, requires a significant amount of time from users; not very attractive website design that does not reflect the peculiarities of the

corporate identity of the fitness club; low level of multimedia content and interface interactivity.

Research data indicate that fitness clubs have sufficient technical conditions to develop online marketing and reorient their professional activities in accordance with modern conditions. The most active fitness clubs use Internet technologies to obtain banking and financial services (87.7%); customer interaction (81.6%); obtaining information (80.5%); to analyze the activities of competitors (66.6%). At the same time, the Internet is used to the full in the marketing activities of modern fitness clubs.

Conclusions / Discussion

The obtained results of our study confirmed the opinion of other authors [3, 8] that the changes that have occurred in the external environment of fitness clubs over the past two years have led to a reorientation of their professional activities. The epidemiological situation forces fitness clubs to look for new forms of conducting classes and making a profit. We agree with the opinion of Yu.A. Lenova, A.S. Bondar, S.A. Stadnik that the introduction of quarantine restrictions was the impetus for the expansion of the socio-economic areas of work of fitness clubs on the Internet. At the same time, this area is actively developing, despite the economic crises and various external and internal obstacles.

Based on the results of the study, the features of the activity of fitness clubs in conditions of quarantine restrictions were determined. The study of the marketing environment of fitness clubs determined a high degree of influence of demographic factors. in particular, the state of health of the population and the epidemiological situation in the country and the city (105 points). It was determined that 42% of users use social media to express their opinions and 39% turn to online sources to inquire about reviews of sporting goods, fitness and sports services or a fitness club. The most active fitness clubs use Internet technologies to obtain banking and financial services (87,7%); interaction with the consumer (81,6%).

Prospects for further research in this direction consist in the development of a marketing program for the development of fitness clubs, taking into account modern conditions.

Conflict of interest. The authors state that there is no conflict of interest that may be perceived as prejudicial to the impartiality of a state, public or commercial organization.

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References

1. Zatsna, L. Ia. (2013), «Innovative possibilities of application of communications in Internet marketing», Halytskyi ekonomichnyi visnyk, №4 (43), pp. 123-130. (in Ukr.).

2. Ziniuk, A. V. (2013), «The role of modern mass media in the promotion of mass sports and a healthy lifestyle», Visnyk ONU im. I.I. Mechnykova. Sotsiolohiia i politychni nauky, T.18, Vol.2(18), pp. 260-266. (in Ukr.).

3. Lenova, Yu. O., Bondar, A. S., Stadnyk, S. O. (2020), «Improving the efficiency of management of domestic fitness clubs in modern conditions of operation», Slobozhanskyi naukovo-sportyvnyi visnyk, № 6, pp. 81-86. (in Ukr.).

4. Sereda, N. V. (2019), «Organizational aspects of using Internet marketing in the activities of a fitness club», Slobozhanskyi naukovo-sportyvnyi visnyk, № 6K, pp. 89-92. (in Ukr.).

5. Stadnyk, S. O. (2018), «Activities of fitness clubs in Kharkiv», Slobozhanskyi naukovo-sportyvnyi visnyk, № 2, pp. 58-62. (in Ukr.).

6. Zminy do postanovy vid 02.06.2020 r. № 33 «Tymchasovi rekomendatsii shchodo orhanizatsii protyepidemichnykh zakhodiv v deiakykh zakladakh fizychnoi kultury ta sportu na period karantynu u zviazku z poshyrenniam koronavirusnoi khvoroby (COVID-19)». Ministry of Health of Ukraine, 2021. 5 p.

URL:https://moz.gov.ua/article/news/pravila-roboti-u-zhovtomu-ta-chervonomu-rivnjah-epidnebezpeki (in Ukr.).
7. Bairner, A. (2018), Sport, nationalism, and globalization: European and North American perspectives. New York: State University of New York Press. 227 p. (in Eng.).
8. Crouhy, M., Galai, D., Mark, R. (2020), Risk Management. New York: McGraw-Hill Education, 744 p. (in Eng.).
9. Damodaran, A. (2016), Strategic Risk Taking: A Framework for Risk Management. Pennsylvania: Pearson Prentice Hall, 408 p. (in Eng.).
10. Williams, J., Chinn, S. J. (2010), «Meeting relationship-marketing goals through social media: A conceptual model for sport marketers», International Journal of Sport Communication, No. 3, pp. 422–437. (in Eng.).
11. Ukrainian internet asociation URL:https://inau.ua/proekty/doslidzhennya-internet-audytoriyi (in Ukr.).

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IMPACT OF BODY FITNESS (BODYBUILDING) CLASSES ON THE MANIFESTATION OF THE PHYSICAL QUALITIES OF ATHLETES FOR 15-17 YEARS

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Purpose: to establish the dependence on the influence of 15-17 year old female athletes involved in body fitness (bodybuilding) on the manifestation of physical qualities during the annual macrocycle at the stage of preliminary basic training.

Material and methods: the research was carried out in fitness clubs: «Tetra», «Record», «Misto», «Ford» of Kharkov, with athletes 15-17 years old, engaged in body fitness (bodybuilding) during an annual macrocycle in the amount of 20 people. All athletes trained according to the classic program designed for body fitness (bodybuilding). The following methods of research were used: analysis of literary sources and testing of the level of motor qualities in certain age categories.

Results: presented pedagogical testing to determine the level of motor abilities of young athletes 15-17 years old, engaged in body fitness (bodybuilding). Exercises were identified that are advisable to use at these stages of preparation: burpe (number of times in 30 s); jumping rope (number of times in 30 s); raising the body from a supine position (number of times in 40 s); jumping lunges (number of times in 30 s);

running 30 m (s); flexion and extension of the arms (wringing) in the TRX simulator (number of times in 40 s); bending forward from a sitting position (sm).

Conclusions: as a result of testing motor qualities using nonspecific exercises for body fitness (bodybuilding), it was found that indicators improve every year in all exercises (p> 0,05), especially in the exercise of raising the trunk. lying on his back, the number of times in 40 s, which significantly increased in the age range from 15 to 17 years. The speed-strength abilities of young athletes of 15-17 years old, engaged in body fitness (bodybuilding), were manifested to a greater extent in the age interval from 16 to 17 years.

Key words: testing, physical qualities, bodyfitness (bodybuilding), athletes

Introduction

The popularity of bodybuilding as a new sport, which began to develop in Ukraine, is constantly growing among different segments of the population (V.G. Oleshko, 2011; V.Yu. Jim, 2013) [4; 9]. Methods for the formation of a good sports physique in bodybuilding have found wide application in various fitness technologies and contributed to their development (V.D. Zverev, 2003; V.V. Usichenko, 2010; V.Yu. Jim, 2015; A.A. 2019) [5; 6; 12; 13]. The creation of sports clubs and federations for bodybuilding and fitness contributes to the improvement of the population and practically confirms that strength and physical beauty are a symbol of the harmonious development of a person, one of the components of personality formation..

The division of the structure of training athletes into relatively independent types allows to a large extent to systematize the control system of the training process and the development of special training programs based on the specifics of any kind of sport (V.M. Platonov, M.M. Bulatova, 1995; V.V. Mulik, L.M. Taran, 1999; Yu.V. Verkhoshansky, 2005, etc.) [3; 5; 8; 10].

The main tasks of training at the age of 15-17 years is the versatile development of physical qualities, health promotion, elimination of deficiencies at

the level of physical development and physical fitness, the creation of motor potential, which will ensure the assimilation of various motor skills (including those corresponding to the specifics of future sports specialization). Particular attention is paid to the formation of a sustainable interest of young athletes to purposeful long-term sports improvement. Versatile training at this stage with a small amount of special exercises is favorable for further sports development. The desire to increase the volume of specially preparatory exercises and fulfill the bit standards in individual numbers of programs lead to a rapid increase in results. At this stage, to a greater extent than at the previous one, technical improvement is carried out on the basis of the chosen kind of sport.

Analysis of recent research and publications. Analysis of domestic and foreign special literature has shown that many works are devoted to training programs that allow you to increase muscle mass and reduce the fat component (V.Yu. Jim, 2013, 2015; V.M. Platonov, 2015; O. Tikhorsky, E. Jim, R. Ponomarenko, I. Petrenko, L. Kanunova, 2021) [4; 5; 11; 14; 15]. But it should be noted that the problem of the training process in bodyfitness (bodybuilding) during the annual macrocycle has not been sufficiently covered, which determined the relevance of the chosen research topic.

To date, the scientific concept of long-term training of athletes has been formed: from beginners to masters of sports of international class as a single process obeying certain patterns of a complex specific training system with its inherent characteristics and development paths (Yu.V. Verkhoshansky, 2005; V.M. Platonov, 2015) [3; 11].

Connection of research with scientific programs, plans, themes. The study was carried out in accordance with the Consolidated plan of research work of the Kharkov State Academy of Physical Culture for 2016-2020. on the topic "Methodological and organizational-methodological foundations for determining the individual norm of a person's physical condition" (state registration number 0111U000192).

Purpose of the study is to establish the dependence of the influence of body

fitness (bodybuilding) on the manifestation of physical qualities of athletes aged 15-17.

Material and Methods of research

The study was carried out on the basis of fitness clubs: "Tetra", "Record", "Gorod", "Ford" in Kharkov with athletes 15-17 years old in the amount of 20 people involved in body fitness (bodybuilding). All athletes trained according to the classic body fitness program. The following methods of research were used: analysis of literary sources and testing of the level of motor qualities in certain age categories.

Results of the research

Our research was aimed at identifying the level of physical readiness of female athletes of 15-17 years old, engaged in body fitness (bodybuilding), representing the process of developing power qualities that contribute to the manifestation of the level of sportsmanship of female athletes.

As a pedagogical test to determine the level of power capabilities of 15-17 year old female athletes involved in body fitness (bodybuilding), we have selected exercises that are advisable to use at these stages of training.

Table 1

Dynamics of indicators of general physical fitness of female athletes 15-17 years old, going in for body fitness (bodybuilding) (n=20)

Indicators	15 years	16 years	17 years
	$\overline{X}_1 \pm m_1$	$\overline{X}_2 \pm m_2$	$\overline{X}_3 \pm m_3$
Burpee, number of times in 30 s	5,1±0,63	5,8±0,61	8,1±0,55
Jumping rope, number of times in 30 s	44,8±0,69	46,6±0,62	52,2±0,45
Raising the body from a supine position, number of times in 40 s	17,8±0,53	19,3±0,56	21,8±0,49
Jumping lunges, number of times in 30 s	14,8±0,71	15,6±0,68	16,7±0,44
Running at 30 m, s	8,7±0,78	7,9±0,69	6,8±0,39
Flexion and extension of the arms (push-ups) on the TRX simulator, number of times in 40 s	14,3±0,66	15,9±0,68	17,8±0,58
Leaning forward from a sitting position, cm	16,2±0,34	16,8±0,32	17,2±0,33

Testing of strength qualities in the training process was carried out with the use of general preparatory exercises: burpe, number of times in 30 s; jumping rope, number of times in 30 s; raising the body from a supine position, number of times in

40 s; jumping lunges, number of times in 30 s; running 30 m, in s; flexion and extension of the arms (wringing) in the TRX simulator, number of times in 40 s; bending forward from a sitting position, see (Table 1)

The manifestation of speed-strength qualities in girls in the period from 15-16 years old did not significantly change (p>0,05), at the same time, the changes revealed in the age intervals of 16-17 and 15-17 years, significantly improved (p<0,05-0,001) (Table 2).

Table 2

Matrix of reliability of the difference in burpees and jumping rope among athletes 15-17 years old engaged in body fitness (bodybuilding) (n=20)

Age	16 years	17 years
15 years	t = 1,55;>0,05	t = 3,82; <0,01
	t =1,94;>0,05	t = 2,91; <0,01
16 years		t = 2,2; <0,05
		t = 0,78;>0,05

Note: in the numerator – burpee, number of times in 30 s; in the denominator – jumping rope, number of times in 30 s

In the course of the study, the speed-strength qualities of girls aged 15-16 did not change significantly (p>0,05) (Table 2). However, in the period from 16 to 17 years, the burpee indices increased significantly for 30 s (p<0,05) (Table 2). Testing for the manifestation of speed did not show significant changes: jumping rope, number of times in 30 s (p>0,05) (Table 2). Significant changes in the development of speed-strength qualities are observed in the period from 15-17 years old (p<0,05-0,01) (Table 2).

The results of testing raising the body from a supine position for 40 s increased in the age intervals from 15 to 17 years (p<0,05-0,001), while in girls from 15 to 16 years old, as well as from 16 to 17 years old, there were changes not reliable (p>0,05) (Table 3)

The results of the number of lifting of the trunk from the supine position in 40 s increased significantly in the period from 15 to 17 years (p<0,001) (Table 3), while in girls from 15 to 16 years of age they were unreliable (p>0,05) (Table 3). Testing of

speed-strength qualities using the number of lunges in a jump in 30 s did not reveal reliability in the period from 15 to 16 years old (p>0,05), however, significant changes occurred in the period from 15-17 years old (p<0,05) (Table 3).

Table 3

Matrix of reliability of the difference in the indicators of torso lifting from a supine position and lunges in a jump of athletes 15-17 years old, engaged in body fitness (bodybuilding) (n=20)

Age	16 years	17 years
15 years	t = 1,95>0,05	t = 5,5; <0,001
	t =0,81;>0,05	t = 2,28; <0,05
16 years		t = 3,36; <0,05
		t = 1,36;>0,05

Note: in the numerator - lifting the body from a supine position, number of times in 40 s; in the denominator - lunges in a jump, number of times in 30 s

In the manifestation of speed qualities in running on 30 meters, insignificant changes were determined in the period from 15-17 years old (p<0,05). However, in the period from 15 to 16, from 16 to 17, no differences were found (p>0,05). There was a statistically significant increase in the results of the strength indicators of the muscles of the upper extremities in the amount of flexion and extension of the arms on the TRX simulator for 40 s, in girls from 15 to 17 years old (p<0,05-0,001) (Table 4).

Table 4

Matrix of the reliability of the difference in the indicators of 30 m running (in s) and flexion and extension of arms on the TRX simulator for 40 s of athletes 15-17 years old engaged in body fitness (bodybuilding) (n=20)

Age	16 years	17 years
15 years	t =0,75; >0,05	t = 2,11; <0,05
	t = 1,69; >0,05	t = 3,98; <0,001
16 years		t = 1,39; >0,05
		t = 2,13; >0,05

Note: in the numerator - 30 m run; in the denominator - flexion and extension of the arms on the TRX simulator, number of times in 40 s

As can be seen from Table 4, the results of running on 30 m in girls from 15 to 16 years old and from 16 to 17 years old are absent (p> 0.05). Nevertheless, the flexion and extension of the arms on the TRX simulator have a statistically significant difference in the period from 15 to 17 years (p<0,05-0,001).

Flexibility testing did not reveal the reliability of the results in the period from 15 to 17 years old (p>0,05) (Table 5)

Table 5

Age	16 years	17 years
15 years	t = 1,29;>0,05	t = 2,11;>0,05
16 years		t = 0,87;>0,05

Conclusions / Discussion

The analysis of scientific and methodological literature indicates that the training process is one of the complex and multifunctional systems in the training of young bodybuilders. The stability of the results of the training process in body fitness depends on the training methodology.

Currently, power sports and body fitness (bodybuilding) in particular are rapidly developing in Ukraine. The analysis of scientific and methodological literature has shown that in bodybuilding the number of works devoted to this sport is constantly increasing. The founders of the theory of training in bodybuilding were the brothers Ben and Joe Weider - the trainers of many champions, including the famous Arnold Schwarzenegger. Schwarzenegger supplemented and improved the methodology of the Weider brothers. The problems of bodybuilding have also been disclosed by such domestic scientists as: V. Usicheno, 2006; V.G. Oleshko, 2011; V.Yu. Jim, 2013, 2015; O.A. Tikhorsky [4; 5; 9; 12; 13; 14; 15].

At the same time, bodybuilding research was mostly sporadic. In recent years, scientists have conducted research on the content and methods of the training process of highly qualified bodybuilders with different methods of developing endurance and strength qualities. However, the question of the influence of aerobic and strength training in body fitness (bodybuilding) in the competitive period has not been

considered, which prompted research on these issues. The research carried out has supplemented the theoretical and practical foundations of bodybuilding training, which can be used in the preparation of young athletes.

The material presented in this publication shows that the general physical fitness of athletes 15-17 years old, training in the fitness clubs "Tetra", "Record", "Gorod", "Ford" in Kharkov, in most of the indicators correspond to the peers who are engaged in various strength sports.

As a result of the testing of motor qualities with the use of nonspecific body fitness (bodybuilding) exercises, it was found that the indicators improve every year in all exercises ($p < 0.05$-0.001). The speed-strength abilities of athletes involved in body fitness (bodybuilding) were more pronounced in the age range from 15 to 17 years.

Prospects for further research suggest determining the influence of bodyfitness (bodybuilding) on the functional state of 15-17 year old female athletes engaged in bodyfitness (bodybuilding) during the annual macrocycle.

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References

1. Aaberg, E. (2014), Myshechnaya mekhaníka [Muscle mechanics]. Minsk: Popurri, 224 p. (in Russ.)

2. Arkhireyev, V. (2013), Bodibilding. Kniga-trener [Bodybuilding. Trainer book] M.: Eksmo, 320 p. (in Russ.)

3. Verkhoshanskiy, Yu. V. (2005), «Theory and methodology of sports training: the block system of training high-class athletes», Teoriya i praktika fizicheskoy kul'tury, №4, pp. 2-12. (in Russ.)

4. Dzhym, V. Yu. (2013), «Features of nutrition of bodybuilders in the preparatory period of training», Slobozhans′kyy naukovo-sportyvnyy visnyk, № 4, pp. 15-19. (in Ukr.)
5. Dzhym, V. Yu. (2015), «Peculiarities of nutrition of ectomorph athletes who are engaged in bodybuilding in the transition period of training», Slobozhans′kyy naukovo-sportyvnyy visnyk, № 5 (49), pp. 34–39. (in Ukr.)
6. Zverev, V. D. (2003), Planirovaniye trenirovochnoy nagruzki v podgotovitel'nom periode v bodibildinge s uchetom silovoy napravlennosti [Planning the training load in the preparatory period in bodybuilding, taking into account the strength orientation]: ucheb. -metod. posobiye. SPb. : SPbGAFK im. P. F. Lesgafta, 55 p. (in Russ.)
7. Kanunova, L.V., Plotnikov, Ye.K., Piven, O. B. (2020), «Differentiation of loads in the basic mesocycle with SFP in young weightlifters 14-15 years taking into account the phases of a specific biological cycle», Slobozhans′kyy naukovo-sportyvnyy visnyk, № 5 (79), pp. 58-64. (in Ukr.)
8. Mulyk, V. V., Taran, L. M. (1999), «Structure of regenerative microcycles in the competitive period in skilled biathletes», Slobozhans′kyy naukovo-sportyvnyy visnyk, pp. 78–85. (in Ukr.)
9. Oleshko, V. H. (2011), Pidhotovka sport·smeniv u sylovykh vydakh sportu [Training of athletes in power sports]: navch. posib. dlya vuziv. K. : DIA, 444 p. (in Ukr.)
10. Platonov, V. M., Bulatova, M. M. (1995), Fizychna pidhotovka sportsmena [Physical training of the athlete]. K. : Olimpiys′ka literatura, 320 p. (in Ukr.)
11. Platonov V. N. (2015), Sistema podgotovki sportsmenov v olimpiyskom sporte. Obshchaya teoriya i yeye prakticheskiye prilozheniya [The system of training athletes in the Olympic sport. General theory and its practical applications] Kiyev : Olimp. lit., 808 p. (in Russ.)
12. Tykhors′kyy, O. A. (2019), «The use of the method of" Drop-set "by qualified bodybuilders of Kharkiv region in the basic mesocycle», Problemy i perspektyvy rozvytku sportyvnykh ihor i yedynoborstv u vyshchykh navchal′nykh zakladakh. T.

1. pp. 1001-104. (in Ukr.)
13. Usychenko, V. (2006), «Periodization of the annual cycle of training athletes specializing in bodybuilding», Pedahohika, psykholohiya ta medyko-biolohichni problemy fiz. vykhovannya i sportu, № 7, pp. 123–125. (in Russ.)
14. Tykhorskyi O. et al. (2021), «Anthropometrical changes of highly-skilled female bodybuilders during basic mesocycle of annual preparation», Gazzetta Medica Italiana-Archivio per le Scienze Mediche. T. 180. №. 9. C. 429-434. (in Eng.)
15. Tykhorsky O., Dzhym E., Ponomarenko R., Petrenko I., Kanunova L. (2021), «Anthropometrical changes of highly-skilled female bodybuilders during basic mesocycle of annual preparation», Gazzetta Medica Italiana - Archivio per le Scienze Mediche 2021 September, №180 (9), pp. 429-434.(in Eng.)
16. Baechle T.R., Earle R.W., Wathen D. (2008), Resistance training. In: Essentials of Strength Training and Conditioning. Beachle TR and Earle RW, eds. Champaign, IL: Human Kinetics, pp. 381-412. (in Eng.)
17. Chernozub A., Korobeynikov G., Nakonechyi I. (2013), «Determination of optimal load in young with different physical capability Saglamliq», Health Baku, №3, pp. 26-34. (in Eng.)
18. Fletcher G.F., Balady G.J., Amsterdam E.A. et al. (2001), «Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association», Circulation, №104 (14), pp. 1674-1694. (in Eng.)

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