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CONTENT

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Features of the respiratory and cardiovascular system responses of girls 10–12 years of age on the swimming load

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Purpose: *study of the respiratory and cardiovascular system responses of girls aged 10–12 years on a dosed swimming load.*

Material & Methods: *the study involved 45 girls of 10–12 years old, engaged in the section of sports swimming. The method of spirography was measured: BH, RV, Pv of inhalation and exhalation, VC, MBV, MVL, RB, OC_2. Cardiovascular parameters were recorded: HR, BP, SV, MBV.*

Results: *the study showed that swimming the control 50 and 100-meter distances in the same age group is different due to the effect on the respiratory and circulatory systems, depending on the sport of swimming.*

Conclusions: *the results of the study showed that the greatest impact on the indices of the cardiorespiratory system of adolescents aged 10–11 years was observed while swimming the back crawl; and 12-year-old subjects performed larger loads "more economically". The dynamics of the studied functional systems of 12-year-olds showed that the greatest changes are observed when swimming 100 m breaststroke. In general, the load of 50 and 100 m distances is feasible for teenagers with all the sports swimming methods being studied.*

Keywords: *swimming, load, cardiovascular system, adolescents.*

Introduction

The age period from 10 to 12 years in girls is characterized by significant vegetative-endocrine changes in the body. At this age, the functional capabilities of the muscles and the cardiovascular system change [1; 3]. At the same time, at the age of 12, the extreme lability of the functions of respiration and blood circulation is noted, and the oxygen regimes of the body become less effective and economical [4; 6; 7]. We must not forget that, despite significant differences in the functional state of the apparatus of external respiration and circulation, young swimmers and their peers – not athletes, the body has not yet reached maturity and their age development and formation occurs in accordance with the same general biological laws. Therefore, the question of the impact of sports swimming on the body of young swimmers should be considered not only from the point of view of the influence on it of the specific features of the aquatic environment, but also taking into account the anatomical and physiological features.

Systematic training of adolescents in swimming favorably affects the development of external respiration apparatus, increases its functionality. In connection with the structural and functional changes of the heart that occur in the process of systematic training, adolescents are ahead of their peers who are not involved in sports for 1–2 years in terms of its development [6].

It is well known that, on the one hand, many factors are characteristic of swimming, which facilitate (compared to "ground" sports) the muscular work of young swimmers in the aquatic environment, on the other hand, swimming imposes extremely high demands on the apparatus of external respiration and blood circulation. Therefore, it is extremely important that the entire training system of young swimmers is built taking into account the age and anatomical and physiological characteristics of their body [5; 8].

Purpose of the study: study of the respiratory and cardiovascular system responses of girls aged 10–12 years on a dosed swimming load.

Material and Methods of the research

Studies of the reactions of the cardiovascular and respiratory systems of young swimmers to the dosed load are of undoubted interest [9; 12]. The characteristics of these effects on the developing organism of adolescents have practically not been studied.

As a metered load was taken swim for a 50-meter distance in different sports swimming methods. The study was conducted in the swimming pools of legal and polytechnic universities with the participation of 45 girls of 10–12 years old, who regularly attend the sports swimming section.

The method of spirography was measured: respiratory rate (RR), breathing volume (BV), reserve inspiratory and expiratory volume (Rv inspiration and Rv exhalation), vital capacity (VC), minute respiration volume (MRV), maximum lung ventilation (MLV), respiratory reserve (RR), oxygen consumption (OC_2). Blood pressure (BP) was measured by the method of N. S. Korotkov, the heart rate (HR) was recorded by the meth-

od of electrocardiography. According to Starr's formula [8] in the modification of N. S. Pugina and Ya. Yu. Bamash [2], the stroke (SV) and the minute volume of blood circulation (MVC) were calculated for adolescents. All indicators were recorded at rest and in the first 30 seconds after exercise.

Results of the research

At the first stage of the study, the reaction of the respiratory and cardiovascular systems to swimming 50-meter distances at an arbitrary speed was studied. The average time in the swims was: 87,6 s – for girls 10 years; 82,3 s – for 11-year-olds and 63,4 s – for 12-year-old athletes. The difference between 10 and 12 year old girls is significant (t=6,9).

As can be seen from Table 1, after the swimming load a greater degree of stress was experienced by the respiratory system of girls 10 and 11 years old. Thus, the MRV for 10 and 11-year-old swimmers increases to a greater extent than for 12-year-olds, while the VC in the 1st minute of recovery has changed slightly.

In subjects of all ages, the increase in BV after exercise occurred due to a decrease in Rv inhalation and mainly in exhalation Rv. The exhalation rate decreased the most in 10-year-olds, which indicates a large load on the respiratory muscles when swimming in a crawl on his chest.

MLV after exercise in girls 11–12 years old practically did not change, while in girls 10 years old it slightly decreased. This suggests that the capacity of the ventilatory function of the lungs of girls 11–12 years after the load remained high, while in the subjects of 10 years it was low. This is also confirmed by indicators of the dynamics of taxiway. It declined sharply in 10-year-olds. This is also indicated by the values of oxygen consumption. The lowest oxygen consumption was recorded in girls 11 years old, slightly higher rates were observed in 12-year-olds, and the highest oxygen consumption was recorded in athletes 10 years (Table 1).

Large consumption of O_2 in 10-year-old girls was provided by a high stress of the cardiovascular system. It should be noted that the largest increase in heart rate was recorded in swimmers 10 years. MVC increased in all 3 age groups due to the growth of both heart rate and SV. The largest increase in the MVC was also registered in girls 10 years of age and was achieved due to a greater heart rate, while the SV increased evenly in all age groups.

In 12-year-old athletes, blood pressure usually changed according to the normotonic type, whereas in subjects aged 10 and 11 years, both hyper- and dystonic types of reactions took place, which was reflected in the level of diastolytic pressure (Table 2).

Despite the fact that the tension of the cardiovascular and respiratory systems of girls 10 years old at the studied distance is the highest, there is reason to believe that this load is feasible for them, because after swimming the control distance MLV, which characterizes the functional ability of the respiratory apparatus, they have decreases slightly. At the same time, the RR of the subjects of this age decreased sharply. Apparently, a distance of 50 m imposes a requirement bordering on the limiting abilities of girls of 10 years.

Girls 11 years old had a greater voltage ventilation function than the cardiovascular. Despite a slight increase in swimming speed, the load for them is somewhat smaller than for 10-year-olds. The reserve capacity of 11-year-old athletes is somewhat larger, the MLV tends to increase and the RR is higher than that of 10-year-olds.

Dynamics of measurements of all indicators of girls 12 years old with a higher swimming speed is most adequate. This is evidenced by a change in heart rate and MVC.

Thus, the dynamics of the performance of the heart and respiration in most 10–12-year-old subjects is favorable, which gives grounds to consider the 50-meter distance to be adequate to the capabilities of their body.

The next stage of the study was to study the reaction of the respiratory and cardiovascular systems to swim the 100-meter distance at an arbitrary speed using the front crawl, back crawl by girls 10–12 years old and the breaststroke method by girls 11–12 years old.

An analysis of the research results showed that swimmers of the 100-meter distance of swimmers for 10 years did not have significant differences between the swimming methods of the crawl on the chest and back and ranged from 0,44 to 0,49 $m \cdot s^{-1}$. An analysis of the research results showed that swimmers of the 100-meter distance of swimmers for 10 years did not have significant differences between the swimming methods of the crawl on the chest and back and ranged from.

A higher CO_2 (19,2 $ml \cdot (min \cdot kg)^{-1}$ versus 16,4) was observed after swimming the crawl on the back. It was provided by an increase in MRV almost 5 times and MVC more than 3 times (Table 3, 4). With the way the crawl on the chest, the tension of the fan function was sharper (MRV increased 8.6 times), whereas the dynamics of the indicators of circulatory function when swimming by way of the crawl on the back, on the contrary, is more pronounced (MVC was 320% against 265).

When swimming with a front crawl, the respiratory type of compensation for deviations that occurred during exercise was more often observed; when swimming, the back crawl is a mixed type of compensation.

In subjects 11 years old, the difference in the speed of swimming distances by a crawl on the chest and on the back was not significant. The levels of functioning of the respiratory and cardiovascular systems did not have such significant differences as they had in girls 10 years. Mixed type of compensation prevailed in both ways. However, in subjects 11 years old, a higher oxygen demand in the first 30 seconds after the load was, like that of 10-year-olds, when swimming on a back crawl.

Despite the lower swimming speed, in the early recovery period after swimming the breaststroke method, CO_2 was noted more than in the first two methods. The higher values of MRV and MVC in the first 30 seconds after the swimming load using the breaststroke method also indicate that the effect on the body is the greatest.

In girls of 12 years, as in other age groups, after swimming with the breaststroke method, the degree of stress in the

Balamutova, N., Kucherenko, G., Shiryaeva, S. & Sheyko, L. (2019), "Features of the respiratory and cardiovascular system responses of girls 10–12 years of age on the swimming load", *Slobozhanskyi Herald of Science and Sport*, Vol. 7 No. 2(70), pp. 4-8, doi: 10.5281/zenodo.3042561

Table 1

Dynamics of lung volumes and ventilation parameters of girls 10–12 years old at the swimming load, % of the rest level

Age	RR	BV	MRV	VC	Rv inspiration	Rv exhalation	MLV	RR	OC_2
10 years t	150,9± 4,95 2,24	249± 27,4 3,44	356± 71,2 2,23	92,9± 1,73 3,99	83,9± 35,5 2,28	54,7± 5,31 1,83	81± 13,8 5,23	18,1± 13,8 0,88	336± 13,6 8,27
11 years t	216± 24,4 3,9	232± 32,4 3,66	463± 55,2 6,17	105± 9,29 0,21	78± 10,4 1,71	77± 7,84 1,17	108± 4,31 0,40	37,4± 11,4 3,08	190± 12,9 4,34
12 years t	155,8± 13,2 2,58	206,4± 27,1 4,74	298± 38,0 3,34	95,5± 4,73 0,49	97,9± 5,43 0,21	72,5± 10,7 5,01	107± 12,9 0,25	50,5± 9,12 2,25	237,5± 42,5 3,04

Table 2

Dynamics of hemodynamic parameters of girls 10–12 years old at the swimming load, % of the rest level

Age	HR	Systolic pressure	Diastolic pressure	Pulse pressur	Systolic volume	Minute volume
10 t	200± 10,4 8,42	121,4± 2,12 5,90	103,5± 4,40 0,43	142± 4,40 3,68	113,5± 5,9 1,33	226± 8,4 6,80
11 t	167± 8,1 7,36	118± 2,92 2,89	101,3± 9,50 0,106	147,5± 22,5 2,09	114,5± 14,2 1,07	197± 23,0 1,32
12 t	171,7±9,10 4,13	107,7± 2,88 5,97	88,7± 1,21 1,34	174± 9,41 11,07	117,1± 3,03 3,16	206± 11,6 6,25

functions of respiration and circulation was higher than in the swimming methods for the crawl on the chest and on the back. Compared to 11-year-olds, the older responded to the 100-meter breaststroke swimming with a lower degree of adaptive changes in the indices of the respiratory and circulatory systems. In 12-year-olds with all methods of swimming a mixed type of compensation prevailed. Thus, swimming a 100-meter distance with the same or similar speed in the same age group differs in the strength of its effect on the respiratory and circulatory systems, depending on the method of swimming. In general, the load is feasible for students with all the swimming methods studied (MLV are not reduced, RR is above zero).

Conclusions / Discussion

The peculiarities of the reactions of the respiratory and cardiovascular systems of the subjects to swim the same distance revealed by us do not contradict the ideas of the development of the aerobic abilities of children and adolescents in modern literature [10; 11].

The results of the study confirmed the correctness of our conclusions that large loads per unit of body weight (both in power and in terms of CO_2) were observed in 10–11-year-old swimmers when swimming using the crawl on the back. More trained subjects with a swimming experience of 2–3 years

Table 3

Indicators of the respiratory function of girls 10–12 years after swimming a distance of 100 m in various ways, % of the rest level

Age	Way of swimming	Time, min	RR	BV	MRV	VC	MLV	RR	OC_2
10	Front crowl Back crowl	3.25,2 3.4,0	200± 29,5 223,5± 8,86	440± 37,2 212,4± 23,6	860,3± 114,8 476± 59,2	84,7± 83 89,7± 87	115± 3,06 126,6± 4,92	23,7± 7,62 28,3± 8,81	283,5± 13,7 340,3± 10,9
11	Front crowl Back crowl	2.52,8 3.14,0	202± 17,7 190,9± 5,05	213,8± 24,8 225,3± 9,01	431,6± 46,8 433,6± 22,8	81,6± 2,67 95,1± 1,08	103,7± 3,19 130,2± 4,3	33,4± 8,56 50± 4,81	214,1± 11,96 303± 10,5
12	Breaststroke Front crowl Back crowl	3.40,0 2.41,9 2.44,6	220,4± 9,32 202± 22,6 239,3± 4,91	186,7± 17,2 187,9± 20,1 174,4± 12,6	420,9± 24,5 377,6± 34,0 427,9± 45,6	85,6± 2,03 89,5± 3,15 90,6± 1,68	92,4± 7,92 108,2± 10,6 137,7± 4,61	21,5± 3,9 82,4± 17,7 4,46± 7,19	400,6± 4,4 177± 38,3 213,8± 7,15

Table 4

Indicators of the cardiovascular system of girls 10–12 years old after swimming a distance of 100 m in various ways, % of the resting level

Age	Way of swimming	Speed	HR	BPmin	BPmax	SV	MVC
10	Front crowl Back crowl	0,49 0,44	210± 9,03 218,2± 5,15	98,7± 1,36 97,4± 2,96	127,4± 7,26 146,9± 6,32	126,3± 6,55 146,9± 3,17	265,1± 25,1 320,7± 8,86
11	Front crowl Back crowl	0,58 0,51	192,1± 7,08 214,4± 5,69	93,7± 13,6 97± 2,22	126,5± 10,4 148,8± 4,79	132± 7,12 145,8± 16,3	246,4± 23,9 309,6± 16,2
12	Breaststroke Front crowl Back crowl	0,45 0,62 0,61	218,5± 2,71 195± 60,4 219,5± 9,14	95,5± 1,48 89,7± 2,53 97± 1,1	149± 4,6 130,3± 4,25 147,3± 3,97	146,8± 3,95 131,8± 8,09 140± 4,33	319,9± 9,42 254± 18,5 307,6± 18,3

perform larger loads "more economically" (from the point of view of CO_2 and the level of functioning of the respiratory and circulatory system).

Thus, the dynamics of indicators of the cardiorespiratory system is favorable, which gives reason to consider 50 meter and 100 meter distances to be adequate to the body's capabilities of 10–12 year old adolescents.

Prospects for further research are to study the reactions of the cardiorespiratory system to the swimming load of young swimmers 10–12 years old.

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Functional status of rowers on kayaks in the process of preliminary selection

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Purpose: *conduct a comprehensive study of the functional status of athletes specializing in rowing, for the subsequent determination of the prospects in this sport.*

Material & Methods: *students of various sports schools in the age group of 13–14 years were examined, young men – 23 people, girls – 28 people, a total of 51 athletes'. Individual indicators were determined by the method of measuring the effect of the training action developed by us, and visual-motor and auditory-motor reactions, the level of musculo-articular sensitivity and coordination of movements, the power of forced inspiration and exhalation were measured.*

Results: *the conducted studies characterize the functional state and functional capabilities of the body of athletes. The optimal structure of sports activities contributes to their improvement, which, based on the laws of development of physical qualities, in this age period, can not significantly affect the level of sports results, but it has a great impact on the emergence of a corresponding functional basis and maximum realization of individual abilities. Features of the reaction of the body of athletes are a manifestation of effective individual adaptation to intense and complex stimuli of training and competitive activity.*

Conclusions: *proposed tests for measuring the effect of the training action, electromyoreflexometry, pneumotachometry and reverse dynamometry are quite informative in sports practice and allow you to determine and evaluate the individual prerequisites for sports achievements, to identify the individual characteristics of the athlete's body, the possibility of correcting them and managing the training process.*

Keywords: *rowing on kayaks, functional state, measurement of the effect of the training action, electromyoreflexometry, pneumotachometry, reversible dynamometry.*

Introduction

The system of training of athletes is determined by the complexity, dynamism, multiplicity, constant increase in the number of essential elements that determine the qualitative and quantitative characteristics of a specially organized process of education, training, development, enhance the functional capabilities of an athlete [1; 2].

At the preliminary stage of many years of training, it is revealed that a student chooses to practice a certain kind of sport, taking into account his morphofunctional and psychophysiological features. One of the main points that determine future sporting success is age, in rowing on kayaks – 13–16 years old is considered the most favorable for the start of regular training [3; 4].

The functional state of the athlete's body is characterized as a system of coordinated sustainable functioning of integrative physiological mechanisms that ensure the constancy of various physiological constants, as well as the adaptation of all body systems to intense physical and psycho-emotional specific effects. The functional state is a dynamic concept, constantly changing under the influence of internal and external factors, including intense physical and psycho-emotional stress [4; 5].

Each physical quality is based on certain functional capabilities of the organism, which are based on specific functional processes and physiological mechanisms for their improvement. Functional preparedness, functional capabilities are determined by the state and capabilities of the vegetative components of the response to stress, the improvement of energy supply mechanisms, aerobic performance, which is an integral indicator of the functions of the respiratory system, which characterizes oxidative processes [6–8].

The physiological basis of the steady state of the body of athletes is determined by the level of development of the functions necessary for this type of sports activity, their combination and interdependence, specificity for each sport and even for a particular specialization in a particular sport (role, distance, etc.) that characterize the effectiveness competitive activity [9; 10].

Functional training in sports increases the functionality that allows, without harm to health, to transfer increased amounts of training and competitive loads, while achieving high sportsmanship. According to the structure of functional preparedness of athletes in a particular sport, it is necessary to purposefully develop relevant, limiting and determining, in this sport, components, physiological mechanisms and functional properties [2; 5].

Functional training is a systematic, multifactorial process of managing the individual biological reserves of the human body

Bogush, V., Bogatyirev, K., Reznichenko, O., Sokol, O., Veselova, I. & Farionov, V. (2019), "Functional status of rowers on kayaks in the process of preliminary selection", *Slobozhanskyi Herald of Science and Sport*, Vol. 7 No. 2(70), pp. 9-14, doi: 10.5281/zenodo.2995015

using various means and methods of physical, technical, tactical and psychological preparation. The basis of increasing the functional capabilities are the development processes of the organism adaptation to physical loads and the mobilization of functional reserves [3; 9].

Purpose of the study: conduct a comprehensive study of the functional status of athletes specializing in rowing, for the subsequent determination of the prospects in this sport.

Material and Methods of the research

Surveyed students of sports schools and the Higher School of Physical Education, specializing in rowing. Individual indicators were determined in the age group: 13–14 years old, young men – 23 people, girls – 28 people, in total – 51 athletes.

The study of the functional state included a test measuring the effect of a training action (META), created on the basis of a tapping test, which allows determining the complex of kinematic characteristics of movements in an autonomous mode. This technique allows you to study the pace of movements and their accuracy by the sum of points gained, as well as the accuracy of a single movement. The study of movements performed with maximum speed and accuracy was considered in different conditions, successively in three time periods: for 15 s, 60 s and 15 s. Such a statement of the problem provided an objective determination of the pace and accuracy of movements in various conditions: with an optimal functional state in the first period of time, in the process of long work in the second, after a long and maximum pace of work movements in the third period. A detailed methodology for studying the effect of a coaching action has been published in Slobozans`kij naukovo-sportivnij visnik, 2015, No. 4 (48), pp. 19-25 [11].

Determination of latent periods of visual-motor and auditory-motor reactions was carried out using an electromyoreflexometer (EMR) using a standard technique that reflects the characteristics of receptor perception, the nervous and muscular systems.

The level of muscular-articular sensitivity and coordination of movements, as well as the diagnostic capabilities of the principle of repeated reproduction of a given load were studied by the method of reverse dynamometry (DM_{rev}), which was modified and adapted for the purposes of our study.

Measurement of the power of forced inspiration and expiration was carried out using a pneumotachometer (PT). Estimated air velocity in $l\ s^{-1}$ with the maximum fixed inspiration and expiration.

The results of observations were processed by methods of variation statistics.

Results of the research

The results of a survey of 13–14-year-old boy's trainings on rowing are presented in Table 1.

In the first period of the test of measuring the effect of the training action, the following average results were: pace – 31±1,24 hits, sum of points – 251±8,96, accuracy of one hit – 8,09±0,157 points; maximum indicators: pace – 36 hits, total points – 278, accuracy – 7,72 points; minimum indicators: pace – 23 hits, total points – 175, accuracy – 7,61 points.

In the second period, the following averages were noted: the pace – 33,25±1,382 hits, the sum of points – 253,75±9,77, the accuracy – 7,63±0,250 points; maximum: pace – 39 hits, total points – 295, accuracy – 7,56 points; minimum: pace – 24,5 hits, total points – 192,5, accuracy – 7,85 points.

In the third period – average indicators: pace – 34±1,53 hits, total points – 258±10,39, accuracy – 7,59±0,163 points; maxi-

Table 1

Survey results (rowing, boys 13–14 years old)

		Indicators	M±m	M_{max}	M_{min}	σ	C
Effect of a training action	First period	Pace (number of hits)	31±1,24	36	23	4,11	13,23
		Total points	251±8,96	278	175	29,65	11,81
		Accuracy (points)	8,09±0,157	7,72	7,61	0,52	6,51
	Second period	Pace (number of hits)	133±5,53 (33,25±1,382)*	156 (39)	98 (24,5)	18,30	13,76
		Total points	1015±39,08 (253,75±9,771)	1180 (295)	770 (192,5)	129,34	12,74
		Accuracy (points)	7,63±0,250	7,56	7,85	0,84	11,17
	Third period	Pace (number of hits)	34±1,53	41	25	5,05	14,85
		Total points	258±10,39	310	201	34,38	13,33
		Accuracy (points)	7,59±0,163	7,56	8,04	0,54	7,07
	Total	Pace (number of hits)	198±2,57 (33±0,428)	233 (38,8)	146 (24,3)	8,52	4,30
		Total points	1524±51,08 (254±8,513)	1768 (294,6)	1146 (191)	169,09	11,13
		Accuracy (points)	7,69±0,14	7,58	7,84	0,46	5,99
Test	EMR (s)	Sound	0,182±0,0078	0,249	0,167	0,0258	14,2
		Light	0,216±0,015	0,269	0,158	0,035	16,2
	PT ($l \cdot s^{-1}$)	Inhale	5,66±0,199	6,5	4,4	0,66	11,7
		Exhale	5,26±0,15	6,1	4,5	0,51	9,51
	DM rev. (kg)		1,03±0,162	2,0	0,3	0,536	52,0

Remark. ** – in parentheses are the data reduced to a single time indicator of 15 s, in particular, 133±5,33 (33,25±1,382).*

mum indicators: pace – 41 hits, total points hits 310, accuracy hits 7,56 points, minimum: tempo hits 25 hits, total points hits 201, accuracy – 8,04 points.

The total values for the three periods of the test of measuring the effect of the training action were as follows: averages – a pace of 33±0,428 hits, the accuracy of all movements or the sum of points – 254±8,513, the accuracy of one movement – 7,69±0,14 points; maximum: pace – 38,8 hits, total points – 294,6, accuracy – 7,58 points; minimum: pace – 24,3 points, total points – 191, accuracy – 7,84 points.

Athletes maintained a high rate of movement, which in the second period was more than the first by 2,25 hits (7,26%), the amount of points increased by 2,75 (1,09%), the accuracy decreased by 0,46 points (6,03%).

In the third period, compared to the first period, the rate increased by 3 hits (9,68%), the accuracy of all movements increased by 7 points (2,79%), the accuracy of one strike decreased by 0,5 points (6,59%); compared to the second, they increased: the pace – by 0,75 strikes (2,26%), the sum of points – by 4,25 (1,67%), the accuracy was almost unchanged, decreased by 0,04 points (0,53%).

Accuracy of movements in the first period on the maximum and minimum values was less than the average, respectively, by 0,37 points (4,79%) and 0,48 points (6,31%); in the second period, with the maximum rates and the sum of points, the accuracy was less than the average by 0,07 points (0,93%), that is, it did not change, with the minimum – the accuracy was noted more than the average values by 0,22 points (2,88%); in the third period, according to the maximum results, the accuracy of one strike was virtually the same with the average value, the difference was 0,03 points (0,39%), the minimum – more than the average by 0,45 points (5,93%).

By the sum of the results of three periods when comparing, the maximum indicator was more than the average for the pace – by 5,8 hits (17,56%), the sum of points – by 40,6 (15,98%), and the accuracy was less by 0,11 points (1,45%); minimum indicator: less than the average pace by 8,7 strikes (35,81%), total points – by 63 (32,98%), accuracy – more by 0,15 points (1,95%).

Athletes aged 13–14 years showed a high starting speed, the ability to maintain distance speed, good speed endurance.

Sensoriomotor reactions were determined for a sound stimulus and were on average 0,182±0,0078 s, the best result was 0,167 s, less than the average by 0,015 s (8,98%), the worst – 0,249 s, more than the average – by 0,067 s (36,81%); on the light stimulus, the average value is 0,216±0,015 s, the best result is 0,158 s, which is less than the average by 0,058 s (36,71%), the worst is 0,269 s, more than the average by 0,053 s (24,54%).

The results of pneumotachometry were observed – an average of 5,66±0,199 l s^{-1} on inspiration, the maximum – 6,5 l s^{-1} more than the average on 0,84 l s^{-1} (14,84%), the minimum – 4,4 l s^{-1}, less than the average by 1,26 l s^{-1} (28,64%); on an exhalation – 5,26±0,15 l s^{-1}, the maximum – 6,1 l s^{-1} more than the average on 0,84 l s^{-1} (15,97%), the minimum – 4,5 l s^{-1}, less than average at 0,76 l s^{-1} (16,89%).

The indicator of reverse dynamometry determined the error in the execution of a given muscular effort of 20 kg, which was on average 1,03±0,162 kg, maximum 2 kg (10%), minimum 0,3 kg (1,5%).

Features of the reaction of the body of athletes are a manifestation of effective individual adaptation to intense and complex stimuli of training and competitive activity.

The results of testing the functional state of athletes aged 13–14 are presented in Table 2.

Table 2

Survey results (rowing, girls 13–14 years old)

Indicators			M±m	M_{max}	M_{min}	σ	C
Effect of a training action	First period	Pace (number of hits)	28±1,24	32	23	3,86	2,78
		Total points	227±1,47	248	179	21,2	3,15
		Accuracy (points)	8,11±0,34	7,75	7,78	0,77	9,42
	Second period	Pace (number of hits)	122±6,92 (30,5±1,73)	142 (35,5)	106 (26,5)	15,4	13,9
		Total points	947±37,72 (236,8±9,43)	1103 (275,8)	734 (183,5)	158,4	16,7
		Accuracy (points)	7,76±0,96	7,77	6,92	0,215	2,75
	Third period	Pace (number of hits)	32,2±1,92	38	28	4,29	13,3
		Total points	241±11,5	269	209	25,8	10,7
		Accuracy (points)	7,48±0,33	7,08	7,46	0,73	9,73
	Total	Pace (number of hits)	182,2±10,14 (30,37±1,69)	212 (35,33)	157 (26,17)	31,4	21,27
		Total points	1415±10,62 (235,8±1,77)	1620 (270)	1122 (187)	237,8	16,85
		Accuracy (points)	7,77±0,211	7,64	7,15	0,472	6,05
Test	EMR (s)	Sound	0,227±0,022	0,286	0,170	0,049	21,93
		Light	0,270±0,016	0,312	0,231	0,035	12,87
	PT (l·s^{-1})	Inhale	4,1±0,326	4,7	3,0	0,73	17,8
		Exhale	4,6±0,249	5,3	4,0	0,56	12,13
	DM rev. (kg)		2,24±0,33	3,3	1,6	0,73	32,57

Remark. ** – in parentheses are the data reduced to a single time indicator of 15 s, in particular*, 122±6,92 (30,5±1,73).

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In the first period of the test, the measurement of the effect of the training effect averages were as follows: the pace of 28±1,24 beats, maximum – 32 hits, minimum – 23 hits; the sum is 227±1,47 points, the maximum is 248 points, the minimum is 179 points, the accuracy is 8,11 points; at the maximum rate and the amount of points – accuracy of 7,75 points, minimum – 7,78 points, respectively, an increase in the rate of 5 hits (21,74%) and 1,8 hits (5,66%), the sum of 30 points (16,76%) and 25,5 points (13,89%), accuracy decreased by 0,32 points (4,29%) and increased by 0,54 points (7,81%).

In the second period of the test, the average values were noted at the level of: a pace of 30,5±1,73 hits, a sum of 236,8±9,43 points, an accuracy of 7,76±0,96 points; maximum rate of 35,5 strikes, the amount of 275,8 points, accuracy of 7,77 points; the minimum is a pace of 26,5 hits, a sum of 183,5 points, an accuracy of 6,92 points.

In the third period, the average indices – a pace of 32,2±1,92 hits, a sum of 241±11,5 points, an accuracy of 7,48±0,33 points; with a maximum pace of 38 hits, the amount of 269 points, accuracy of 7,08 points; the minimum pace of 28 hits, the amount of 209 points, the accuracy of 7,46 points.

The sum of the three periods averages – the pace of 30,37±1,69 hits, the amount of 235,8±1,77 points, the accuracy of 7,77±0,211 points; with a maximum pace of 35,33 hits, a sum of 270 points, an accuracy of 7,64 points; with a minimum pace of 26,17 hits, the sum is 187 points, the accuracy is 7,15 points.

When comparing the results of the study of the second period with the first in average, the pace was higher by 2,5 hits (8.93%), the amount was 9,8 points more (4,32%), accuracy was 0,35 points less (4,51%); at the maximum – the pace was determined by more than 3,5 hits (10,94%), the sum was by 27,8 points (11,21%), the accuracy was by 0,02% (0,26%), the minimum – the pace was increased by 3,5 hits (15,22%), the sum is 4,5 points (2,51%), the accuracy is lower by 0.86 points (12,43%).

In the third period, compared to the first and second periods, the average rate increased by 4,2 hits (15,00%) and 1,7 hits (5,57%), on average, the amount increased by 14 points (6,17%) and 4,2 points (1,77%), accuracy decreased by 0,63 points (8,42%) and 0,28 points (3,74%); at the maximum rate, the increase was 6 hits (18,75%) and 2,5 hits (7,04%), a sum of 21 points (8,47%) and a decrease of 6,8 points (2,53%), accuracy decreased by 0,67 points (9,46%) and 0.69 points (9,75%); with a minimum pace – an increase of 5 hits (21,74%) and 1,8 hits (5,66%), a sum of 30 points (16,76%) and 25,5 points (13,89%), the accuracy decreased by 0,32 points (4,29%) and increased by 0,54 points (7,81%).

By the sum of three periods and average indices, the pace was higher than in the first period by 2,37 hits (8,46%), less than in the second and third, respectively, by 0,13 hits (0,43%) and 1,83 hits (6,03%); the amount is more than in the first period by 8,8 points (3,88%), less than in the second and third by 1 point (0,42%) and 5,2 points (2,21%), accuracy is less than the first – by 0,34 points (4,38%), more than in the second and third periods by 0,01 points (0,13%) and 0.29 points (3,88%). In terms of maximum values, the pace and the sum of points is higher than in the first period by 3,33 hits (10,41%) and 22 points (8,87%), actually the same pace with the second period and less than the sum by 5,8 points (2,15%), reduction of pace in relation to the third period by 2,67 hits (7,56%), the sum of points is the same, accuracy is less than in the first and second by 0,11 points (1,44%) and 0,13 points (1,71%), higher than the third by 0,56 points (7,91%). In terms of minimum indicators, the pace and the sum of points is higher than in the first period by 3,17 hits (13,78%) and by 8 points (4,47%), with the second period practically the same, less than in the third one by 1,83 hits (6,99%) and the amount of 22 points (11,76%), accuracy less than in the first and third periods by 0,63 points (8,81%) and 0,31 points (4,34 %), more than in the second by 0,23 points (3,32%).

The deviation from the average values of the maximum values, respectively, was larger: in the first period – in terms of 4 hits (14,29%) and the sum of 21 points (9,25%); in the second period – the pace of 5 hits (16,39%) and the amount of 39 points (16,47%); in the third period – the pace of 5,8 hits (18,01%) and the sum of 28 points (11,62%); cumulatively over three periods – the pace of 4,96 hits (16,33%) and the amount of 34,2 points (14,51%); the minimum ones are less than the average results in the first period in pace by 5 hits (21,74%) and the sum of 48 points (26,82%), in the second period in pace by 4 hits (15,09%) and the sum of 53,3 points (29,05%), in the third period by pace at 4,2 hits (15,00%) and the amount of 32 points (15,31%), in total – at the pace of 4.2 hits (16,05%) and the sum of 48,8 points (26,09%). Accuracy of one movement with maximum and minimum rates of pace and the sum of points gained were noted respectively: in the first period it was less than the average – by 0,36 points (4,65%) and by 0,33 points (4,24%); in the second period – more by 0,01 points (0,13%) and less by 0,84 points (12,14%); in the third period – less by 0,4 points (5,65%) and 0,02 points (0,27%); three periods less by 0,13 points (1,70%) and 0,62 points (8,67%).

The difference from the average values in the sum of the maximum and minimum indicators for pace was observed in the first period – 36,03%, in the second – 31,48%, in the third – 33,01%, in total – 32,38%; on the sum of points is identical – 36,07%; 45,52%; 26,43%; 40,60%, according to the accuracy of one movement, respectively – 8,89%; 12,27%; 5,92%; 10,39%. With a high pace and sum of points, the accuracy of one movement is less than the average results, but not significantly, with minimal indicators – the accuracy of movements was determined practically at the level, as with a large pace and sum of points.

The reaction rate for athletes 13–14 years old, specializing in rowing on sound and light stimuli, was determined on average 0,227±0,022 s, the best result was 0,170 s, lower than the average speed – by 0.057 s (33.53%), the worst 0.286 s, more than the average – by 0,059 s (25,99%); on the light stimulus, the average index is 0,270±0,016 s, the best – 0,231 s, less than the average – by 0,039 s (16,88%), the worst – 0,312 s, more than the average – by 0,042 s (15,56%). Deviations from the average value amounted to a sound signal – in the amount of 59,52% and light – 32,44%; according to the difference between the maximum and minimum values for sound – 7,54%, on light – 1,32%.

Inspiratory airflow rate – 4,1±0,326 l s^{-1}, maximum – 4,7 l s^{-1}, higher than the average by 0,6 l s^{-1} (14.63%), minimum – 3,0 l s^{-1}, less than the average – by 1,1 l s^{-1} (36,67%); on the exhale – 4,6±0,249 l s^{-1}, maximum 5,3 l s^{-1}, more than the average – by 0,7 l s^{-1} (15,22%), minimum 4,0 l s^{-1}, less than the

average by 0,6 l s^{-1} (15,00%), the total deviation from the average value – on the inhale 51,30% and exhalation of 30,22% and the difference between the maximum and minimum values – on the inhale 22,04% and exhale 0,22%.

The error in the performance of the muscular effort was observed on average 2,24±0,33 kg (14,93%), the minimum – 1,6 kg, less than the average by 0,64 kg (10,67%), the maximum – 3,3 kg, more than the average by 1,06 kg (22,00%); the deviation from the average was 32,67%, the difference between the maximum and minimum errors in the reverse dynamometry test – 11,33%.

In determining the functional state of athletes, it is necessary to conduct a comprehensive analysis of the level of development of various physical qualities, coordination abilities, properties of higher nervous activity, the state of the respiratory system, etc., which allow you to purposefully choose sports specialization. Insufficient optimal combination of some factors can be compensated by others, but only some indicators that determine the prerequisites for practicing this sport, which probably cannot be compensated for at all, are of prime importance.

Conclusions / Discussion

Functional preparedness of athletes is a basic, complex, multicomponent property of the organism, the essence of which is the level of improvement of physiological mechanisms, their willingness to provide at the moment the manifestation of all the necessary sports qualities that determine the muscle performance of a specific motor act.

The study of the mechanisms of functional preparedness, the qualities and properties of its characterizing makes it possible to carry out diagnostics of the level of special preparedness of an athlete, to identify weak and strong links. This, in turn, will be the basis of an objective control system for the actual individualization of the training process and the definition of the functional limit for its intensification, which will help in solving a number of problems of modern sports training – increasing the speed and quality of management of the adaptation process, objectification of sports selection, orientation and specialization athletes.

Studying the structure of athletes 'preparedness, the relationship of individual factors causing an effective competitive activity, identifying the contradictory relationships between the individual components of athletic abilities in various sports are the basis for optimizing the athletes' individual improvement, the system of sports selection and planning the training process.

For a qualitative determination of physical abilities and sports orientation, it is necessary to study the individual characteristics of trainees, especially at the stage of preliminary selection at 13–14 years, since at this age it is possible to identify shortcomings in physical and functional development and promptly correct them with appropriate psychophysiological and training effects.

Improvement of all components of the training activity, taking into account the age characteristics of athletes, as well as the patterns of development of motor skills, probably do not significantly affect the level of athletic performance, but they have a great impact on the body and the emergence of a corresponding functional basis, especially in the early age periods of maximum realization of individual abilities.

It is necessary to systematically form knowledge based on modern ideas of the scientific and methodological basis for the development of physical abilities, diagnostics and management of the functional state of athletes to achieve the highest sports result.

The proposed tests – measurement of the effect of the training action, electromyoreflexometry, pneumotachometry, and reverse dynamometry – are sufficiently informative, which makes it possible to determine and evaluate the individual prerequisites for sporting achievements.

The change in the number of movements during the first period of time marks the high mobility of the nervous processes, the second – balance, the third – strength and summarily – the state of the nervous system as a whole, which allows the coach to objectively evaluate the physiological processes occurring in the body and purposefully manage the training and competitive activity .

Sensomotor reactions characterize one of the most important indicators of higher nervous activity - the mobility of nervous processes. Measuring the amount of air during inhalation and exhalation allows you to indirectly determine the ability of the respiratory muscles to work hard, which during regular sports activities can increase significantly. The study of muscular-articular sensitivity and coordination of movements shows the possibility of developing the skill of reproducing a given physical activity.
The studied parameters of the functional state can identify the individual characteristics of the athlete's body, the possibility of their correction and control of the training process.

Prospects for further research. Comprehensive examinations of the psychophysiological and functional characteristics of the body of athletes-rowers will allow the creation of methods for assessing the prospect of athletes in their chosen sport.

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Results of using professional motor test in the program of physical rehabilitation of football players after injuries of the ankle joint

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Purpose: *improving the results of physical rehabilitation of football players aged 18–24 with intra-articular injuries of the ankle joint at the outpatient stage by optimizing and increasing the effectiveness of the differentiated use of rehabilitation measures that were integrated into the training process.*

Material & Methods: *this work was based on the results of observation of 36 athletes who play football in the clinic of the "MirMajidErslan" Medical Center in Beirut (Lebanon) based on the physical therapy room. Victims of the control group received a set of rehabilitation measures according to the traditional program of physical rehabilitation adopted in this clinic. The victims of the main group were offered a set of rehabilitation measures of the program developed by us, which included the use of therapeutic gymnastics integrated into the training process, the use of modified ethnic Arabic bath procedures and the consistent use of procedures with elements of ethnic Arabic massage.*

Results: *analysis of the results of physical rehabilitation showed that with a positive dynamics of changes in the functional status of the victims of both clinical groups, more pronounced and significantly better results were obtained from the victims of the main group, who underwent physical rehabilitation according to our proposed program.*

Conclusions: *the proposed program of physical rehabilitation of injured athletes after internal articular injuries of the ankle at the outpatient stage, which is included in the training process, is effective and can be recommended for general use.*

Keywords: *ankle joint, physical rehabilitation, oriental massage, Hammam, outpatient stage.*

Introduction

Among the priority problems of modern sports medicine and physical rehabilitation of athletes is the question of the most effective rehabilitation of athletes of team sports in injuries and diseases of the ankle joint, the quick and full return to them of sports performance. An ankle joint is a complex joint that bears a significant load, especially in sports, and therefore is often prone to traumatic injuries. The complexity of the anatomical structure and the weak security of soft tissues with systematic high loads and frequent traumatic actions lead to the fact that the mechanical strength of its elements is insufficient. Ankle injuries account for up to 15% of all joint injuries, while the main contingent of people with this pathology is people of working age, including athletes [4; 10; 14].

Dislocations and fractures prevail among injuries, the frequency of which reaches 30–50% of all injuries of the ankle joint, and up to 12% among all pathologies of the musculoskeletal system. Damage to the ligamentous-capsular apparatus of the ankle joint is the second most common disease after meniscus pathology and is up to 15% among all injuries of the joints. Internal articular ankle fractures account for 1,5–4,0% of all skeletal bone fractures and 5–7% of all internally articular fractures. Most victims with such injuries need long-term treatment [7; 11; 19].

A significant percentage of disability with open injuries of the ankle joint, which ranges from 9,3% to 17,4%, indicates a number of unresolved issues in the treatment of such injuries [11; 12].

For these reasons, it is advisable to further improve, search for and incorporate into the process of rehabilitation after internal articular injuries of the ankle joint the most progressive and scientifically based technologies. Their use should be complex and provide a differentiated approach to the choice of forms and means depending on the nature of the injuries of both the bone and cartilage structures of the joint and the soft tissues surrounding it [2; 12].

A positive solution to the identified problem can be found only if new rehabilitation technologies are added to the existing traditional methods and approaches, which are promising in terms of optimizing or stimulating reparative processes. The need to return qualified athletes to active training and competitive activities sets high requirements not only for their medical support, but also for the subsequent restoration of their health. At the same time, it is necessary to take into account possible material costs and to have a goal of reducing them, including by improving the complex of rehabilitation measures at all stages, and especially at the outpatient level [10].

The main goal of physical rehabilitation, as an integral part of the medical rehabilitation process, is a complex process of restoring the health, physical condition and working capacity of victims with the use of, for therapeutic and prophylactic purposes, exercise and natural factors [1; 13].
The leading role in such programs is given to modern methods of non-drug therapy, while traditional methods of physical rehabilitation, taking into account the ethnic, historical and cultural characteristics of the lives of victims, are currently not being sufficiently applied.

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Purpose of the study: to improve the results of physical rehabilitation of athletes of game sports (by the example of football) with internal articular injuries of the ankle joint at the outpatient stage by optimizing and increasing the effectiveness of the differentiated use of rehabilitation measures integrated into the training process.

Material and Methods of the research

The study was conducted in the clinic of the Medical Center "Mir Majid Erslan" in Beirut (Lebanon) at the base of the physical rehabilitation office during 2016–2018. The basis of this work was based on the results of observation of 36 athletes involved in football. All injured athletes were male, aged 18 to 24 years.

When conducting complex biological surveys with the participation of athletes, they adhered to the Helsinki Declaration of the World Medical Association on the ethical principles of medical research with human participation as the object of study. The content of maximum test loads and physiological parameters measurement procedures complied with the International Rules and requirements for biomedical research involving human subjects. The persons who were tested were acquainted with the content of tests, measurement procedures and agreed to conduct them.

The injured athletes were divided into two equivalent clinical groups – the main and the control group (18 injured athletes each). In terms of age, manifestations of functional disorders and localization of injuries received, the main and control groups were identical.

The study involved victims with closed injuries of the ankle joint of types A1, A2, C1 and C2 according to the classification AO/ASIF [19].

The duration of injury ranged from 4 to 6 months, while athletes from both clinical groups underwent rehabilitation treatment for the first time. The injured athletes of the main clinical group underwent a course of rehabilitation treatment in parallel with the restoration of the training process.

Victims of the I (control) group received a set of rehabilitation measures according to the traditional program of physical rehabilitation adopted at the clinic of the Medical Center "Mir Majid Erslan".

The victim of the II (main) group was offered a set of rehabilitation measures in accordance with the program developed by us.

The victims of both groups immediately before the rehabilitation treatment and at its completion underwent a primary and repeated examination - 30 days after it began, which made it possible to assess the dynamics of changes in the indicators of the state of the body systems.

To assess the effectiveness of vocational rehabilitation of injured athletes using the traditional and proposed programs, we used a standard motor test from the elements of professional technical and physical training of football players. This test is traditional for the training process of football players of different ages and qualifications, is regularly used in sports teams "Hoops", "Champs", "Adab w Riada", which are part of the sports club "Sporting high" in Beirut.

The digital material obtained during the study was processed using the Statisticafor Windows version 6.0 general-purpose data processing software. The significance of differences between groups (comparison of the average values of the indicator for each group) was determined using Student's criterion (t). The confidence level was adopted 95%.

For the victims of both clinical groups, physio-functional measures were performed for all clinical cases. Each phase corresponds to the weekly protocol of rehabilitation activities according to the schedule (Table 1)

The injured athletes of group I were assigned 3 sessions of magnetic therapy for a week with magnetic induction up to 30 mT. Laser therapy in this phase was used 3 times for all patients, taking into account the type of monochrome radiation to the ankle and reflexogenic zones, but, as a rule, in continuous mode with a power of up to 25 mW for 15–30 seconds each, the total time of the procedure was 3 minutes.
Magnetotherapy was intended for all suffered athletes of group I – 3 sessions (with preliminary characteristics), laser therapy – 3 sessions with identical power. The criteria for the

Table 1

Schedule of rehabilitation activities for victims of the control group

Weekday	Procedure	
	morning	day
Monday	TE	magnetic therapy, laser therapy
Tuesday	TE	therapeutic limb massage
Wednesday	TE	laser therapy, magnetic therapy
Thursday	TE	therapeutic limb massage
Friday	TE	magnetic therapy, laser therapy
Saturday	TE	therapeutic limb massage
Sunday		rest

effectiveness of the rehabilitation measures carried out were: full axial load, correct posture, standing, full active flexion and extension in the ankle joint without resistance, restoration of muscle strength to 80% of the strength of the retro-lateral limb, absence of pain syndrome and edema of the limbs.

The group II victims of the complex of rehabilitation measures were designed according to the program we proposed. It also consisted of a protocol that was implemented on schedule for all phases (Table 2). The program of differentiated use of physical rehabilitation facilities for injured athletes developed by us included the use of therapeutic gymnastics, which was integrated into the training process of athletes, and massage with elements of ethnic Arabic massage using modified ethnic Arabic bath procedures.

An oriental massage was intended for the muscles of the affected limb with an emphasis on activating the blood and lymph flow. Physiotherapeutic procedures were replaced by the appointment of three sessions of an Arabic bath of a mixed type, namely, an oriental bath based on an Arabic with a fixed methodical (technological) sequence.

We used the traditional for the state of Lebanon and the Arabic bath of the mixed type spread on its territory. In contrast to the stereotypical and unconventional for most other countries,

Table 2
Schedule of rehabilitation activities for victims of the main group

Weekday	Procedure
Monday	bath + oriental massage
Tuesday	workouts with integrated therapeutic exercises
Wednesday	bath + oriental massage
Thursday	workouts with integrated therapeutic exercises
Friday	bath + oriental massage
Saturday	workouts with integrated therapeutic exercises
Sunday	relaxation

the use of a Hamam type of bath, with a high content of water vapor in the air and humidity up to 90%, we used the classical Arabic bath according to the eastern type with a "dry" warming room for soaring and humidity not higher by 40%. This made it possible to significantly reduce the load on the cardiovascular and respiratory systems of the victims and made it possible to use this bath procedure more frequently and rhythmically in the course of physical rehabilitation. The criteria for the transition to the next phase of rehabilitation were the same as in the affected athletes of group I.

Results of the research

Under the terms of the standard motor test, the athletes regularly and repeatedly used special technical pedagogical exercises during their sporting careers from the elements of professional technical and physical training of football, so the coaching archives kept data on test results, including shortly before injury to the players, made it possible to compare the objective data to the injury and after the rehabilitation and find out the extent to which the athlete returns to the level of professional technical and power conditions (coordination and physical abilities).

According to the conditions of the motor test, the ball should hit the goal area after a stroke, must be performed in different ways and with different parts of the foot, namely:

– tinner surface of the foot (in the position of pronation of the foot), the kick is performed with the ball lifting into the air, and the ball must fly over the goal line;

– outer surface of the foot (in the supine position of the foot) kick is performed with the ball lifting into the air, and the ball must fly over the goal line;

– by bridge of the foot (in the position of bending of the foot) the kick is performed with the ball rolling on the lawn, while the ball should roll over the goal line.

The athlete was given 12 attempts to hit the ball. It was considered the number of hits in the goal area with the observance of the conditions for striking the ball from the center of the penalty line (16 m distance).

An excellent result was considered to hit from 11 to 12 times; good result was hit from 8 to 10 times satisfactory – hit from 5 to 7 times, and unsatisfactory – number of hits, less than 5 (Table 3).
Analysis of the archival test data from the impact on the inner surface of the foot in I (control) group showed that 83% of the athletes had excellent marks, 11% had good marks and only 5% had a satisfactory mark. After the measures of physical rehabilitation in the same test, excellent, satisfactory and unsatisfactory results were equally divided by 33%. That is, the number of excellent results decreased almost 2,5 times, and the number of good and satisfactory increased 3 and 6 times, respectively. There were no unsatisfactory results both before and after the injury.

The obtained data from the test results with the impact of the foot's outer surface in I (control) group found the following. Before injury, 77% had a great result, 11% were good and 16% had a satisfactory score. There were no unsatisfactory results.

According to the results of the data obtained after the physical rehabilitation measures in the same test, 22% had an excellent estimate (the number was reduced by 3,5 times), 33% had a good and satisfactory score (an increase of 3 and 2 times respectively) and 11% were unsatisfactory evaluation.

The analysis of the test results from the impact of lifting the foot showed that according to the results of archival data in this test, 72% had excellent marks, 16% each had good and satisfactory ratings.

After the physical rehabilitation measures taken in this test, the number of excellent marks decreased 6,5 times, while the number of good and satisfactory marks significantly and evenly increased 1,3 and 1,6 times, respectively. In addition, there were unsatisfactory marks for this test (16%), which were absent to the injury.

Analysis of the test with the impact of the inner surface of the foot in group II (main) showed that, according to the results of archival data, there were 77% excellent marks, 11% good and as many satisfactory results.

After carrying out the proposed measures of physical rehabilitation in this test, 55% of excellent results were found (a decrease of 1,4 times) and 44% of good results, which is 4 times more than the archived data.

According to archival data, athletes of the II (main) group for injury in the test from hitting the outer surface of the foot revealed 77% excellent results, 16% good and 11% satisfactory.

The activities of physical rehabilitation allowed to get 50% excellent marks (1,5 times less), 44% good (2,6 times more) and only 5% satisfactory results, half the archival data.

The results of the archival test data with a kick of the foot include 66% excellent results, 11% good and 22% satisfactory results.

The results obtained after the physical rehabilitation measures taken in this test showed that the number of excellent marks decreased by half, but the number of good marks increased 3,5 times and the number of satisfactory ones slightly increased (1,2 times). Unsatisfactory ratings were not found at all.

Conclusions / Discussion

It is undeniable that one of the topical problems of modern

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Table 3

The results of the pedagogical motor test of affected athletes of both clinical groups

Kick the ball in the Gate area with parts of the foot		Control group								Main group							
		Excellent		Good		Satisfactory		Unsatisfactorily		Excellent		Good		Satisfactory		Unsatisfactorily	
		abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%
Inner surface of the foot	Before injury	15	83	2	11	1	5	–	–	14	77	2	11	2	11	–	–
	After rehabilit.	6	33	6	33	6	33	–	–	10	55	8	44	–	–	–	–
Outer surface of the foot	Before injury	14	77	2	11	3	16	–	–	14	77	3	16	2	11	–	–
	After rehabilit.	4	22	6	33	6	33	2	11	9	50	8	44	1	5	–	–
Bridge of the foot	Before injury	13	72	3	16	3	16	–	–	12	66	2	11	4	22	–	–
	After rehabilit.	2	11	4	22	5	27	3	16	6	33	7	39	5	27	–	–
Total		18				100%				18				100%			

sports medicine and physical rehabilitation of athletes is as much as possible and, at the same time, as soon as possible and full-fledged return of their sports performance.

There is no doubt that the ankle joint carries a significant amount of exercise in sports and is therefore often prone to traumatic injury. As is known, damage to the ankle joint capsule is prevalent in second place after the meniscus pathology and accounts for up to 15% among all injuries to the joints, and for the majority of victims with such injuries, long-term treatment is required.

In this case, it is advisable to argue only on the choice of treatment tactics depending on the nature of the injuries of both the bone and cartilage structures of the joint, and the soft tissues surrounding it.

This problem can find a positive solution only if new treatment technologies that are promising in terms of optimization or stimulation of reparative processes are added to existing traditional methods and approaches.

The need to return qualified athletes to active training and competitive activities sets high demands not only on their medical support, but also on the early restoration of their professional conditions. To solve this problem, the author of the article developed and put into practice the program of physical rehabilitation, which, due to the improvement of the complex of rehabilitation measures, was logistically included in the training process.

The analysis of the results of the study suggests that with a positive dynamics of changes in the functional state of the victims of both clinical groups are more pronounced and significantly better results were obtained in victims of the II (main) group who received physical rehabilitation according to our proposed program using the integrated training process of therapeutic gymnastics, procedures of a modified ethnic Arabic bath and consistent use procedures with elements of ethnic Arabic massage.

Also in the affected II (main) group, indicators of the applied methods and scales for evaluating the results in the same observation period were found to be significantly better than the control group, indicating not only the effect obtained, but also a pronounced positive trend in the condition of the affected athletes after the program of complex application physical rehabilitation.

Using the course of physical rehabilitation according to the traditional program in the control group, according to the standard motor test of the elements of professional technical and physical training of football players, allowed to objectively reduce the number of unsatisfactory and satisfactory results and increase the number of good ones.

Using the course of physical rehabilitation according to the traditional program, according to the standard motor test from the elements of professional technical and physical training of football players, allowed the athletes of the main group to receive reliably more good and satisfactory results in the absence of unsatisfactory, which convincingly shows the benefits of the proposed program of physical rehabilitation.

The proposed program of physical rehabilitation of injured athletes after internally articular injuries of the ankle at the outpatient stage, which is included in the training process, is effective and can be recommended for general use.

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Motivational-emotional and cognitive factors of sports preparedness of young basketball players

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Purpose: *to establish the degree of influence of motivational-emotional and cognitive factors on the athletic preparedness of young basketball players, taking into account the exercise of the dominant and subdominant hands.*

Material & Methods: *young basketball players of 12–13 years old were investigated. They carried out testing of physical and technical readiness, determined motivation, personal and situational anxiety, stress resistance, memory, attention, and also the effectiveness of competitive activity.*

Results: *data of physical and technical readiness, competitive activity, cognitive abilities and motivational-emotional state of young basketball players of 12–13 years of preliminary basic training were analyzed and the factors correlated. A significant amount of reliable links of sports readiness with the level of spatial-visual memory and anxiety is shown. Significantly less links of sports preparedness with the level of motivation and resistance to stress.*

Conclusions: *it has been established that improving the athletic fitness of young basketball players aged 12–13 years can be influenced by increased motivation to achieve success, an increase in the level of spatial-visual memory, and a decrease in the level of situational and personal anxiety. At the same time, to improve technical mastery and increase the efficiency of competitive activity, the stress level of young athletes is of little importance.*

Keywords: *young basketball players, sports preparedness, motivation, stress resistance, memory, attention.*

Introduction

The effectiveness of managing the training of athletes is determined by the leading factors that significantly affect athletic fitness [19; 20]. Of particular importance to the factors in the process of technical training of young athletes, in particular, in basketball [4; 10], where the formation of skill occurs in rapidly changing game situations. Among a number of factors, the most significant are psycho-physiological [10; 20], the degree of influence of which is determined by the age and individual characteristics of young basketball players [22].

Considering recent studies, the study of the psycho-physiological functions of athletes is widely represented by various aspects, one of which is cognitive abilities [8; 14; 19; 23], especially attention and memory, which, in the process of improving motor actions, make it possible to single out the details of technology [7]. No less important is the study of the motivation of athletes [2; 18; 16; 25; 27], which provides technical activity of a certain direction [12; 26]. At the same time, the psychological stability of players is no less important, since high emotional tension in sports games can affect the implementation of technical skills [3; 21; 24], especially in competitive conditions [6; 15; 20].

Analyzing the work in this direction, it can be stated that most of the work concerns the contingent of qualified athletes [14; 21; 25; 27], including basketball players [2; 8; 16; 18; 28]. However, there are works with the study of the links of sports preparedness and psycho-physiological functions in groups of young basketball players. In the consideration of our problem, the studies of V. M. Koryagin and A. S. Blavt [10] with the definition of the factor matrix of significant coefficients in different age groups, where the factor of technical readiness and sensorimotor gains significance for the age period of 12–13 years, are interesting. However, more detailed data on the degree of influence of other psycho-physiological abilities on the level of technical skill has been revealed.

Also interesting are the works of Niu Yunfei [20], in which the factors of the game activity of young basketball players are considered, where technical readiness and time perception are the most famous. However, the influence of other psycho-physiological factors on athletic fitness is demonstrated.

Consideration of psychological factors affecting the increase in the level of competitive activity of young basketball players was made by A. Rovny and V. Pasko [26]. The authors present correlations of the accuracy of the performance of techniques with cognitive, sensorimotor abilities and properties of the nervous system. The data presented in the work of A. Rovny and V. Pasko could be supplemented with the correlation of technical mastery with the motivational-emotional component.

Most studies of the technical skill of basketball players are related to the determination of the level and interrelationships of athletes' preparedness when performing techniques with the dominant hand. As I. V. Aksarin, I. Y. Aksarina, B. P. Yakovlev [1] notes, in order to increase the efficiency of the training process, it is important to have information about additional reserves, which consist in the correct use of the subdominant hand. The authors prove the importance of motor asymmetry indicators for the technical improvement of young basketball players, but do not provide data on the influence of factors on the formation of skills in both the dominant and subdominant

hands.

Given the above it can be stated that the literature found insufficient data to characterize the factors of efficiency of sports readiness of young basketball players.

Purpose of the study: to establish the degree of influence of motivational-emotional and cognitive factors on the athletic preparedness of young basketball players, taking into account the exercise of the dominant and subdominant hands.

Material and Methods of the research

Participants in the study were 35 basketball players 12–13 years old. At the time of the study, young basketball players had a training experience of 4–5 years. All athletes at the time of the study were healthy. Young basketball players are informed about the purpose of the study, after which they gave an informational consent to participate in them and confirmed their consent to use the generated data.

For the study of physical and technical fitness, tests were used (shuttle run 3x10 m, passes in pairs of two balls in the amount of accurate passess by the right and left hands, a complex exercise with a stroke of chips and rolls on the time of execution and accuracy of hits in the ring with the right and left hands, the ball on the distance 15 m with the turn of the right and left hands. To study the motivation-emotional state, the blank methods were used: A. A. Rean's questionnaire (the motivation for success and avoidance of failures was studied) [13]; Ch. D. Spielberger's questionnaire for determining the level of personal and situational anxiety [11]; questionnaire "Interpretation of stress symptoms" to determine stress resistance [5]. For the study of cognitive functions, the "Number Arrangement" technique (evaluation of voluntary attention) [11] and a test for determining spatial visual memory [11] were used. The effectiveness of competitive activity was determined by the coefficient taking into account competitive activity.

Participants' studies were conducted on a day-to-day basis from training and training. Testing with a shuttle run of 3x10 m was carried out on a specially prepared site with marking and equipment (cubes). One attempt was made without regard to the result and one test attempt. Before testing technical fitness, young basketball players reported information about the dominant hand, and they were introduced to the task for each exercise just before they were completed. Each participant made two attempts to pass a practical test without taking into account the result, performing left and right hand exercises, the result of which was not counted, and then two attempts were made based on the test result. The research on blank methods was carried out in the audience, limiting the influence of external factors on the condition of athletes. The participants were located at a certain distance from each other to prevent the influence of other athletes on the choice of answer options. To determine the effectiveness of competitive activities, pedagogical observations were conducted in 20 games with the participation of the contingent under study.

The results of the study of each participant were determined as follows:
– in determining the motivation for each correct answer, one point was awarded and the total number of points was calculated, while indicators from 1 to 7 points are diagnosed as a motivation for avoiding failures, 8–9 points – a tendency for motivation to avoid failures, 10–11 points – the type is not defined motivation; 12–13 points – a tendency to motivation to achieve success, and from 14 to 20 points – diagnosed as a motivation to achieve success;

– in defining anxiety, the points were summed by the key of answers: situational anxiety – from the sum of points by (3; 4; 6; 7; 9; 12; 13; 14; 17; 18) subtract the sum of points by (1; 2; 5; 8; 10; 11; 15; 16; 19; 20), then add 50 to the result, i.e. CA=(3; 4; 6; 7; 9; 12; 13; 14; 17; 18) – (1; 2; 5; 8; 10; 11; 15; 16; 19; 20); personal anxiety – from the sum of points by (2; 3; 4; 5; 8; 11; 12; 14; 15; 11; 17; 18; 20) subtract the amount of points by (1; 6; 7; 10; 13; 16; 19), then to the result obtained add 35, that is, PA = (2; 3; 4; 5; 8; 11; 12; 14; 15; 11; 17; 18; 20) – (1; 6; 7; 10; 13; 16; 19)·35. It was taken into account that the lower the sum of points, the lower the level of anxiety, and vice versa;

– in determining stress resistance, the total number of points for answering questions was calculated. In this case, the lower the score, the higher the level of stress resistance and vice versa;

– for the evaluation of voluntary attention, the total number of placed numbers (P), the number of missing numbers (M) and the task execution time (T) were calculated. The indicator of attention distribution is calculated: AD = (P–M):T. At the same time, the higher the distribution index of attention, the better the person's ability to control several objects or phenomena simultaneously;

– to determine the spatial visual memory, the sum of the points for the accuracy of the figures was calculated. The higher the score, the higher the level of spatial visual memory.

When analyzing the performance data of competitive activities of young basketball players, the coefficient was determined by the integral index EFF, which is used in the NBA [9]:

$$EFF=4,8x(X_1x0,78+X_2x0,52+X_3x0,15+X_4x0,68+X_5x0,73+X_6x 0,32+X_7x0,84+X_8x0,63+X_9x0,26+X_{10}x0,94+X_{11}x 0,98+X_{12}x0,89+X_{13}x0,47+X_{14}x0,42+X_{15}x0,36+X_{16}x0,21+ X_{17}x0,05+X_{18}x0,10+X_{19}x0,57),$$

where EFF – efficiency index; X_1 total% of throws in the game; X_2 – 2-point throws, hit; X_3 – 2-point throws, attempts; X_4 – 2-point throws %; X_5 – 3-point throws, hit X_6 – 3-point throws, attempts; X_7 – 3-point throws %; X_8 – free throws, hit; X_9 – free throws, attempts; X_{10} – free throws%; X_{11} – assists; X_{12} – catching the ball; X_{13} – selection in defense; X_{14} - selection in the attack; X_{15} – selection, amount; X_{16} – loss of the ball; X_{17} – block shot; X_{18} – fouls; X_{19} – total points.

All experimental data obtained were processed using Excel. The arithmetic mean and the standard deviation were determined. The significance level is set at 0,05. The correlation, or the relationship between the two quantities, was established by logical reasoning, and the correlation analysis was used to determine the magnitude of the relationship and its nature.

Results of the research

Correlation analysis of the motivational-emotional state and cognitive functions of basketball players aged 12–13 years showed that the level of development of the spatial-visual

Frolova, L., Tymofeev, A. & Khomenko, I. (2019), "Motivational-emotional and cognitive factors of sports preparedness of young basketball players", *Slobozhanskyi Herald of Science and Sport*, Vol. 7 No. 2(70), pp. 20-25, doi: 10.5281/zenodo.3066840

memory of young athletes is significantly influenced by both motivation (r=0,40) and stress tolerance (r=0,56) and situational and personal anxiety (r=–0,54; r=–0,37) (Table 1).

Revealed a moderate degree of dependence of spatial-visual memory with personal anxiety and motivation. Relationships of a significant level of spatial-visual memory are recorded with indicators of stress tolerance and situational anxiety. At the same time, the tendencies towards enhancing the motivation for success and reducing the level of stress tolerance significantly influence the growth of indicators of spatial-visual memory. However, the level of spatial-visual memory may decrease with increasing levels of situational and personal anxiety.

Also obtained correlations of the average degree of dependence of motivation and voluntary attention (r=0,45). With increased motivation to achieve success, the level of voluntary attention can significantly increase. Interdependencies were also found between indicators of stress tolerance and voluntary attention, but at the level of large connections (r=0,53). Increased stress tolerance can affect a significant increase in the voluntary attention of young athletes.

The analysis of sports readiness and cognitive functions of young basketball players aged 12–13 years found significant correlations of different strengths (Table 2).

Indicators of physical prepadness, in this case, manifestations of dexterity, correlate only with indicators of spatial-visual memory at the level of moderate connections (r=–0,34). That is, the higher the levels of development of spatial-visual memory, the faster the young basketball players are oriented toward a distance.

Indicators of technical readiness can significantly depend on both spatial-visual memory and voluntary attention. The spatial-visual memory at a significant level can affect the time for performing a complex exercise with a dominant hand (r=–0,65). In this case, the higher the level of memory development, the faster the young athletes will perform the exercise.

Spatial-visual memory at a moderate level can affect the accuracy of passess with a dominant hand (r=0,37), the time for performing an complex exercise (r=–0,31), the accuracy of throws (r=0,34) and the dribbling (r=–0,34) subdominant hand.

Indicators of voluntary attention correlate with the indicators of passess by the dominant and subdominant hands (r=0,51; r=0,43) and with the indicators of the time for performing a complex exercise with the subdominant hand (r=–0,35).

It was also revealed that the effectiveness of competitive activity can significantly depend on the development of spatial-visual memory at the level of moderate connections (r=0,46). The higher the possibilities of spatial memory, the more efficient the competitive activities of young basketball players can be.

The correlation of sports preparedness and the motivational-emotional state of young basketball players aged 12–13 pointed to the presence of a significant amount of interdependence (Table 3).

Considering the interdependence of physical fitness (manifestations of dexterity) with the motivational-emotional state, one can point out that only the level of stress resistance can significantly affect the rapid and accurate orientation of young athletes as they pass the distance (r=0,55). Moreover, the higher the stress resistance of basketball players, the better the shuttle run.

Taking into account other data, more connections are found between technical preparedness and anxiety. At the same time, there are two times fewer connections of technical pre-

Table 1

Correlation of the motivational-emotional state and cognitive functions of young basketball players 12–13 years old (r)

Factors	Motivation	Stress resistance	Situational anxiety	Personal anxiety
Spatial-visual memory	0,40	0,56	–0,54	–0,37
Random attention	0,45	0,53		

Remark. *Confidence level 95%.*

Table 2

Correlation of sports preparedness and cognitive functions of young basketball players 12–13 years old (r)

Factors	Spatial-visual memory	Voluntary attention
Shuttle run	–0,34	
Passes dominant hand	0,37	0,51
Passes subdominant hand		0,43
Comprehensive exercise dominant hand	–0,65	
Throws into the hoop with a dominant hand		
Comprehensive exercise with subdominant hand	–0,31	–0,35
Throws into the hoop with a subdominant hand	0,34	
Dribbling with the dominant hand		
Dribbling with a subdominant hand	–0,34	
Effectiveness of competitive activity	0,46	

Remark. *Confidence level 95%.*

Table 3

Correlation of sports preparedness and motivational-emotional state of young basketball players 12–13 years old (r)

Factors	Motivation	Stress resistance	Situational anxiety	Personal anxiety
Shuttle run		0,55		
Passes dominant hand		–0,35	–0,40	–0,47
Passes subdominant hand			–0,37	–0,45
Comprehensive exercise dominant hand			0,61	0,52
Throws into the hoop with a dominant hand	0,32	–0,40		–0,40
Comprehensive exercise with subdominant hand				
Throws into the hoop with a subdominant hand			–0,33	–0,33
Dribbling with the dominant hand	–0,36		0,58	0,32
Dribbling with a subdominant hand	–0,50	–0,31	0,50	0,40
Effectiveness of competitive activity	0,44		0,48	0,47

Remark. *Confidence level 95%.*

paredness with motivation and stress tolerance. Strengthening the motivation to achieve the success of young basketball players will significantly affect the accuracy of throws with the dominant hand (r=0,32), as well as the indicators of the dribbling dominant and subdominant hands (r=–0,36; r=–0,50).

A high level of stress tolerance will significantly affect the accuracy of throws and passes with the dominant hand (r=–0,35; –0,40), but will contribute to a decrease in dribbling with the subdominant hand (r=–0,31).

A reduction in the level of situational and personal anxiety can be a factor in the high accuracy of the passes of both dominant (r=–0,40; r=–0,47) and subdominant (r=–0,37; r=–0,45) hands. Also, a low level of situational and personal anxiety significantly contribute to the high accuracy of movements when dribbling withthe dominant (r=0,58; r=0,32) and subdominant (r=0,50; r=0,40) hands.

The performance of a complex exercise situational and personal anxiety can significantly affect the implementation of movements with the dominant hand (r=0,61; r=0,52). At the same time, a low level of anxiety is important for making movements clear and quick.

A low level of situational and personal anxiety can affect the accuracy of throws into the ring with a subdominant hand (r=–0,33), and the accuracy of throws into the hoop with a dominant hand can only be a low level of personality anxiety. (r=–0,40).

In the course of the study it was revealed that the effectiveness of the competitive activity of young basketball players 12–13 years can be influenced by motivational-emotional factors at the level of moderate interdependence. At the same time, the tendency to increase the motivation for success will positively affect the competitive activity of young athletes (r=0,44). But the increase in the level of situational and personality anxiety can be a significant factor in the effectiveness of the competitive activities of basketball players (r=0,48; r=0,47).

Conclusions / Discussion

The study found that with increasing levels of spatial memory and voluntary attention, which play a significant role in shaping the sportsmanship of young basketball players [22], the increased motivation to achieve success [3] can significantly affect. At the same time, a low level of resistance to stress will not affect the weakening of the cognitive functions of young athletes. Although the presence of a high degree of situational and personal anxiety will adversely affect the manifestation of spatial visual memory. Moreover, the competitive activity at this age increases the level of anxiety, which significantly affects the competitive result [24].

Taking into account previous studies, where the indicators of the level of development of agility, in the practice of shuttle run 3x10 m, significantly affect technical preparedness [17], we chose this test to determine the interdependence with psychophysiological factors. Our studies have shown that improving the orientation in space when changing the body position can occur in the conditions of the growth of the level of spatial visual memory when increasing the stress resistance of young basketball players.

Technical readiness, as an important component of sportsmanship, requiring sustained manifestation in competitive activity [26], essentially depends on many factors. The obtained exercise data with a subdominant hand showed that when forming technical skills, as opposed to perfection, it is important to take into account the level of spatial visual memory and voluntary attention, despite the established interdependence of factors. At the same time, the influence of cognitive functions is enhanced when performing a complex exercise with a dominant hand. That is, in the process of improving the combined elements of technology, a significant role is played by the growth of the level of spatial visual memory. It should be noted that the influence of the arbitrary attention on the technical preparation of young basketball players 12–13 years was significantly less than the effect of spatial visual memory. It can be assumed that in this study, other properties of attention, such as stability and concentration, which are associated with the precision of the throwing of young basketball players, become more important [26]. Perhaps in this age period there will be a role and concentration of attention that is already characteristic for skilled basketball players [14].

Research has also shown that in the process of improving the techniques of the game, the motivational-emotional state of young basketball players plays a greater role than in the formation process. This is indicated by a greater number of interconnections between the motivational-emotional state and the performance indicators of the transmissions and the

Frolova, L., Tymofeev, A. & Khomenko, I. (2019), "Motivational-emotional and cognitive factors of sports preparedness of young basketball players", *Slobozhanskyi Herald of Science and Sport*, Vol. 7 No. 2(70), pp. 20-25, doi: 10.5281/zenodo.3066840

complex exercise with falling into the ring with a dominant hand, as compared to the subdominant. Of all motivational-emotional factors, the most influence on technical preparedness is carried out by situational and personal anxiety, which is an integral part of the competitive activity of young athletes, taking into account the changing conditions of the game [24]. Our research shows that a low level of anxiety along with an increase in the level of stress tolerance and an increase in the motivation to achieve success can contribute to an increase in the skill level of young basketball players aged 12–13 years in the process of further improvement. It is noticeable that it is the motivation to achieve success with a high level of stress tolerance that can contribute to the formation of high accuracy of the throws.

The conclusions of our study can also be added that the effectiveness of the competitive activity of young basketball players 12–13 years may depend on the level of development of spatial visual memory in strengthening the motivation to achieve success and reduce the level of anxiety.

Prospects for further research in this direction are to use information about the influence of factors on athletic preparedness in developing programs to improve technical and tactical preparedness of young basketball players during the preliminary basic training phase and the implementation of experiments on their implementation..

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Analysis of indicators of physical development of children of senior preschool age

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Children's health is the most valuable asset of every civilized society; it creates the physical, intellectual, spiritual and social foundation of the state. It was established that the deviation of physical development indicators from the age norms of development and the disharmony of development is accompanied by changes in the health status of children.

Purpose: *make an analysis of indicators of the physical development of children 5–6 years.*

Material & Methods: *analysis and synthesis of scientific and methodological literature, Internet resources and educational programs, pedagogical observation, determination of the level of physical development (anthropometry method), index method (Pigne index), methods of mathematical statistics.*

Results: *analysis of anthropometric indicators of length and body weight, chest circumference in boys and girls 5–6 years old allowed us to determine that these indicators in all three gender and age groups correspond to the average level.*

Conclusions: *children 5–6 years old, head circumference are low (<54 cm). Biological age in 50,0% of boys and in 62,1% of girls in I, II and III age groups corresponds to the passport age. The majority of boys 5–6 years old (64,3%) and girls (59,2%) have a harmonious constitution (p>0,05), 35,7% and 40,8% of children have a disharmony in development, respectively. According to the Pigne index, in children of 5–6 years old, in all three age groups, normostenic (5,2%) and asthenic (94,8%) body types are observed.*

Keywords: *children 5–6 years of age, physical development, biological age, body harmony, preschoolers.*

Introduction

Children's health is the most valuable asset of every civilized society; it creates the physical, intellectual, spiritual and social foundation of the state. The physical health of a child is such a state of his body when the indicators of the main physiological systems are within the normal range and adequately change in the process of its interaction with the environment, the harmonious interaction of all organs and systems, their dynamics and balance [6].

Indicators of physical development are important parameters of health. Physical development is the process of changing the forms and functions of the human body during its individual life, characterized by a set of features that determine the external indicators of the physical condition of the body at a certain stage of its development (A. Sabirov, V. Pantic, G. Gatz, 2016).

According to G. S. Nikiforov (2006), physical development in general form is a state of the human body, which is characterized by the possibilities of adaptation to various environmental factors, the level of physical development, physical and functional readiness of the body to perform physical activities [14]. B. H. Landa (2017) believes that the path to health begins with its diagnosis, measurement of quantitative and qualitative indicators [3; 12].

In the scientific works of V. I. Fedorenko (2015) it was found that deviations of physical development indicators from age norms of development and disharmony are accompanied by changes in the health status of children: the greater the disruption in physical development, the greater the likelihood of illness [19]. Children who have a harmonious physical development by age are considered the least vulnerable. But almost a third of children have marked deviations in their health status, which are associated with a violation of the pace of age development under harmonious status (V. Pasechnik, G. L. Petrina, 2017 [15], I. G. Bondar, 2014 [2]).

Modern views on the need to study the physical development of preschool children are considered in a number of scientific studies (B. K. Assessing, 2004 [1]; Yu. M. Shevchenko, S. M. Dubyaga 2009; D. Chayka, N. V. Moskalenko, 2012; N. V. Moskalenko, A. V. Polyakova, J. Kovrov, 2013 [13], V. A. Druz, G. P. Artemyeva, N. V. Nechitailo, 2014, S. Zamrozevich-Shadrina, 2014 G. Petrenko , 2015 [16], V. I. Fedorenko, L. N. Kitsula, 2015; I. Vovchenko, 2016 [5]; K. A. Slabinskaya, M. A. Mameshina, 2017 [17], S. P. Duditska, 2017 [8]). Scientists note a tendency to reduce the level of physical development of preschoolers, which is due to the fact that children of senior preschool age have a high need for physical activity and cannot always realize it at the proper level. It should be borne in mind that the independent physical activity of children 5–6 years old in the conditions of preschool education institutions is increasingly limited to an increase in the duration of studies with a static posture and an increase in children's interest in computer technologies (A. Bohinich, 2007; M. A. Runova, 2007). This leads to the search for new approaches to the use of physical education in the educational process of children of senior preschool age, taking into account their level of physical development and somatic health.

Purpose of the study: make an analysis of indicators of the physical development of children 5–6 years.

Material and Methods of the research

Studies were conducted in the educational complex number 28 and the institution of preschool education number 337, the Dnieper. The study involved 135 children 5–6 years old, of whom 67 (49%) are girls and 68 (51%) boys. The children were divided by gender and into three age groups [4] 5 years, 5,6 and 6 years (Table 1).

Research methods: analysis and synthesis of scientific and methodological literature, Internet resources and educational programs, pedagogical observation, determination of the level of physical development, index method (Pigne index), methods of mathematical statistics.

Results of the research

Physical development is a complex of morphofunctional traits characterizing the age level of a child's biological development. The physical development of preschool children, along with the disease, is one of the most important indicators of the health of the child population (T. Yu. Krucevich, 2011 [11]; E. S. Vilchkovsky, N. F. Denisenko, 2011 [4]). To determine the level of physical development, we used indicators: body length, body mass, chest circumference (CC) (according to E. S. Vilchkovsky, N. F. Deniseko, 2011), head circumference (HC) (according to N. A. Tupchiy, 2001) and the Pigne Index (according to M. V. Chernorutsky). The results were compared with regulatory [4; 10; 18; 20].

One of the most stable indicators of physical development is body length, since it has the least impact on the environment. This is a peculiar indicator of not only the process of human growth at certain age stages, but also the level of maturity of children (A. D. Dubogai, 1991, V. Pasechnik, 2017 [15]). According to the studies of the body length of girls and the age group, the average is 109,23±6,49 cm, II age group – 112,95±6 cm, Group III – 116,19±4,32 cm. Significant difference between the results and There are no groups II and III ($p>0,05$). The difference between the maximum and minimum indicators of body length in girls 5–6 years is reduced, that is, there is a slowdown in the growth of body length.

The body weight of a child depends on the influence of various factors, on lifestyle and on environmental effects (V. P. Murza, 2001, V. Pasechnik, 2017). The average body mass of girls and the age group was 17,92±2,13 kg, Group II – 17,50±2,42 kg, Group III – 18,06±2,62 kg. Comparing the indicators of the body mass of girls between the I, II and III age groups, it can be noted that there are no significant differences ($p>0,05$). The difference between the maximum and minimum value in terms of body mass of girls 5–6 years old is 3–5 kg, which is natural.

The chest circumference indicators in girls I, II and III age groups correspond to the age norm (53–62 cm). There are no significant differences between the groups ($p>0,05$). We compared the results of measuring the head circumference with the average for this age group [18]. The study found that most girls (95%) have a low level (<54 cm).

The study of the physical development of boys 5–6 years old showed that the average length of the body in the I age group is 110±4,38 cm, in the second age group – 115,11±3,88 cm, in group III – 117,04±4,87 cm. A significant difference between the results is observed in boys I and II age groups ($p<0,05$). There are no significant differences in indicators of body length between age groups II and III ($p>0,05$). The difference between the maximum and minimum indicators of body length in boys 5–6 years old decreases, that is, there is a slowdown in the growth rate of body length.

In boys I, II and III age groups, according to body weight studies, the average index is approximately the same 18,52±2,22 kg. Significant differences between these age groups are not observed ($p>0,05$). Tracing the indicators of the third age group, it can be noted that the maximum indicator was 25 kg, and the minimum – 15 kg, with a difference between the indicators of 10 kg. There is no significant difference between the indicators of body weight of boys II and III age groups ($p>0,05$). In terms of body mass indicators of boys of all three age groups, the difference between the maximum and minimum values is about 6–10 kg, which is natural and individual in the development of each child.

The average chest circumference in boys of all ages, compared with standard values, are at an average level (54–52 cm). The head circumference indicators of boys is low (<54 cm).

The average indicators of the body length of boys and girls and the age group have no significant differences ($p>0,05$). But there are significant differences in I and III age groups between the maximum values of girls and boys ($p<0,05$). As the age of children increases, the difference between maximum and minimum values in I, II and III age groups between boys and girls decreases, which indicate a slowdown in growth.

When comparing the average body weight of girls and boys of all three age groups, there is a difference of ±1–2 kg, this is due to the different growth rates of children. There is no significant difference between the chest circumference of boys and girls ($p>0,05$).

The distribution of boys of the I, II and III age groups by levels of physical development showed that the majority of boys I (52,6%) and III (73,9%) age groups have an average growth rate in body length. Almost ⅓ boys of the II age group (38,9%) have an average level of indicators of body length. The aver-

Table 1

Distribution of children by age groups

No. i/o	Sex of the child	Age groups of children (%)					
		I group (5 years)		II group (5,5 years)		III group (6 years)	
		Age range	%	Age range	%	Age range	%
1.	Girls	4,9–5,2	38,8	5,3–5,8	23,9	5,9–6,2	23,9
2.	Boys		27,9		26,5		33,8

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age and high levels were observed in 61,1% of boys.

In terms of body weight, 42,1% of boys of the I age group have an average level, 26,4% – low and below average. 31,6% of boys of 5 years have above average and high levels. Most boys of the II age group (61,6%) have an average level, and 33,3% have a low and below average. More than half of children in age group III (69,5%) have a low and below average level in terms of body weight.

In terms of chest circumference, the average level is observed in boys of the II (77,8%) and III (65,2%) age groups. In 31,6% of boys and age groups were low and below the average level of CC, the average level – in 47,4% and above average and high – in 21.0% of children. In terms of head circumference, most boys I (94,7%), II (83,3%) and III (87,0%) of the age groups have a low level.

The distribution of girls 5–6 years by levels of physical development showed that the indicators of body length almost half of girls I (50,0%), II (50,0%) and III (56,3%) of age groups are on average. Body mass indexes for most girls in the 1st and 2nd age groups are also on average (61,5% and 66,7% respectively). In the second age group, 37,5% of the girls have an average level and 50,1% are below the average and low body mass. In 56,3% of girls 6 years of age, body mass indexes are on average, and 43,8% are low and below average.

More than half of the girls I (65,4%), II (81,3%) and III (81,3%) of the age groups according to CC indicators have an average level. Indicators of the head circumference in most girls I (88,5%), II (93,8%) and III (75,0%) of age groups are at a low level.

The non-parametric (centimetric) method and the tables of the centile distribution of attributes are used for the individual assessment of physical development and harmony of the physical development of children. According to the method, the area of "very low" values ranges from up to 3 cents, "low" values – from 3 to 10 centiles, "below the average" – from 10 to 25 cents, the "average" level – from 25 to 75 centiles, "above average" – from 75 to 90 centiles, "high" values – from 90 to 97 centiles, and the area of "very high" values – above 97 centiles.

If the difference in centile "corridors" between any of the three indicators (body length, body weight, chest circumference) does not exceed one, then we can speak of a harmonious physique, otherwise, a disharmonious one. (E. D. Duca, T. L. Vasilyeva, N. V. Mishina, 2000 [9]).

In the first age group, both boys (57,9%) and girls (65,4%) have a harmonious physique. The disharmony physique – in 42,1% of boys and 34,6% of girls (Table 2). There is a high percentage of boys (72,2%) in the second age group with a harmonious physique, and the majority of girls in this age group (56,3%) show disharmony physique.

Almost the same number of children of the III age group (51,1%) has a harmonious physique, and disharmonious – 47,8% of boys and 50,0% of girls.

The proportionality of the physical development of the body of children 5–6 years old, we determined by the anthropometric coefficient of the Pigne index. If we evaluate it by the method of E. S. Vilchkovsky, then in our study in 17,6% of boys and in 20,9% of girls, proportional physical development is observed (Figure 1). 82,4% of boys and 79,1% of girls have disproportion in physical development.

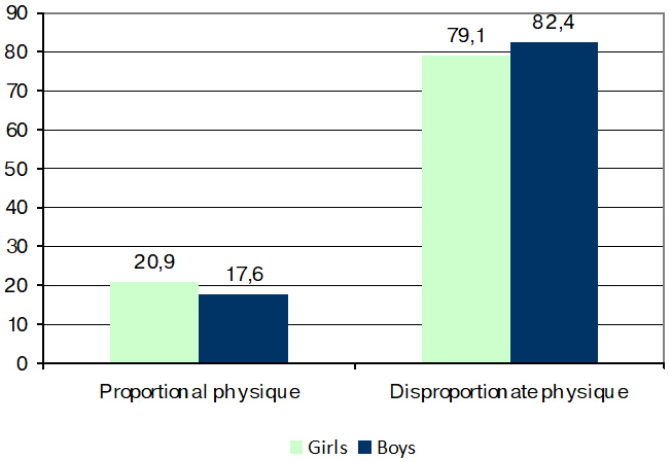

Figure 1. Distribution of children 5–6 years of age according to the Pigne index (according to E. S. Vilchkovsky)

Pigne index estimation according to V. M. Chornorutsky provides a definition of the constitution of the body of children 5–6 years. Thus, in the study, it was possible to distinguish the normostenic type in 5,2% of children and asthenic body type in 94,8% of boys and girls of I, II, and III age groups.

Scientists note [7; 11], determining the biological age in conjunction with the indicators of physical development allows us to more accurately assess the level of functional capabilities of the main systems of the body, increases (A. V. Polyakova, N. V. Moskalenko, 2015). Determining the compliance of biological age with a passport is an important criterion that necessitates the selection of adequate means and methods in planning physical education classes in preschool education institutions (A. V. Polyakova, 2015, T. Yu. Krutsevich, N. I. Vorobev, G. V. Bezverkhnyaya, 2011). The biological age of children 5–6 years old was estimated by the method of N. A. Tupchiy, where the author uses the method of assessing body proportions and the child's height according to gender and age standards [18].

Table 2

Percentage distribution of children 5-6 years old by harmonious physical development

No. i/o	Sex of the child	5 years		5,6 years		6 years	
		HP	DP	HP	DP	HP	DP
1.	Boys	57,9	42,1	72,2	27,8	52,2	47,8
2.	Girls	65,4	34,6	43,7	56,3	50,0	50,0

Remark. *HP – harmonious physique, DP – disharmony physique.*

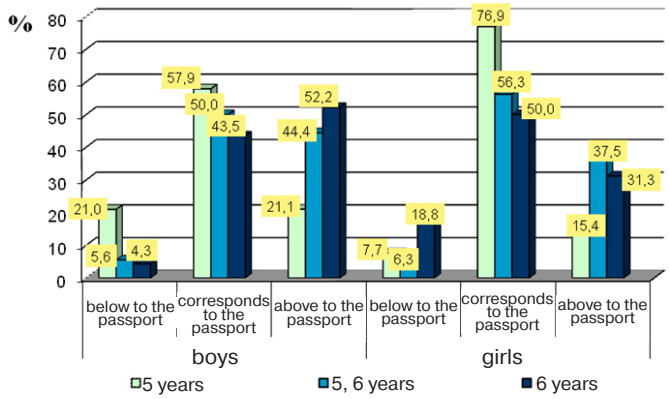

Figure 2. Distribution of children 5–6 years of biological age

Comparing the biological age (according to indications of physical development) with the passport one (Figure 2), one can see the correspondence of the indicators in 57,9% of boys and 76,9% of girls in the first age group.

In the second age group, the biological age corresponds to a passport in 50,0% of boys and 56,3% of girls. In almost half of boys (52,2%) and girls (50,0%) of the age group III, there is a discrepancy between the biological and passport age in the direction of increasing the number of children with a biological age higher than the passport age. Thus, the biological age of 54,8% of children (boys – 30,4%, girls – 24,4%) correspond to the passport age with a tendency to acceleration in 36,3%.

Conclusions / Discussion

Analysis of the results of the study of the physical development of children 5–6 years old showed that in all three age and gender groups anthropometric indicators correspond to the average level. There is no significant difference between the groups according to the student's criterion ($p<0,05$). In most preschoolers, head circumference indicators are low.

Harmonious physique have a 60,0% of children, 40,0% – disharmonious. According to the Pigne index in 19,3% of preschoolers, proportional physical development is observed. Only 5,2% of children have normostenic type of structure of body. Biological age in 54,8% of preschool children corresponds to the passport.

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Features of technical and tactical actions of highly skilled athletes when swimming a distance of 100 meters by front crawl

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Purpose: *to determine the features of technical and tactical actions of highly skilled athletes when swimming a distance of 100 meters by front crawl.*

Material & Methods: *analysis and generalization of literary sources, video filming, timekeeping, methods of mathematical statistics. The contingent of subjects consisted of athletes who specialized in a distance of 100 meters in the way of swimming the front crawl and had the level of sports qualification master of sports of Ukraine, master of sports of international grade.*

Results: *dynamics of indicators of technical and tactical skill among highly skilled athletes during their overcoming the 100 meter distance by front crawl has been investigated; characterized by the variability of technical and tactical actions of highly skilled athletes in different parts of the competition distance of 100 meters; determined the degree of influence of speed, pace and "step" of the cycle of rowing movements on the result of swimming a distance of 100 meters using the front crawl.*

Conclusions: *overcoming the distance of 100 meters by the front crawl has its own specifics, which is reflected in changes in the indicators of technical and tactical master hood; model characteristics of the most influential parameters of technical and tactical actions of highly skilled swimmers can serve as a guideline for improving the training process of athletes depending on their distance specialization.*

Keywords: *front crawl, 100 meters, highly skilled athletes, technical and tactical actions, dynamics, interconnection, model characteristics.*

Introduction

The level of development of modern sports swimming requires specialists to search for ways to improve the training of athletes based on the study of a wide range of different fields, among which a significant role is devoted to the analysis of competitive activities (A. V. Boroday, 1990; A. A. Krasnikov, 1992; L. P. Matveev, 1996; V. N. Platonov, 2004; Kh. A. Sanosyan, 2009).

A systematic and ongoing analysis of the competitive activity of swimmers is an important means of managing the training process, since it is closely connected with various aspects of training – technical, physical, tactical and psychological. Knowledge of its structure, compliance with the functional capabilities and technical and tactical features of an athlete create the necessary prerequisites for achieving the planned result at competitions (V. M. Comotsky, 1986; L. P. Makarenko, 1996; V. A. Parfenov, A. V. Parfenov, L. V. Parfenova, V. A. Shcherbina, 1992; A. A. Pilipko, 2014, A. A. Pilipko, 2017; V. M. Platonov, 2012).

Despite a sufficient amount of accumulated information on the study of competitive activity, over time, the nuances of passing distances of different lengths by athletes of different ages, gender, skill level, determining the individual characteristics of their technical and tactical actions in various swimming methods require more detailed study.

Purpose of the study: to determine the features of technical and tactical actions of highly skilled athletes when swimming a distance of 100 meters by front crawl.

Objectives of the study:

1. Investigate the dynamics of technical and tactical skills of highly qualified athletes in overcoming the 100 meter distance by the front crawl method;
2. To characterize the variability of technical and tactical actions of highly qualified athletes in different parts of the competition distance of 100 meters by the front crawl method;
3. To determine the relationship of indicators of technical and tactical skill of high-class athletes and sports results at a distance of 100 meters using the front crawl method.

Material and Methods of the research

The following methods were used to solve the tasks: analysis and generalization of literary sources, video shooting, timing, methods of mathematical statistics.

The study was conducted at the Ukrainian Championships and Cups in swimming. The contingent of test subjects consisted of athletes who specialized in the distance of 100 meters in the manner of the king on the chest and had a level of sports qualification MSU, MSIG. The total number of surveyed was 16 swimmers.

Results of the research

Competitive outcome in swimming depends on many factors, among which one of the leading places is the ability of the athlete to effectively implement technical and tactical actions in a competitive environment.

The peculiarities of the technical and tactical actions of swim-

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mers of high qualification during the overcoming of the distance of 100 meters in the manner of the king on the chest were determined by the indicators of speed, tempo and "step" of the cycle of comb movements, which were evaluated at the starting segment, the distances, the turning and the finishing segments (Figure 1–3).

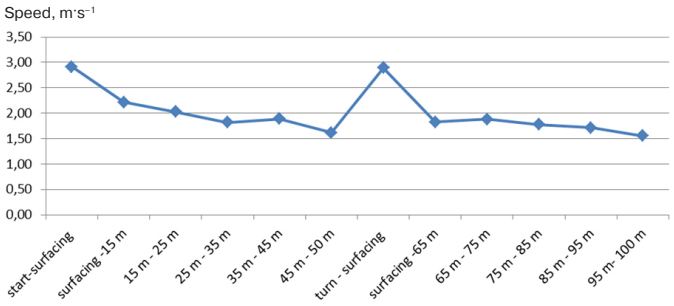

Figure 1. Dynamics of speed indicators during athletes overcoming a distance of 100 meters using a front crawl

As can be seen from Figure 1, the competition distance of 100 meters by the front crawl is overcome by swimmers with a general tendency to decrease in speed in the first half and the relative stabilization of this indicator in the second half of the competition distance.

Athletes demonstrate the highest value of the speed parameter in the "start-surfacing" area (V=2,91 m s^{-1}), which is explained by the inertial acceleration obtained by performing a starting jump and the specificity of swimming movements that are carried out under water.

A further sharp decrease in speed indicators, which occurs to the "35 m" mark, is due to the formation of a coordination structure of movements when overcoming distance segments.

At the "35-45 m" section, there is a slight increase in speed indicators followed by their gradual decrease until the turning shield touches, which is connected with the attempt of the athletes to perform the most rational turn.

A significant surge in speed is observed in the "turn-surfacing" area, which is caused by the fact that swimmers repulse the side of the pool and slide them under water.

The section "65-95 m" is overcome by athletes in an attempt to keep a uniform speed of movement along the distance (its fluctuations occur within 1,56–1,88 m·s^{-1}).

Finishing meters are characterized by the appearance of progressive fatigue, adversely affecting the speed parameters of swimmers.

A significant fluctuation in the pace of rowing movements occurs at the first 50 meters of the competition distance (Figure 2).

The highest rate of pace was recorded in the area of "surfacing – 15 m" (70,52 cycles/min), which is explained by the attempt of athletes to maintain high rates of speed after the start by increasing the frequency of rowing movements.

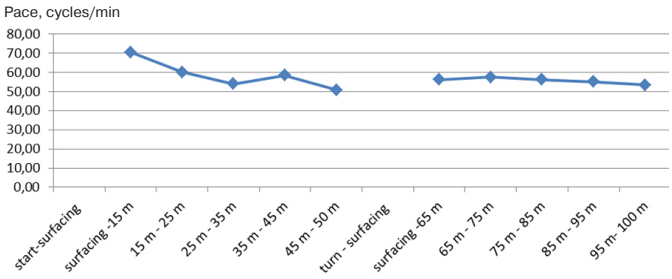

Figure 2. Dynamics of pace indicators of rowing movements during athletes overcoming a distance of 100 meters using a front crawl

Over the next 20 meters, a decrease in pace to the level of 54,03 cycles per minute is observed, followed by a slight increase in this indicator over the next 10 meters.

When swimming up to the turntable, the movements of the athletes slow down, which is explained by the specifics of the turn.

The second half of the distance is overcome by swimmers with a relatively equal frequency of movements.

Such an indicator of technical and tactical skill as the "step" of the stroke movement cycle is the most unstable among sprinter swimmers (Figure 3).

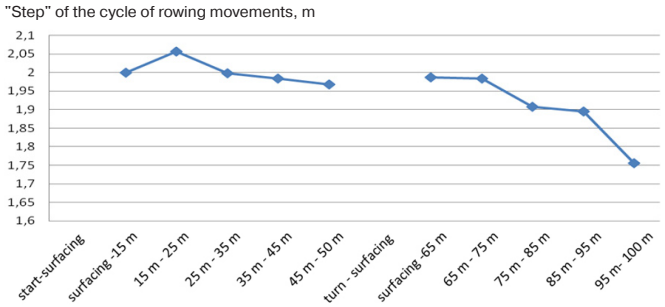

Figure 3. Dynamics of indicators of the "step" of the cycle of rowing movements during the athletes overcoming a distance of 100 meters using a front crawl

If in the first half of the competition distance its changes are relatively insignificant, then the second half of the distance is characterized by a noticeable reduction in the length of the stroke.

The highest rate of "step" of the cycle of stroke movements is fixed at the site "15-25 m" (2,06 m), when athletes perform powerful motor actions at an optimal pace due to the effective repulsion phase.

The rapid shortening of the stroke length, especially in the "75-85 m" and "95-100 m" areas, is explained by the appearance of progressive fatigue, which is reflected in the swimming technique, namely, it provokes such an error as a shortening of the stroke.

Thus, the swimming distance of 100 meters in the way of front crawl has its own specifics, which affects the changes in the indicators of technical and tactical skill.

The analysis of the obtained digital material suggests that, despite the similar picture of the passage of a distance of 100

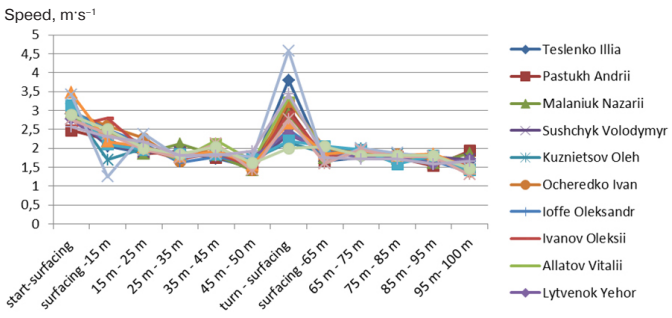

Figure 4. Dynamics of individual indicators of speed in the process of athletes overcoming the distance of 100 meters using a front crawl

meters, in some of its sections the parameters of technical and tactical skills of athletes differ significantly (Figure 4–6).

As can be seen from Figure 4, the most noticeable difference in speed indicators is observed in the sections "surfacing-15 m" and "turn-surfacing" (coefficient of variation is 17,56 and 24,81, respectively).

Significant individual differences in the parameters of the pace of rowing movements are demonstrated by athletes mainly in the first half of the competitive distance (Figure 5).

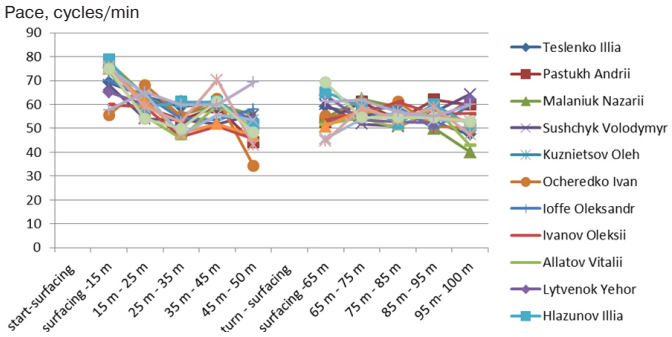

Figure 5. Dynamics of individual indicators of the pace of stroke movements in the process of athletes overcoming the distance of 100 meters using a front crawl

This is especially noticeable during the swim to the rotary shield.

In the second half of the competition distance, the frequency of rowing movements among highly qualified swimmers is noticeably different after the turn and at the finishing meters.

Such an indicator of technical and tactical skill as the "step" of the cycle of rowing movements is characterized by relative stability over the course of overcoming all 100 meters of competitive distance (Figure 6). The only exceptions are individual athletes who have a significant fluctuation in the value of the stroke length parameter (A. Ivanov, I. Ocheredko, N. Malanyuk).

Considering the dynamics of changes in tempo and "step" of the stroke cycle, it can be concluded that the vast majority of athletes are trying to compensate for the shortening of the stroke by increasing the pace of movements. This is especially noticeable at the finishing meters of the distance, when, against the background of progressive fatigue, there is

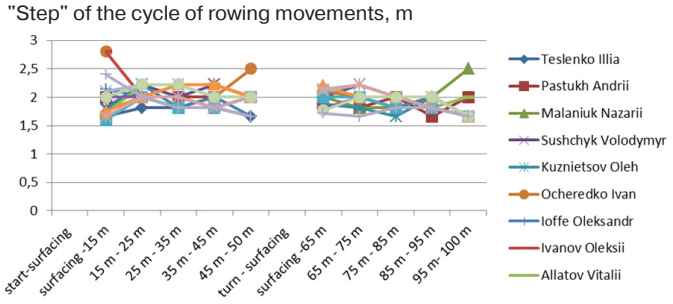

Figure 6. Dynamics of individual indicators of the "step" of the cycle of stroke movements in the process of athletes overcoming a distance of 100 meters using a front crawl

a significant deterioration in the performance of the repulsion phase.

Investigating the degree of influence of technical and tactical indicators on the result of overcoming the competitive distance of 100 meters with a highly qualified fin of the chest crawl method, we determined the parameters that are most important for demonstrating high results at the chosen distance (Figure 7–9).

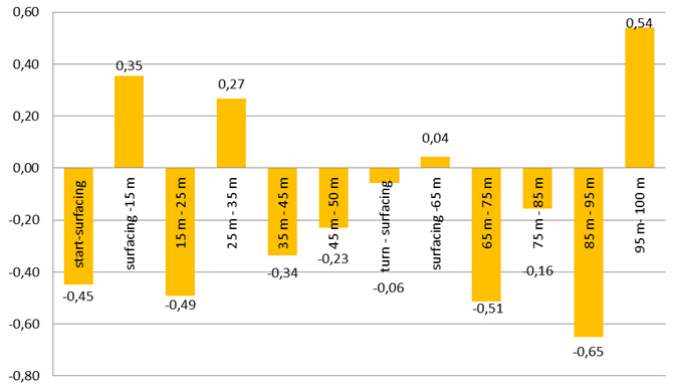

Figure 7. The degree of correlation between the indicators of the speed of swimming of various parts of the competition distance of 100 meters by the front crawl and the final sports result

As can be seen from Figure 7, the speed indicators on the sites are most significantly affected by the parameters: "65 m – 75 m" (R=–0,51), "85 m – 95 m" (R=–0,65) and "95 m – 100 m"(R=0,54).

The average degree of the correlation relationship is traced between the final result and the speed of overcoming by the athletes of the sites "start-surfacing" (R=–0,45) and "15-25 m" (R=–0,49).

The effect of the rate index of the stroke movements is less significant (Figure 8).

The most significant indicators of the "step" of the cycle of the stroke movements were recorded in the sections: "surfacing – 15 m" (R=–0,57) and "surfacing – 65 m" (R=–0,44) (Figure 9).

Having determined the parameters of technical and tactical skill of highly skilled swimmers witch most influence the final

Pilipko, O. (2019), "Features of technical and tactical actions of highly skilled athletes when swimming a distance of 100 meters by front crawl", *Slobozhanskyi Herald of Science and Sport*,Vol. 7 No. 2(70), pp. 31-35, doi: 10.5281/zenodo.2996861

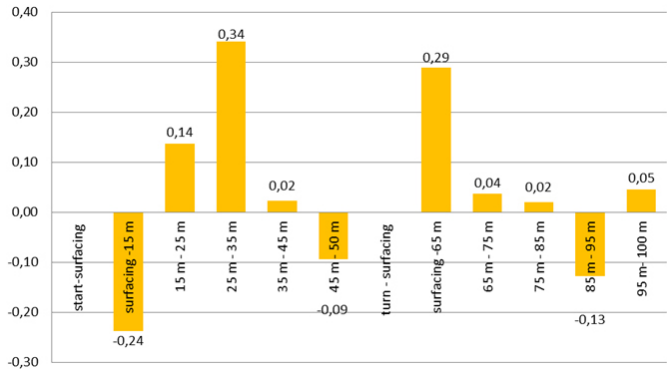

Figure 8. The degree of correlation between the pace indicators of stroke movements when swimming different sections of the competition distance of 100 meters by the front crawl and the final sports result

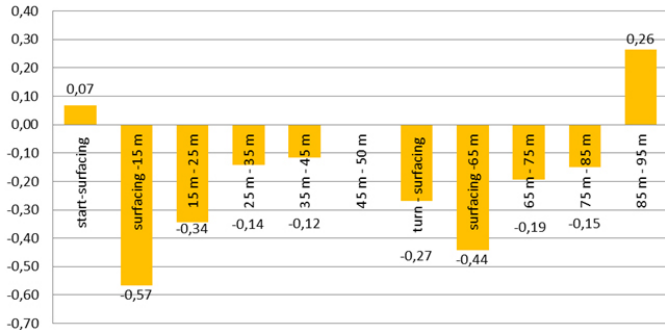

Figure 9. The degree of correlation between the indicators of the "step" of the cycle of stroke movements when swimming different sections of the competition distance of 100 meters using the front crawl and the final sports result

result of overcoming the distance of 100 meters using the crawl on the chest, we developed their model characteristics (Table 1).

The use of model characteristics makes it possible to determine the compliance of the individual parameters of a particular athlete with their subsequent selection of the most effective ways to improve the training process aimed at eliminating deficiencies in the preparedness of a swimmer.

Conclusions / Discussion

The results of the study confirm the opinion of many experts that the competitive result in swimming depends on a number of factors. One of the leading places in this list is occupied by the ability of an athlete to effectively implement technical and tactical actions in a competitive struggle. Having advanced the hypothesis that the techno-tactical actions of swimmers during the overcoming of various competitive distances have their own peculiarities, we have proved that the distance of 100 meters in the way of front crawls is overcome by athletes of high qualification with the general tendency to decrease the indicators of speed and rate of stroke movements on the first half of the distance and their relative stabilization in the second 50 meters. A noticeable shortening of the length of the stroke takes place at the second half of the competitive distance of 100 meters. It was confirmed that the dynamics of technical and tactical skills are related to the level of physical and functional fitness of athletes, as well as due to the individual style of competitive struggle. It was determined that the sporting result at a distance of 100 meters in the way front crawl is under the significant influence of speed indicators swimming segments: "65 m – 75 m" (R=–0,51), "85 m – 95 m" (R=–0,65) and "95 m – 100 m" (R=0,54), as well as the "step" parameter of the stroke movement cycle recorded at the "surfacing – 15 m" section (R=–0,57). It can be argued that the orientation on the model characteristics of the most influential indicators of technical and tactical skill of highly skilled swimmers allows us to improve the training process of athletes, depending on their distance specialization.

Table 1

Model indicators of technical and tactical skill of athletes who specialize in swimming front crawls at a distance of 100 meters

No. i/o	Indicators	Model values
1.	Speed at sections "start - surfacing", m·s^{-1}	2,91
2.	Speed at sections "15 m – 25 m", m·s^{-1}	2,03
3.	Speed at sections "65 m – 75 m", m·s^{-1}	1,88
4.	Speed at sections "85 m – 95 m", m·s^{-1}	1,71
5.	Speed at sections "95 m – 100 m", m·s^{-1}	1,56
6.	"Step" cycle stroke movements at sections "surfacing – 15 m", m	2,00
7.	"Step" cycle stroke movements at sections "surfacing – 65 m", m	1,99

The prospect of further research is to determine the characteristics of technical and tactical actions of highly qualified athletes when swimming distances of 200 and 400 meters using the front crawl.

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Monitoring student performance using computer technology

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Purpose: *to develop a computer program for students of the department of martial arts of KhSAPC, which allows you to monitor and account for their knowledge in the discipline "Theory and methods of the chosen sport" and "Varieties of wrestling".*

Material & Methods: *analysis of scientific and methodological information, computer programming method.*

Results: *analysis of scientific and methodological information confirmed the relevance and significance of the problem of using computer technologies that create conditions where the student becomes an active subject of educational activity interested in achieving the goals of vocational education. The use of computer test programs is a fairly perfect means of monitoring and evaluating knowledge because of its objectivity in analyzing the results obtained. A computer program, CCT (ControlComplexTasks), designed for use in mobile devices, which allows you to quickly evaluate the current and course performance of students of the department of martial arts, was developed. Based on the analysis of teaching materials on the discipline "Theory and methodology of the chosen sport" (specialization "Wrestling", "Judo and Sambo", "Martial Arts") and the general course "Varieties of Wrestling" 520 control and integrated tasks for 1–4 year students of the department of martial arts, consisting of questions and three answers, one of which is correct.*

Conclusions: *a computer program has been developed and introduced into the educational process, which allows monitoring and accounting for the mastering of theoretical knowledge of students of the martial arts department of the KSFC in the discipline "Theory and methodology of the chosen sport" and "Varieties of wrestling".*

Keywords: *students-martial arts, computer program, control, accounting, test tasks.*

Introduction

At the present stage of development of the theory and methodology of sports activities, one of the promising areas for improving the educational process is the use of computer technologies, which allows to create conditions for the transition from a passive to a truly active version of the organization of the learning process, in which a student becomes an active subject of educational activity interested in achieving goals vocational education [1; 2].

For the educational process in the university is characterized by the study of large volumes of scientific information, which is a prerequisite for the preparation of competent specialists. Preparing a specialist who is capable of self-development to participate in innovation activity is impossible using only reproductive teaching methods that involve the elementary transfer of ready-made knowledge to students and reproducing the information received by them [5; 6].

Computer technology provides many opportunities to make complex educational material more accessible for understanding and remembering. All this contributes to the development of the intellectual, creative potential of the student's personality, stimulates the development of critical, analytical thinking, teaches them to work with various sources of information, develops skills for independent knowledge acquisition [4].

In the series of didactic means used in the process of teaching at a higher educational institution, the specific weight is control. The value of control increases due to the reduction in the share of classroom activities in parallel with the increase in students' independent work. Testing and assessing the knowledge and skills of students is an important component of the learning process and is carried out throughout the school year.

At the present stage of development of educational technologies, new forms based on the use of computer technologies are replacing traditional forms of knowledge control: automated testing systems, interactive practical work, reports and abstracts made using presentation technology, etc. [8].

The advantages of using automated testing systems lie in the promptness of obtaining information about students' knowledge, the objectivity of the results obtained, and the possibility of identifying topics and questions poorly mastered by them.

Computer test – a tool that reveals the fact of mastering educational material, consists of a task for the activity of a certain level and standard, that is, a sample of complete and correct performance of actions. Comparison of the student's answer with the standard by the number of correctly performed operations makes it possible to determine the mastery point. When creating computer tests, it is necessary to consider the level of mastering the student for whom the tests are intended [9; 10].

Purpose of the study: to develop a computer program for students of the department of martial arts of KSAPC, which allows you to monitor and account for their knowledge in the discipline "Theory and methods of the chosen sport" and "Varieties of wrestling".

Objectives of the study:

1. To analyze the scientific and methodological information on the use of computer technology in the education system.
2. To systematize the test tasks for the objectivity of the assessment of the theoretical knowledge of martial arts students of KhSAPC.
3. To develop and introduce into the educational process a computer program for monitoring and recording knowledge of students of the department of martial arts of KhSAPC.

Material and Methods of the research

To solve the research problems, the following methods were used: analysis of scientific and methodological information, computer programming method.

Results of the research

Based on the study of scientific and methodological information, it was revealed that the requirements for computer testing technology have been developed at present, which include [7]:

1. The person being tested must be notified of the number of tasks in the test and time constraints.

2. The researcher should be able to perform a demonstration test at least once before beginning the certification test in order to become familiar with the interface of the program and the methods of introducing conclusions.

3. During testing, the test task and controls should be located on the monitor screen.

4. The way to input the output should be simple and convenient. The input entered by the test should be displayed on the monitor screen.

5. Tested person should be able to: confirm the end of the introduction of the answers to the tasks (after confirming the end of the input of the answer is no longer possible to correct it) after the end of testing, immediately review the result of the answers.

Thus, the use of computer test programs is a fairly perfect means of monitoring and evaluating knowledge because of its objectivity in analyzing the results obtained.

Considering all the above, in the 2016–2017 school year, a software computer application "CCT" was developed to monitor the progress of student fighters (implementation act dated November 14, 2016), testing of this program was carried out at the department of martial arts. During the testing, the positive aspects of the program implementation were noted due to: simplicity and intuitiveness of the application interface; efficiency and objectivity of the estimates; increasing students' interest in the process of obtaining professional knowledge in the discipline being studied.

It was also determined the absence of additional features, due to which it would be possible to improve this computer program, namely: setting the time limit for passing the test; formation of a list of questions according to selected content modules; creation of the mode "Express survey"; creating a database on the results of responses; the ability to quickly share a report on the passage of control and complex tasks with students and teachers; the ability to use a computer program on both smartphones and tablet computers. The information that was obtained during the testing led to the development of a new version and methodology for using a computer program. This program took into account the comments, corrected software bugs, improved performance.

The new computer program "CCT" (Control Complex Tasks) is designed for use in mobile devices, allows you to quickly evaluate the current and course progress of students of the department of martial arts.

Based on the analysis of educational material on the discipline "Theory and methodology of the chosen sport" (specialization "Wrestling", "Judo and Sambo", "Martial Arts") and the general course "Varieties of Wrestling" 520 control and complex tasks were selected for students of 1–4 courses of martial arts, which include one question and three answer choices, one of which is correct.

The computer program "CCT" was created for mobile devices running iOS and can be used both on smartphones (iPhone) and on computer tablets (iPad). The block diagram of the computer program is shown in Figure 1.

Fig. 1. Block diagram of the computer program "CCT"

The main screen of the computer program (Figure 2) is simplified as much as possible and allows you to select the required discipline, the number of informative modules, which will allow you to create a list of questions for test tasks, view a database of saved indicators, and configure application settings depending on the tasks of the upcoming testing.

The time allowed for answers to all questions can be chosen in the range from 5 to 20 minutes.

The mode "Express survey" allow you to randomly select a certain number of questions depending on the selected time limit provided for the test. So, when choosing an interval of

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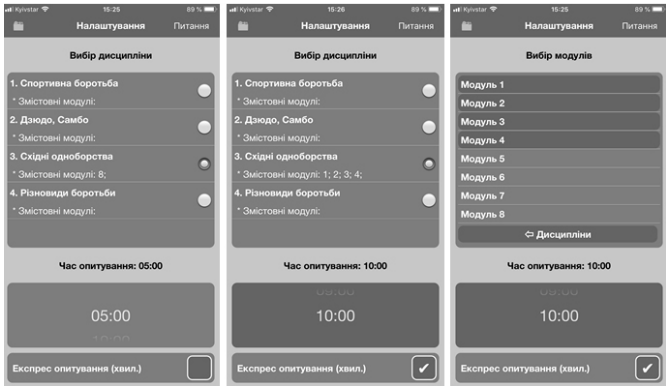

Figure 2. Main screen of the computer program "CCT"

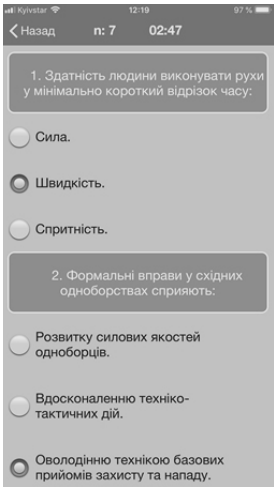

Figure 3. Screen test tasks computer program "CCT"

1 minute, you are asked to answer three questions, with an interval of 2 minutes – 6 questions, 3 minutes – 9 questions, and the like. Formation of a report on the results of the implementation of control and complex tasks in the "Express survey" mode is carried out as in the main mode of operation of a computer program.

On the screen (Figure 3), where the control and complex tasks for the corresponding course are presented, there are such additional features: view all the questions; answer questions in any order; complete the test after all the tasks have been completed if the time limit has not yet been reached.
After the time allotted for answers has expired, the program itself switches to the test results viewing mode and offers to save the established report.

The report on the passage of all control and complex tasks includes: date of passing the test; information about the subject; testing mode (general testing or rapid testing); content modules, on the basis of which test tasks were formed; the number of correct answers; the total number of responses received; test time; the number of points (0–100) ECTS score; national scale assessment; list of questions that were answered incorrectly.
You can also share the established report; send it to an email

Figure 4. Screen "Results" of the computer program "CCT"

address or a method that can be offered by a mobile device, both with the actual test performer and with the teacher leading the discipline (Figure 4).

If the end of the test tasks and the available report are confirmed, it is not possible to return to the previous screen.
On the "Results" screen ("Textbook" tab) there is an opportunity to familiarize yourself with educational and methodological documentation relating to this discipline, and to receive information on problematic issues of educational material.

Thus, the use of computer-aided testing programs in the educational process allows, based on the analysis of students' responses, to adjust the educational process and devote additional time to consider topics for which the student has insufficient knowledge, to shape the dynamics of student performance, to intensify cognitive interest in learning.

Conclusions / Discussion

Analysis of the literature confirmed the relevance and significance of the problem of using computer technologies that create the conditions for turning a student into an active subject of educational activity, is interested in achieving the goals of vocational education.

Selected tests for the evaluation of theoretical knowledge of students of martial arts KhSAPC.

A computer program has been developed and introduced into the educational process, which allows monitoring and accounting of the mastering of knowledge of students of the department of martial arts of the KhSAPC in the discipline "Theory and methodology of the chosen sport" and "Varieties of wrestling".

Prospects for further research will be aimed at expanding the test tasks, and supplementing their methodological support, as well as complementing the SST computer program with the ability to analyze the performance dynamics with a demonstration of the level of learning topics.

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Age features of structural rearrangements of the vertebral motor segment in conditions of limited motor activity

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Purpose: *to study in the age aspect structural changes of the lumbar intervertebral discs and adjacent structures of the spine of rats with limited motor activity to determine the patterns of their restructuring under conditions of experimental hypokinesia.*

Material & Methods: *study was performed in an experiment on male Wistar rats of different ages. The hypokinesia regimen was achieved by keeping animals in small cells, which restricted movement. The research methods included morphometry, macro- and microscopy, standard histology methods with hematoxylin-eosin and picrofuchsin staining according to Van Gieson, as well as statistical analysis of the data were obtained.*

Results: *it is determined that the restriction of mobility contributed to the change of all parts of the vertebral motor segment. The shape and linear dimensions of the intervertebral discs change, the level of its diffuse feeding from the vertebral bodies decreases.*

Conclusions: *it has been established that the absence of mechanical stimulation of intervertebral disks, in the mode of experimental hypokinesia, reduces the level of metabolism in cells, inhibits the processes of adaptive tissue remodeling and contributes to the disruption of intact structures.*

Keywords: *experimental hypokinesia, vertebral motor segment, intervertebral disk.*

Introduction

The state of insufficient motor activity of the body or hypokinesia is an extreme factor in the modern environment. The decrease in motor activity tends to spread due to the introduction of advanced technologies and widespread mechanization and automation, replacing physical labor. There is scientific evidence that in conditions of hypokinesia, which is caused by a sedentary lifestyle of a modern person, the structure of articular and metaphysical cartilages is disturbed (B. A. Nikityuk, B. I. Kogan, 1974; B. I. Kogan, S. I. Lominoga, 1978; V. G. Koveshnikov et al., 1980; I. V. Khrustaleva, B. V. Krishtoforova, 1987; L. A. Vieira et al., 2018). Regarding the intervertebral disc (ID), the complex morpho-functional assessment of its rearrangements under various conditions of hypokinesia still requires its study. The intervertebral disc is the central link in the vertebral motor segment, the lesion of which triggers the dystrophic processes of the adjacent structures of the spine and leads to the development of osteochondrosis (V. G. Kolotusha and others,2005; M. De Christopher et al., 2018; H. N. Fernando et al., 2011).

Among the diseases affecting the vertebral motor segments, degenerative diseases are much more common than neoplasms, inflammatory diseases and developmental pathologies, in connection with which degenerative diseases of the spine become of paramount clinical importance (L. A. Vieira et al., 2018; V. G. Kolotusha and others, 2005; J. Kremer 2013; Hui Li et al., 2017; Justin A. Iorio et al., 2016), including in sports (V. A. Kolesnichenko, V. A. Stroud, 2005; V. N. Levenets, 2002).

In this regard, it is important to clarify the response of the system of ID to various modes of hypokinesia.

Purpose of the study: to study in the age aspect structural changes of the lumbar intervertebral discs and adjacent structures of the spine of rats with limited motor activity to determine the patterns of their restructuring under conditions of experimental hypokinesia.

Material and Methods of the research

The study was performed on male Wistar rats of three age groups: 1, 3 and 12 months of age. Work with laboratory animals was carried out in accordance with the requirements of the "European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes", 1986. A total of 90 animals of the experimental series (ES) and 90 animals of the control series (CS) were observed in the experiments.

The hypokinesia regimen lasted 23 hours a day and was achieved by keeping animals in small cells, which limited their movement. Feeding animals consistent with the standard diet of vivarium.

The research methods included a macroscopic assessment of the state of ID, a study of the vascular bed of the vertebral region, which is bordered by ID, with a filling of blood vessels with ink and gelatin mass, methods of histological, histoenzymological, electronic studies, morphometry, cytophotometry and statistical analysis of the data.

Macro and microscopic studies were performed using a MBR-1 binocular loupe; at the same time, the shape, color,

consistency and degree of preservation of MD were evaluated.

For histological studies, the material was fixed in 10% neutral formalin and was compacted into celloidin after conventional treatment. Sections from tissues 10–12 μm thick were stained with hematoxylin-eosin and pikrofuksin according to Van Gieson.

Histochemical analysis was performed after staging reactions on certain enzymes of the Krebs cycle and glycolysis on frozen sections. The activity of the following enzymes Krebs cycle: malate dehydrogenase (EC 1.1.1.37) (MDH), succinate dehydrogenase (EC 1.3.99.1) (LDH) of glycolytic enzymes – alpha-glycerophosphate dehydrogenase (EC 1.1.1.8) (α-GPDH) and lactate dehydrogenase (EC 1.1.1.27) (LDH) and its isoenzymes.

Enzyme activity was assessed on a two-beam scanning cytospectrophotometer MUF-5. Measurements were carried out using the plug-in method with a working wavelength of 546 nm, a probe diameter of 200 μm and a lens 50 Preliminary study was made of the suitability of the material in photometric works by recording the absorption spectrum on objects of various densities.

Electron-microscopic studies were carried out on an electron microscope EMS-100 BR with an increase from 12,000 to 30,000.

After applying the prefix (2,5% glutaraldehyde) and saline, the material was fixed in osmionic acid, dehydrated and compacted in an organic resin – dupupan.

To assess the conditions of diffuse nutrition of the ID, the blood supply to the subchondral parts of the vertebral bodies was studied, with the adjoining ID. The filling of the vascular bed was carried out with a 5% solution of ink with gelatin with the application of heparin. The number of microvessels in the cranial and caudally located vertebrae, corresponding to the four zones of the vertebral motor segment, was calculated on enlightened sections with a thickness of 20 μm:

Zone 1 – ventral part of the body of the cranially located vertebra
Zone 2 – the dorsal part of the body of the cranially located vertebra
Zone 3 – ventral part of the body of the caudally located vertebra
Zone 4 – dorsal part of the body of the caudally located vertebra.

Micromorphometry included measurements of the cranio-caudal and ventro-dorsal diameters of the lumbar intervertebral disks with the help of an ocular screw micrometer MOS-1-15 with the calculation of the relative sizes of these diameters.

Evaluation of statistical differences was determined using Student's criterion.

Results of the research

1. Rearrangements of macro- and microstructures of intervertebral disks under hypokinesia.

As the results of the research show, the restriction of the mobility of animals leads to a change in the structure of ID. These changes took place against the background of a significant decrease in body weight of rats ($p<0,005$). After 30 weeks of hypokinesia, in ES 1-month-old rats, body weight decreased by 38,02% relative to CS, by 27,06% in 3-month-old and by 22,18% in 12-month-old (Table 1).

Under conditions of prolonged 30-day hypokinesia, the ID lost its characteristic shape, color, and consistency. They differed from the CS white and gray color and pastoznost. The form of ID gradually changed: on the sagittal sections, the disc lost a slightly wedge-shaped form and became more rectangular.

After a 30-day hypokinesia, an increase in the cranio-caudal size of the ID and a decrease in ventro-dorsal .

The increase in cranio-caudal size compared with CS was 33,22% in 1-month-old rats, 9,42% in 3-month-old rats and 12,22% in 12-month-old rats, the decrease in ventro-dorsal size was 8,59%, 15,27% and 4,14%. As a result, the relative magnitudes of the two linear dimensions of the disk increased; that in 1-month-old rats 1,27, in 3-month-olds – 1,45, in 12-month-olds – 1,93. The greatest changes in the linear dimensions and structure of the ID were observed in the V-VI lumbar segments (Fig. 1).

Counting the number of injected mascara microvessels in the subchondral parts of the adjacent vertebral bodies showed that under conditions of hypokinesia their number decreases and, as a result, the conditions of diffuse nutrition of the MD deteriorate. The greatest decrease in the number of microve-

Table 1

Changes in the linear dimensions of the fifth intervertebral disk of rats under conditions of experimental hypokinesia in the age aspect

Experiment series	Intervertebral disc size				Evaluation of statistical significance	
	Cranio-caudal size (μm)		Ventro-dorsal size (μm)			
	CS	ES	CS	ES		
	$\bar{X}_1 \pm m_1$	$\bar{X}_2 \pm m_2$	$\bar{X}_3 \pm m_3$	$\bar{X}_4 \pm m_4$	t	p
1+30	581,0±17,9	870,0±14,61	1217,0±11,07	1112,4±24.0	$t_{1,2}=12,51$ $t_{3,4}=3,96$	$p_{1,2}<0,001$ $p_{3,4}<0,001$
3+30	863,7±6,82	953,5±10,15	1640,9±17,06	1390,3±16,69	$t_{1,2}=7,34$ $t_{3,4}=10,5$	$p_{1,2}< 0,001$ $p_{3,4}< 0,001$
12+30	1175,0±5,99	1338,5±12,0	2701,1±17,95	2589,2±21,49	$t_{1,2}=12,19$ $t_{3,4}=3,99$	$p_{1,2}<0,001$ $p_{3,4}<0,001$

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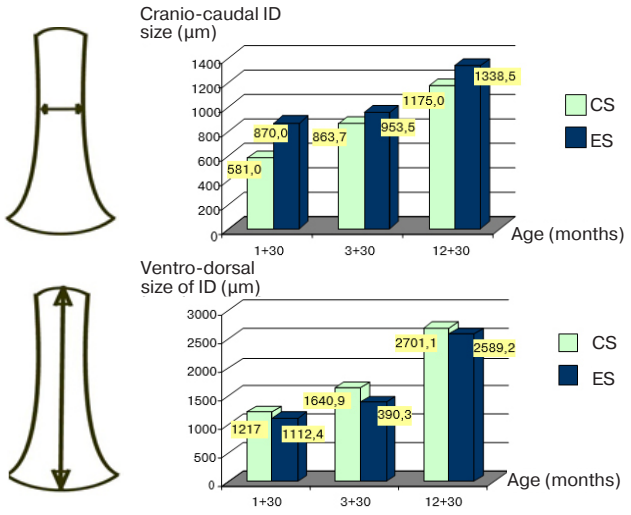

Figure. 1. Relative changes in the linear dimensions of ID after 30-day hypokinesia

ssels was found in the caudally located vertebrae and, especially, in their dorsal section (Table 2).

Hypokinesia caused the expansion of perivascular spaces and the phenomenon of perivascular edema. Microscopic experiments also found that the restriction of mobility contributes to the edema of the tissues of ID and the violation of histotopographic ratios of its components. This was manifested by an increase, almost twofold, in the volume of the gelatinous nucleus and the difference in the plates of the fibrous ring.

The gelatinous nucleus occupied a more central position in ID, structural disorders of its notochordal cells were observed. In both layers of the fibrous ring, the phenomena of dystrophy spread, the presence of cells with pyknotic modified nuclei increased. These changes were mainly noted in V-VI lumbar intervertebral discs.

2. Ultrastructural age features of intervertebral discs under hypokinesia.

After a 7-day hypokinesia, the morphological evidence of the adaptation process to the stress factor is associated with signs of dystrophic damage. Characterized by an increase in the nucleus of cells, the clearing of the mitochondrial matrix, the uneven expansion of individual tubules of the endoplasmic reticulum and the Golgi complex.

The 30-day hypokinesia contributed to damage to the cells and matrix of the fibrous ring, which was most pronounced in young animals. It was found that in these conditions in the 1-month rats the shape of the chondrocytes nucleus changed, cells with huge nuclei of unusual form appeared, and the presence of heterochromatin in the peripheral-membrane localization increased. In these cells there was a significant vacuolation of the cytoplasm, high osmophilia of its sites and the phenomena of edema organoids. Individually preserved mitochondria had a sharply enlightened matrix and several reduced chests. Permanent finds were fragments of a nuclear substance, freely arranged in the matrix.

Morphological indicators of damage to the matrix under the influence of hypokinesia were the loss of bonds of collagen fibers in bundles, the violation of the periodicity of the structure of collagen, the appearance of common and elegant sections along the fibers, as well as the fragmentation of some fibers.

ID 12-month-old rats, according to electronic studies, were more stable in conditions of even prolonged hypokinesia. However, in comparison with the control, in the collage-fiber cartilage the processes of cell and matrix dystrophy spread and the phenomena of tissue destruction developed.

3. Histochemical age-related features of intervertebral discs under hypokinesia.

Histochemical experiments proved that the detected structural changes unfolded against the background of a decrease in the activity of oxidative phosphorylation and glycolysis enzymes.

In 1-month-old rats after 30-dobio hypokinesia, the activity of malate dehydrogenase (MDH) decreased relative to the control by 13,4% with a slight change in the activity of α-GPDH. The activity of lactate dehydrogenase (LDH) decreased the most – by 60,9% and its LDH-1 isoform – by 81,5%.

In 3-month-old rats, MDH activity decreased by 10,47%, α-GPDH – by 27,08%, LDH – by 27,08%, LDH-1 – by 74,96%.

For 12-month-old rats, the activity of MDH decreased only by 3,05%, α-GPDH – by 20,02%, LDH – by 19,94%, LDH-1 by 47,94%. The most resistant to changes in all age groups was the LDH-4 isoenzyme.

Thus, adaptation to hypokinesia in young and mature animals has a certain difference, but in general, 1 month old rats were more sensitive to real estate, which is consistent with the data of microscopic studies.

Table 2

Age-related changes in the density of microvessel distribution, which were contrasted with mascara, in the lumbar vertebrae under hypokinesia ($X+S_x$)

Experimental series	Zones in the vertebral bodies			
	1	2	3	4
1 month + 7 days of hypokinesia	18,66±1,054	17,66±1,358	18,83±1,352	16,5±1,50
1 month + 30 days of hypokinesia	10,0 ±1,032	8,0 ±0,68	9,0 ±1,032	7,16±0,75
3 months + 7 days of hypokinesia	17,83±1,01	16,33±0,714	16.06±0,666	13,83±1,01
3 months + 30 days of hypokinesia	9,0±0,966	8,83±0,601	9,83±0,601	7,17±1,79
12 months 7 days hypokinesia	7,17±0,477	6,83±0,723	6,83±0,601	5,83±2,50
12 months 30 days hypokinesia	5,33±0,843	3,66±0,334	5,0±0,774	4,5 ±0,39

Conclusions / Discussion

The morphology of ID and its adjacent structures in conditions of hypokinesia is devoted to a small number of works that still lack comprehensive data on changes in all components of MD in conditions of reduced mobility (T. A. Glushko et al., 1987; V. G. Koveshnikov, A. E. Sac, 2005; A. E. Sac, 2010).

As evidenced by the data presented in the work, under conditions of hypokinesia, the communication system of the vertebral bodies of the ID undergoes significant structural-metabolic rearrangements, it may be associated with the processes of tissue edema and violation of the conditions of its diffuse nutrition.

The restriction of mobility contributes to the change of all departments of ID. The shape and linear dimensions of ID change, the level of its diffuse feeding on the part of the vertebral bodies decreases, the activity of metabolism in cells changes. These changes manifested themselves after 7 days of hypokinesia and were most obvious after 30 days of hypokinesia.

Under conditions of hypokinesia, the cranio-caudal diameter of the ID increased, while in young animals the ID lost its sphenoid shape. The gelatinous nucleus occupied a central position in ID and assumed a spherical shape. With an increase in the duration of the real estate of rats in the fibrous ring, the metabolic resources of the cells decreased and the dystrophic damages of organoids and matrix grew. These changes predominated in the fifth and sixth lumbar ID, which may be due to the difference in the blood supply of the cranial and caudal parts of the lumbar spine. In addition, during hypokinesia, the delayed processes of ossification of cartilage apophyses in the vertebral bodies were detected, which also changed the course of age-related alterations in ID and spinal segments as a whole.

The complex of data obtained suggests that the limitation of motor activity is a significant factor damaging ID. The main reason for this is the absence in the conditions of hypokinesia of the load necessary for the formation of the supporting structures of the ID. The absence of mechanical stimulation of ID reduces the level of metabolism in cells, inhibits the processes of adaptive tissue remodeling and contributes to the violation of intact structures. Prolonged hypokinesia contributes to the greatest damage to the structures of MD in young animals.

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Mechanism of formation of competitiveness of non-Olympic sports

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The article analyzes the competitiveness of non-Olympic sports in Kharkiv. A mechanism for the formation of competitiveness non-Olympic sports are proposed.

Purpose: *develop a mechanism for the formation of competitiveness of non-Olympic sports.*

Material & Methods: *analysis of literary sources and documents, questioning, organizational modeling, methods of marketing analysis (SWOT-analysis), expert assessment, methods of mathematical statistics. The research was conducted in 5 sports schools in Kharkiv, where non-Olympic sports are cultivated. In total, 136 people participated in the study. The composition of the respondents included: directors, deputy directors, methodologists, trainers.*

Results: *on the basis of marketing analysis, the mechanism of formation of competitiveness of non-Olympic sports was revealed.*

Conclusions: *as a result of the study, information on the formation of the competitiveness mechanism for non-Olympic sports has been summarized. A competitiveness mechanism was developed for non-Olympic sports and the effectiveness of the developed mechanism was confirmed using the method of expert assessments.*

Keywords: *marketing, competitiveness, non-Olympic sports.*

Introduction

For non-Olympic sports, the formation of competition policy is currently of particular relevance, given the current state of popularity and the development of non-Olympic sports and the sports industry. Today, there are a large number of private, public, and state physical education and sports organizations, in which non-Olympic sports are cultivated, equipped with the appropriate material and technical base and equipment, and successfully compete in the sports and sports services market. The optimal combination of competitive policy measures, mainly economic and organizational-administrative, provide an opportunity to effectively realize their competitive advantages and ensure high competitiveness in a competitive environment (N. G. Dolbisheva, 2015, N. V. Sereda, 2013; 2015).

Purpose of the study: develop a mechanism for the formation of competitiveness of non-Olympic sports.

Material and Methods of the research

The study used the following research methods: analysis of literary sources and documents, questionnaires, organizational modeling, methods of marketing analysis (SWOT-analysis), expert assessment, methods of mathematical statistics. The study was conducted in 5 of the Children's Sports School of Kharkov, where non-Olympic sports are cultivated. A total of 136 people participated in the study. The structure of the respondents included: directors, deputy directors, methodologists, trainers.

Results of the research

Competition policy is an important component of the economic policy of physical education and sports organizations for non-Olympic sports and acts as a general guide to action and decision-making that facilitate the achievement of competitive development goals in the market of physical culture and sports. For the formation of competition policy it is necessary to consider the following factors:

– taking into account the factors of external and internal environment that affect competitive development;

– the definition of developmental determinants as a combination of factors that form competitive advantages or create the necessary prerequisites for this;

– the use of modern approaches to the formation of a competitive policy to take into account the characteristics and complexity of the functioning of a sports school for non-Olympic sports in modern economic conditions;

– the choice of modern tools and ways to achieve competitive advantages (T. I. Goncharuk, 2003).

Since the competitive policy of non-Olympic sports is formed in accordance with the nature of the competitive environment and taking into account the existing competitive potential, it is important to understand the interrelation of competition policy with the components of the internal and external environment (Figure).

Competitive marketing policies of sports schools for non-Olympic sports should be aimed at balancing economic relations between other physical education and sports organizations and competitors, forming an effective internal economic mechanism for non-Olympic sports. The process of forming a competitive policy should cover all areas of sports school in non-Olympic sports in order to create stable competitive

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positions in the market of physical education and sports services and ensure long-term competitiveness. The basis of an effective competition policy of a sports school in non-Olympic sports is the perfection of the mechanism of formation of competition policy, providing for a system of interrelated methods, means and levers, ensuring the formation of stable competitive positions due to the effective combination of various areas of sports school management. The effectiveness of a competition policy formation mechanism depends on its organizational structure, management structure and style, planning, technology for the provision of physical education and sports services, labor organization and motivation, the availability of quality management policies, etc. schools for non-Olympic sports, in particular, the conjuncture of the consumer market in general and its individual segments (G. A. Fathutdinow 2013; S. V. Gerasimchuk, 2014, A. A. Yarinyuk, 2014).

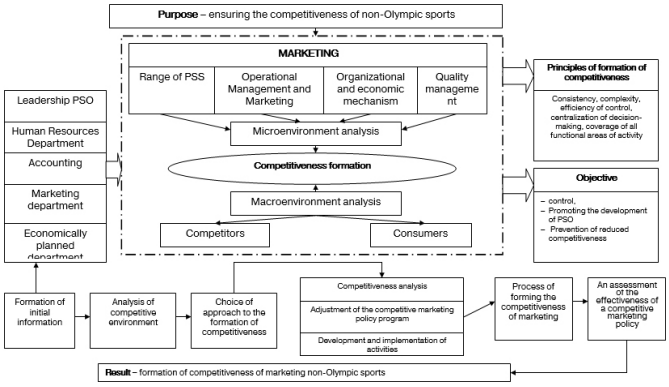

Figure. Mechanism of formation of competitiveness of non-Olympic sports

The mechanism of forming a competitive policy is based on the following main stages: 1) formation of initial information; 2) analysis of the competitive environment; 3) choice of approach to the formation of a competitive policy; 4) the process of forming a competitive policy; 5) assessment of the effectiveness of the competition policy. A necessary condition for increasing the competitiveness of non-Olympic sports is the timely investigation of the degree of influence of macro- and micro-factors on all stages of the implementation of the mechanism (L. L. Antonyuk, 2004; R. Hoye, 2011).

At the first stage of the formation of the initial information is carried out by such departments as economically planned, marketing, accounting, personnel department. Formation of the initial information is as follows:

1) study the needs of potential consumers;

2) identification of major competitors;

3) collection of data on competitors;

4) collection of data on the potential consumer;

5) choice of the nomenclature of competitiveness criteria.

Next, you should outline the circle of major competitors and collect data about them. Understanding what competitors offer will help management to find ways by which customers will be offered the most appropriate service. For non-Olympic sports one of the important steps in the formation of baseline information is the collection of data on competitors. Competitors have a significant impact on the creation of innovative physical education and sports services and the introduction of new sports. The second stage is characterized by an analysis of the competitive environment of non-Olympic sports, which includes the analysis of internal and external (N. V. Sereda, 2013).

The complexity of the process of formation of competition policy is determined by the number of interrelated controls, the effectiveness of the mechanism of their combination, interaction. The process of forming a competitive policy for non-Olympic sports involves the implementation of the following steps:

1) formation of a list of competition laws;
2) definition of industry competition rules;
3) formation of a policy of interaction with direct competitors;
4) formation of a policy of interaction with the main forces in the industry;
5) reduction of the results of the implementation of the previous stages to a single form;
6) comparison of the consolidated regulations on the available competitive potential and their adjustment;
7) definition of the main provisions of the competition policy of non-Olympic sports and their approval by top management.

The final stage in the formation of a competitive policy is the assessment of the effectiveness of the competition policy. In forming a competitive policy, the following principles should be guided by: systematic, comprehensive, effective control, centralization of decision-making, coverage of all functional areas of activity of sports schools for non-Olympic sports.

The main tasks solved by the competition policy are the following: control over the competitive influence in the non-Olympic sports; promoting the development of non-Olympic sports; preventing the reduction of competitiveness.

The methodological basis for controlling the formation of competitive marketing advantages for non-Olympic sports is the classification of factors influencing the formation of competitive advantages, goal-setting mechanism, principles and properties of the management mechanism, the concept of information and analytical support. The competitiveness factors for non-Olympic sports should be transformed into competitive advantages. In this case, competitive advantages should be understood as factors of competitiveness of the region and non-Olympic sports, which ensure its attractiveness and competitiveness in comparison with other territorial formations. Classification of factors is carried out on the basis of a clear and understandable criterion (or criteria), which allows one to uniquely attribute the factor to one group or another. In our study, the competitive advantages and disadvantages were determined using the method of marketing analysis – SWOT analysis. The use of this method allows the generation of new competitive advantages that are concentrated in the region. Due to this, one can not only assess the contribution of each factor to the competitiveness of non-Olympic sports, but also develop a system of private sectoral and functional strategies, as well as a common regional strategy for increasing competitiveness, based on mechanisms for the search and use of internal and external environmental capabilities.

The effectiveness of the developed mechanism for the development of competitiveness for Neo-Olympian sports was due

to the method of expert evaluation. Experts were practitioners of the field of physical culture and sports and research staff, with a total of 20 experts at the expert level. Experts evaluated the 3 groups of expected effects:

– economic: attraction of extrabudgetary funds, expansion of the spectrum of sports school services, increase of investment attractiveness of sports school activity, implementation of the position of "sports manager", activation of advertising activity;
– organizational and managerial increase of the level of efficiency of making managerial decisions, optimization of the mechanism of management of the sports school where non-Olympic sports are cultivated, improvement of the regulatory framework regulating the functioning and development of non-Olympic sports, simplifying the mechanism of building a strategy for the development of neo-Olympian sports, developing a creative approach to organizational -management activities;
– social: strengthening the image of non-Olympic sports, increasing the contingent of those engaged in non-Olympic sports, achieving higher sports results for pupils, increasing the level of competitiveness of non-Olympic sports in the market of sports and fitness services, maintaining the stage of training of athletes and a sustainable contingent.

The main indicators of the social effect from the implementation of the mechanism, the experts determined the following: an increase in the contingent involved in the Youth Sports School (45 points) and increase the competitiveness of the sports school in the market of sports and fitness services (47 points). The results obtained indicate a positive change from the implementation of the mechanism and increase the level of competitiveness.

We note that unanimously experts expect the expansion of the spectrum of physical education and sports services of the sports school from the introduction of the developed mechanism – 1 place. From the following group of indicators, the thoughts of practitioners and scholars fled. Researchers have put the first place in the list – the improvement of the regulatory framework regulating the activity of the Youth Sports School (47 points), and practitioners – the simplification of the mechanism for building a sports school development strategy (46 points).

The level of consistency of experts in each group was high and confirmed the accuracy of the examination. So, according to the group of indicators of social effect: the coefficient of concordance in science was W=0,72; for specialists W=0,73. The group of indicators of economic effect: the coefficient of concordance in science was W=0,71; for specialists W=0,72. In all groups, the coefficient of concordance was $W \geq W_{gr}$, which means consistency of expert opinions.

Conclusions / Discussion

According to the results of the study, a mechanism for the formation of competitiveness for non-Olympic sports was formed. The developed mechanism includes a block of formation, namely the analysis of the macro- and microenvironment of non-Olympic sports. For the effective implementation of the proposed mechanism, the implementation algorithm was defined including: the formation of initial information, the analysis of the competitive environment, the choice of approach to the formation of a competitive mechanism and the analysis of the competitiveness of non-Olympic sports.

An expert evaluation was carried out to confirm the effectiveness of the developed mechanism for the development of competitiveness for the Neolympic sports. Experts determined the main indicators of the social effect from the implementation of the mechanism as follows: an increase in the contingent of those engaged in non-Olympic sports (45 points) and an increase in the competitiveness of non-Olympic sports in the market of physical education and sports services (47 points). The level of consistency of expert opinions in each group was high and confirmed the reliability of the examination. In all groups, the coefficient of concordance was $W \geq W_{gr}$, which means consistency of expert opinions.

Prospects for further research. Develop an organizational plan for the implementation and realization of the developed mechanism in the work of sports schools.

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Changes in the indicators of the physical condition of students under the influence of classes in sports sections

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Purpose: *investigate changes in the indicators of the physical condition of students under the influence of classes in sports sections.*

Material & Methods: *to solve the purpose, the following research methods were used: analysis and synthesis of references, methods for determining the functional state of the body, methods for assessing the level of physical health (using the methodology of G. L. Apanasenko), methods for determining motor activity, methods of mathematical statistics. The study involved 50 students of Volodymyr Dahl East Ukrainian National University Severodonetsk.*

Results: *it was found that under the influence of classes in the sports sections of martial arts, the greatest improvement in physical condition indicators was observed. In the experimental groups (in martial arts and athletics) a greater positive trend was recorded than in the control group. An analysis of the practice of martial arts for indicators of the physical condition of students allows us to state that a marked optimization of the work of the cardiovascular and respiratory systems was noted. The positive effect of sectional athletics on physical condition indicators, especially on speed, was recorded. The study confirmed the feasibility of using sectional classes in martial arts and athletics with students.*

Conclusions: *experimental materials presented in this study allowed us to state the pronounced positive effect of classes in athletics and martial arts sports sections on physical condition indicators, namely, on the functional state, level of physical performance and physical health of boys and girls aged 17–18. The most pronounced differences are observed in the indices of Rufe, Stange, Genchi, who significantly ($p<0.01$ (EG-1), $p<0.001$ (EG-2)) improved in both experimental groups.*

Keywords: *physical activity, physical condition, students, healthy lifestyle, physical performance, athletics, martial arts.*

Introduction

Statistical data indicate a deterioration in health, an increase in the incidence of diseases, and various deviations in the state of health of today's young people [10]. Along with an increase in the incidence of students, there is deterioration in physical health indicators, their inconsistency with generally accepted standards. Among the factors affecting the increase in the incidence of students and the low level of physical development, it should be noted the lack of physical activity. The combination of factors determines the level of physical fitness and efficiency, which, in turn, are important indicators of professional training of students.

At present, among students, there is a tendency to deterioration in the level of the general physical state of their body, in particular, physical fitness, as well as the functional state of the leading physiological systems and the level of physical health in general. According to the World Health Organization (WHO), more than 80% of children and adolescents have significant deviations in their health status. At the same time, one of the most promising ways to solve this problem is the development and implementation of health-improving technologies in the educational process [1; 2].

The tasks related to improving physical fitness and improving the health of young people still remain a serious state problem [4; 5; 7].

The specifics of training in institutions of higher education and the age characteristics of a growing organism place high demands on all functional systems [6]. Some researchers indicate that during their studies in institutions of higher education, students' health tends to deteriorate against the background of a decrease in their physical activity [3; 8]. Preserving and strengthening the health of student youth is one of the most important tasks facing universities. Successful training of highly qualified specialists is closely related to improving the health and improving the performance of students.

Only 35–40% of the total daily motor need of students satisfies physical education programs for higher education programs [8]. The fact that most students lack the necessary motivation to exercise further aggravates the situation. Meanwhile, the level of manifestation of the basic motor abilities of young people in higher educational institutions, which is achieved in the process of regulated physical education classes, does not meet the needs of the present [9]. Many researchers note that the existing system of physical education in universities requires further improvement and development. At the present stage, issues related to the development and improvement of basic physical qualities, in particular, speed-strength qualities, are of particular relevance.

There is a contradiction between the growing demands on the training process of physical education and the limited capabilities of the traditional methodology, which does not allow for increasing the level of physical fitness and does not contribute to improving the functional state of students. There is a need to find the most effective means and methods of physical training, corresponding to the functional capabilities of the student's body. Issues related to the use of martial arts to en-

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hance the impact on physical condition and eliminate the adverse effects that characterize the activities of students and, to a greater extent, university students, are highly relevant and have not yet been adequately reflected in the practice of physical education. The lack of consensus on many issues of choice and effectiveness of the methods and methods used to improve the students' physical condition indicates that this issue has not been studied enough.

Purpose of the study: investigate changes in the indicators of the physical condition of students under the influence of classes in sports sections.

Material and Methods of the research

Analysis of the scientific and methodological literature has shown that the recommendations in the literature on the development and improvement of physical qualities among students are divided and contradictory. The choice of training tools, methods, and most importantly, the magnitude of physical activity is empirical. This necessitates research in this area.

To solve this goal, such research methods were used – analysis and synthesis of literature, methods for determining the functional state of the body, methods for assessing the level of physical health (according to the method of G. L. Apanasenko), methods for determining motor activity, methods of mathematical statistics. Material systematization and initial mathematical processing were performed using Microsoft® Excel tables.

Studies were conducted on the basis of the Volodymyr Dahl East Ukrainian National University. The study involved 50 students EUU them. V. Dahl. Severodonetsk. The presented contingent of students was involved in the study voluntarily with written consent to participate in all stages of the experiment, as well as to further analysis and disclosure of their personal data when reviewing and reporting on the research results.

Results of the research

Physical condition is a combination of indicators such as physical performance, physical development and physical fitness. The level of physical fitness of students is influenced by regular exercise.

Studies of a significant number of authors on this problem have shown the positive effect of systematic physical education and sports on such components of the general physical condition as the level of health and functional state of the body develops [11; 12].

The physical fitness of students is closely related to the level of motor activity and physical fitness. Therefore, physical education classes, which for the majority of students are the only means of increasing motor activity, are of great importance for strengthening and maintaining the health of the younger generation. Students with a higher level of motor activity, physical fitness and work ability have the best ability to mobilize memory, emotional stability and more confidence in their actions. It is known that the most effective for development of motor potential and strengthening of students' health is the use in the process of physical education of means of sports training.
The hypothesis of this study is the assumption of improved indicators of the physical condition of students under the influence of sectional exercises in athletics and martial arts.

For the purpose of the work, an experimental study was conducted of 35 young men and 15 girls aged 17–18 years old for 8 months, students of the 1st course of the EUU V. Dahl. All students and students were divided into three groups: the first experimental group (EG-1) (10 young men and 5 girls), whose representatives, in addition to compulsory physical education, also engaged in athletics in the section (short-distance running), the second experimental (EG-2) (10 boys and 5 girls), representatives of which also additionally, in addition to compulsory physical education classes, were engaged in martial arts, and control (CG) (15 boys and 5 girls), whose representatives were engaged in physical education according to the traditional program for higher educational institutions. Compulsory physical education classes were held once a week. Classes were held in sections three times a week. Testing of motor skills (indicators of physical fitness and physical development) of students was carried out using the following exercises: shuttle running 4x9 m, 100 m run, standing long jump, push-ups in the support lying on the floor (girls), pulling up on the crossbar (young men). A comparative assessment of the cardiovascular and respiratory systems was carried out using

Table 1

Indicators of students' physical condition at the beginning of the experiment (boys), $\bar{X}\pm m$

No. i/o	Test name	CG	EG-1	compared to CG	EG -2	compared to CG
1.	Standing long jump, cm	217,2±1,72	218,1±1,75	t=0,37 (p>0,05)	215,8±1,69	t=0,58 (p>0,05)
2.	Pulling up on the crossbar, number of times	10,7±0,55	10,5±0,48	t=0,27 (p>0,05)	11,1±0,53	t=0,52 (p>0,05)
3.	Shuttle running 4x9 m, s	10,2±0,12	10,4±0,1	t=1,28 (p>0,05)	10,3±0,11	t=0,61 (p>0,05)
4.	100 m run, s	14,8±0,17	14,6±0,15	t=0,91 (p>0,05)	14,7±0,14	t=0,47 (p>0,05)
5.	Rufie test, c. u.	10,43±0,13	10,36±0,11	t=0,41 (p>0,05)	10,52±0,16	t=0,44 (p>0,05)
6.	Stange test, c. u.	60,36±0,69	61,7±0,61	t=1,45 (p>0,05)	62,17±0,64	t=1,92 (p>0,05)
7.	Genchi test, c. u.	33,1±0,37	32,2±0,38	t=1,7 (p>0,05)	33,5±0,32	t=0,82 (p>0,05)

the Rufie test, the Stange test and the Genchi test. Indicators of physical condition of students at the beginning and at the end of the experiment are reflected in tables 1–4. The students of the control group classes were held 1 time per week, and in the experimental – 4.

At the beginning of the study, no significant intergroup differences between the boys and girls of the experimental and control groups were recorded (Tables 1, 2).

Analysis of test results after 8 months of classes showed that students of experimental groups, compared with the results of students of the control group, have the best performance for all the tested tests (Tables 3, 4).

In the control group after the experiment, indicators of physical condition did not improve significantly. In young men, the indicators significantly improved relative to the initial results in the shuttle run – by 6,25% ($p<0,01$), in the run for 100 m – by 8,03% ($p<0,001$) and Shtange test – by 3,85% ($p<0,05$) (Table 3). At the end of the experiment, for girls in the CG, the indicators significantly improved with respect to the initial results of the Stange test – by 5,88% ($p<0,01$) and the Genchi test by 4,05% ($p<0,05$) (Table 4).

The greatest improvements in physical indicators in the Rufie, Stange and Genchi samples at the end of the experiment were found in a group of students engaged in martial arts, which indicates that the functions of the cardiovascular and respirato-

Table 2

Indicators of students' physical condition at the beginning of the experiment (girls), $\bar{X}\pm m$

No. i/o	Test name	CG	EG-1 compared to CG		EG-2 compared to CG	
1.	Standing long jump, cm, cm	170,3±1,93	169,4±2,11	t=0,31 (p>0,05)	171,4±1,85	t=0,41 (p>0,05)
2.	Push-ups in the support lying on the floor, number of times	15,1±1,06	15,7±1,18	t=0,38 (p>0,05)	15,8±1,25	t=0,43 (p>0,05)
3.	Shuttle running 4x9 m, s	11,2±0,12	11,1±0,15	t=0,52 (p>0,05)	11,4±0,17	t=0,96 (p>0,05)
4.	100 m run, s	17,4±0,16	17,6±0,19	t=0,26 (p>0,05)	17,3±0,18	t=0,42 (p>0,05)
5.	Rufie test, c. u.	11,9±0,14	11,57±0,13	t=1,73 (p>0,05)	11,63±0,12	t=1,46 (p>0,05)
6.	Stange test, c. u..	54,25±0,61	55,94±0,57	t=2,02 (p>0,05)	55,71±0,55	t=1,78 (p>0,05)
7.	Genchi test, c. u.	28,7±0,33	28,6±0,31	t=0,22 (p>0,05)	28,3±0,28	t=0,92 (p>0,05)

Table 3

Indicators of students' physical condition at the end of the experiment (boys)

No. i/o	Test name	CG at the beginning and at the end of the experiment	EG-1 compared to CG		EG -2 compared to CG	
1.	Standing long jump, cm	219,5±2,15 t=0,84 (p>0,05)	228,4±2,03	t=3,01 (p<0,01) Δ=3,8%	224,8±1,95	t=1,83 (p>0,05)
2.	Pulling up on the crossbar, number of times	11,3±0,39 t=0,89 (p>0,05)	11,4±0,41	t=0,18 (p>0,05)	12,1±0,45	t=2,35 (p<0,05) Δ=12,4%
3.	Shuttle running 4x9 m, s	9,6±0,12 t=3,54 (p<0,01) Δ=6,25%	9,2±0,1	t=3,2 (p<0,01) Δ=5,5%	9,1±0,09	t=2,67 (p<0,05) Δ=4,2%
4.	100 m run, s	13,7±0,14 t=5,17 (p<0,001) Δ=8,03%	13,4±0,17	t=2,27 (p<0,05) Δ=3,8%	13,2±0,15	t=1,46 (p>0,05)
5.	Rufie test, c. u.	10,15±0,11 t=1,64 (p>0,05)	9,47±0,1	t=4,57 (p<0,001) Δ=7,2%	8,93±0,12	t=7,49 (p<0,001) Δ=12,02%
6.	Stange test, c. u.	62,78±0,63 t=2,59 (p<0,05) Δ=3,85%	66,22±0,65	t=3,8 (p<0,01) Δ=5,2%	71,14±0,72	t=8,74 (p<0,001) Δ=13,32%
7.	Genchi test, c. u.	33,61±0,32 t=1,04 (p>0,05)	35,51±0,38	t=3,82 (p<0,01) Δ=5,4%	37,24±0,35	t=7,65 (p<0,001) Δ=10,8%

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Table 4

Indicators of students' physical condition at the end of the experiment (girls)

No. i/o	Test name	CG at the beginning and at the end of the experiment	EG-1 compared to CG		EG-2 compared to CG	
1.	Standing long jump, cm, cm	174,6±1,83 t=1,62 (p>0,05)	180,3±1,95	t=2,13 (p>0,05)	178,7±1,76	t=1,61 (p>0,05)
2.	Push-ups in the support lying on the floor, number of times	17,9±0,62 t=2,28 (p>0,05)	18,7±0,45	t=1,04 (p>0,05)	20,1±0,57	t=2,61 (p<0,05) Δ=12,3%
3.	Shuttle running 4x9 m, s	11±0,12 t=1,18 (p>0,05)	10,7±0,13	t=4,69 (p<0,01) Δ=8,9%	10,6±0,15	t=2,26 (p>0,05)
4.	100 m run, s	17,1±0,18 t=1,25 (p>0,05)	16,5±0,17	t=3,74 (p<0,01) Δ=5,6%	16,2±0,16	t=2,42 (p>0,05)
5.	Rufie test, c. u.	11,6±0,13 t=1,57 (p>0,05)	10,9±0,12	t=3,96 (p<0,01) Δ=6,4%	10,3±0,11	t=7,63 (p<0,001) Δ=11,21%
6.	Stange test, c. u.	57,64±0,57 t=4,06 (p<0,01) Δ=5,88%	61,32±0,65	t=4,26 (p<0,01) Δ=6%	63,83±0,68	t=6,98 (p<0,001) Δ=10,74%
7.	Genchi test, c. u.	29,91±0,31 t=2,67 (p<0,05) Δ=4,05%	31,9±0,34	t=4,33 (p<0,01) Δ=6,2%	33,78±0,35	t=8,28 (p<0,001) Δ=12,94%

ry systems work better in them. In the EG boys, in the control exercises, the indicators significantly improved in relation to the control group of the Rufie test – by 12,02% (p<0,001), the Shtange test – by 13,32% (p<0,001) and the Genchi test – by 10,8% (p<0,001) (Table 3). At the end of the experiment, the girls in the group of oriental martial arts significantly improved relative to the control group of the Rufй test – by 11,21% (p<0,001), the Stang's test – by 10,74% (p<0,001) and the Genchi test – by 12,94% (p<0,001) (Table 4).

Martial art is a universal sport that positively affects the state of the whole organism. Regular martial arts exercises have a positive effect on the nervous and cardiovascular systems; they are an effective means of developing the respiratory system. Exercises from the arsenal of martial arts should not replace the program lessons, but only supplement them, provide an opportunity to update and expand their content, increase the level of physical activity for a young body.

An analysis of the data presented showed that, although not essential for boys and girls, only by 4,2% (boys), but reliably (p<0,05), the results from the shuttle run improved, indicating a significant improvement in speed performance (Table 3). Studies have shown that to a greater extent, there were changes in the indicators for pulling up on the crossbar by 12.4% (boys, p<0,05) and by 12,3% by flexing and push-ups in the support lying on the floor (girls, p<0,05), indicating significant improvement of strength quality (Table 3, 4).

Boys and girls who were systematically engaged in the sections on athletics, there was a positive dynamics of the studied parameters. So, for students there was a tendency towards a more pronounced rate of improvement of the level of physical condition, physical performance, functional state of the external respiration system, as well as the level of physical health. Significant improvement in performance at the end of the experiment in EG-1 compared with the CG was observed:

– at a boys: in standing long jump – by 3,9% (p<0,01), in shuttle run – by 5,5% (p<0,01), in running at 100 m – by 3,8 % (p<0,05), in the Rufie test, by 7,2% (p<0,001), in the Strange test, by 5,2% (p<0,01), in the Ghency test, by 5,4% (p<0,001) (Table 3);

– at a girls: in shuttle run – by 8,9% (p<0,01), in running at 100 m – by 5,6% (p<0,01), in the Rufie test – by 6,4% (p<0,01), in the Strange test – by 6% (p<0,01), in the Ghency test – by 6,2% (p<0,01) (Table 4).

Conclusions / Discussion

The study confirmed the results of the authors [3, 8; 10] about the need to study changes in the indicators of the physical condition of students under the influence of various sports, and deepens the data of scientists [3; 9; 11] for that matter.

The conducted studies allowed establishing reliable changes in the indicators of physical condition and physical development in students of the experimental and controlling groups. The most pronounced differences were observed in the indices of Rufie, Stange, Genchi, who significantly (p<0,01 (EG-1), p<0,001 (EG-2)) improved in relation to the CG indicators.

Under the influence of classes in the martial arts sections, a pronounced optimization of the functioning of the cardiovascular and respiratory systems was established. The study

confirmed the feasibility of classes in the sections of martial arts for students.

The presented experimental materials allowed to ascertain the positive effect of sectional exercises in athletics on the indicators of the functional state of the cardiovascular and respiratory systems, the level of physical performance and physical health of boys and girls.

Prospects for further research in this direction will be the possibility of improving indicators of the physical condition of students through sectional classes in other sports.

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Improving the culture of performing competitive compositions by young gymnasts through the use of non-traditional means of training

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Purpose: *to develop and evaluate the effectiveness of methods for improving the culture of young gymnasts performing competitive compositions through the use of non-traditional means of training in the training process.*

Material & Methods: *the study involved 12 athletes 8–10 years old engaged in artistic gymnastics. To solve the set tasks, methods characteristic of theoretical and applied research in the field of physical education and sport were used. The analysis of literary sources is carried out to identify the features of the use of auxiliary (non-traditional) means in the process of forming the culture of movements of young gymnasts. Pedagogical methods (testing, experiment) were used to assess the level of formation of a culture of movements in young athletes based on an assessment of the manifestation of their coordination abilities. The methods of mathematical statistics were used to process the experimental material and assess the reliability of the data obtained.*

Results: *according to the results of the study, it was revealed that the use of auxiliary (non-traditional) means in the training process of young gymnasts contributed not only to the active development of coordination of their movements (orientation in space and time, stability to balance, etc.), but also allowed the level of culture of the performance of the basic elements of competitive compositions by them, had a positive impact on the results of their competitive activity.*

Conclusions: *the results of the whole complex of the conducted studies testify the effectiveness of the technique of increasing the culture of movements in young gymnasts by using nontraditional means in the training process.*

Keywords: *rhythmic gymnastics, young gymnasts, testing, non-traditional means, culture of movements.*

Introduction

The modern stage in the development of rhythmic gymnastics is characterized by an increase in the level of performing arts athletes, the increasing complexity and entertainment of competitive compositions. This trend is conditioned by the rules of the International Gymnastics Federation (FIG), adopted for the period 2017–2020 [11]. The aggravation of the sports competition of the national teams leads to the attention of the trainers and scientists to increase the efficiency of the long-term training of athletes, the search for non-traditional means of their training, which contribute to more effective mastery of young athletes of various competitive exercises, their combinations and their performance of competing compositions in general. It should be noted that the performance of competing compositions and their elements is a reflection of the complex and fine coordination of the athlete's movements, their ability to convey emotions by performing compositions without objects and objects (rope, hoop, ball, club, ribbon), which is an important element of the gymnastic culture [6; 7; 9].

The provisions are formulated to highlight the need for research aimed at finding new, non-traditional means of training young gymnasts, because, since 1999, the rules of competition have changed five times (competition rules 1997–2000, 2001–2004, 2005–2008, 2009–2012, 2013–2016, 2017–2020). Changes in the rules of the competition and new requirements for competitive compositions of gymnasts have not been duly reflected in the regulatory documents governing the process of many years of training Ukrainian athletes involved in rhythmic gymnastics. This is due to the fact that the process of their preparation is carried out in accordance with the curriculum for rhythmic gymnastics for children's and junior sports schools, specialized schools of the Olympic reserve, schools of high sporting skills, which was adopted in 1999 [1]. The latest changes in the rules of competitions in rhythmic gymnastics [11] reduced the number of mandatory elements, included the performance of compositions of dance steps, increased the significance of the artistic component of the performance of competing compositions. According to experts [6; 8; 10 and others]. These changes include the increase of the entertainment of competing compositions, imposes special requirements on the artistic craftsmanship of athletes. In general, the competition composition should be a synthesis of the strength, beauty and elegance of movements, which is achieved through various forms of exposure to the natural attributes of athletes, that is, the forms of "culturing" (processing, facial, improvement) of the characteristics of their data by nature, including their coordination abilities that are the basis of the formation of a culture of performing exercises in rhythmic gymnastics [12].

It should be noted that in the annual cycle of training of athletes engaged in rhythmic gymnastics [1], only in the initial stage and the stage of preliminary basic training the emphasis is on the complex development of motor activity of gymnasts and the formation of an individual gymnastic style of exercising and general motor competence, that is, the formation of a definite level of gymnastics culture. Analysis of the curriculum

for rhythmic gymnastics [1] also indicates that the concept of "gymnastic culture" and its essence remains undiscovered. It is this theoretical and practical conflict caused by the relevance of this study.

Purpose of the study: to develop and evaluate the effectiveness of methods for improving the culture of young gymnasts performing competitive compositions through the use of non-traditional means of training in the training process.

Material and Methods of the research

The study involved 12 gymnasts who are engaged at the stage of preliminary basic training. The study used the following methods: theoretical analysis and synthesis of literary sources; pedagogical methods (testing, experiment) and methods of mathematical statistics.

An additional experiment lasted for the summer training cycle (from September 2017 to May 2018). Comprehensive changes in the culture of performing competitive compositions by young gymnasts were evaluated on the basis of a comparison of the results they showed at competitions held at the beginning of the experiment (October 2017) and at the end (May 2018).

At the beginning of the study, based on the assessment of the manifestation of the coordination abilities of young gymnasts, the level of their movement culture was determined. The use of a comprehensive test program and a scale of differentiated assessment of spatio-temporal parameters, resistance to posture (balance) preservation, orientation in space and a sense of rhythm made it possible to determine the level of development of coordination abilities of young athletes involved in rhythmic gymnastics.

Based on the analysis of scientific and methodological literature [3; 4; 5; 13], coaching experience and the results of initial testing of the level of development of coordination abilities of young athletes, an experimental technique was developed aimed at improving their culture of movements through the use of non-traditional means in the training process. Experimental methods of sports training included the systematic and purposeful use of various sets of exercises in the training process on the Bosu Balance Trainer (BOSU) universal balancing platform, with tennis balls and on a gymnastic bench. The proposed method envisaged the following complications in mastering basic exercises in the BOSU simulator, with tennis balls and on a gymnastic bench: various changes in the position of the arms and head; use of asymmetric hand positions; exceptions to the floor support when performing exercises and the BOSU simulator and gymnastic bench; performing exercises without visual control and on the toes; the use of a variety of jumps, an increase in the number of repetitions, the time of holding the static position of the body and the amplitude of movements. It should be noted that in rhythmic gymnastics technical training is characterized by the complicated coordination actions of sportswomen, performed simultaneously with the manipulation of objects against the background of musical accompaniment. Therefore, an important element of the experimental technique was the use of musical accompaniment when performing the developed sets of exercises, which helped the gymnasts to develop artistic taste, cultivate a sense of beauty of movement, culture of behavior and was important in teaching movements, especially in developing expressiveness and artistry. In addition, the music created a positive emotional background to improve the performance and discipline of athletes.

Table 1

Changes in the level of coordination abilities of young gymnasts throughout the study (t_{th} =2,07 where p<0,05), (n=12)

Classification of coordination abilities	Test exercise	$\bar{X}$±m		results increase, %	t_p	p
		At the beginning of the experiment	At the end of the experiment			
Orientation in space and time	Juggling tennis balls with right hand, number of times	8,0±0,26	9,2±0,20	15%	3,49	<0,05
	Juggling tennis balls with left hand, number of times	2,9±0,20	4,2±0,35	44%	3,10	<0,05
Evaluation and regulation of space-time and dynamic parameters of movements	Shuttle run 3x10 m, s	10,8±0,11	10,6±0,07	2%	2,04	>0,05
	Pace with eyes closed on the right leg, s	41,4±0,71	46,3±1,06	12%	3,80	<0,05
	Pace with eyes closed on the left leg, s	28,2±1,43	34,7 ±1,40	23%	3,67	<0,05
Keeping posture (balance)	Test "Top", s	4,90 ±0,19	5,8 ±0,20	18%	3,18	<0,05
	Three rolls – pace on the right leg, points	7,5 ± 0,10	8,1 ±0,11	8%	3,91	<0,05
	Three rolls – pace on the left leg, points	5,3±0,20	5,9±0,24	11%	1,88	>0,05
Coordination of movements	Test exercise to determine motor memory, the number of attempts	2,6±0,24	3,8±0,18	46%	3,74	<0,05
Sense of rhythm	Clapping palms in a given rhythm, the number of tasks performed	2,2±0,14	2,5±0,13	14%	1,71	>0,05

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Results of the research

To assess the level of formation of the culture of movements in athletes on the basis of an assessment of the manifestation of their coordination abilities, the gymnasts of the study group were tested at the beginning and at the end of the experiment. A comparative analysis of changes in the level of coordination abilities of young gymnasts during the study is presented in Table 1.

As can be seen from the presented materials (Table 1), in the test "Juggling tennis balls with right hand", the improvement in the result at the end of the study was 15%. The athletes showed the average result in this test – 8,0±0,26 times at the beginning of the study and 9,2±0,20 times at the end. The difference between these indicators in accordance with Student's criterion is statistically significant, since $t_p > t_{th}$ (Table 1).

When performing the test "Juggling tennis balls with left hand", the following dynamics of changes are observed: an improvement in the result was 44%; the average result was 2,9±0,20 times at the beginning of the study and 4,2±0,35 times at the end. Comparison of these results by the Student's criterion shows that the difference between the mean group values is statistically significant ($p<0,05$).

The results of the study indicate that when performing the test "Shuttle run of 3x10 m, s", athletes showed a result of 10,8±0,11 s at the beginning of the study and 10,6±0,07 s at the end. The difference between these indicators is not statistically significant, because $t_p=2,04<t_{th}=2,07$.

The following indicators of the development of the ability to maintain posture (balance) also underwent shifts over the study period. If at the beginning of the study gymnasts could perform the "Pace with closed eyes on the right leg" on average for 41,4±0,71 s, then at the end this result increased to 46,3±1,06 s. The result of the comparison of these indicators indicate a statistically significant difference, since ($p<0,05$). The increase in the results shown by the gymnasts in this test during the study is 12%. Even better changes in the test results were observed when performing this test task for the left leg: at the beginning – 28,2±1,43 s, at the end – 34,7±1,40 s. In accordance with the student's criterion, the difference between averages is statistically significant ($p<0,05$). Improving the result is 23% (Table 1).

Improvement of results by 18% occurred in the test "Top". The athletes show the results of this test (initial testing – 4,90±0,19 s, retesting – 5,8±0,20 s) indicates that the difference between the average results shown during the exercise on the ability to maintain posture (equilibrium) is statistically significant since $p<0,05$ (Table 1).
To assess the development of the ability to maintain posture (balance) gymnasts who are engaged at the stage of preliminary basic training, performed the test "Three rolls – pace on the right leg". The average group results shown by the gymnasts were as follows: at the beginning of the study – 7,5±0,10 points, at the end – 8,1±0,11 points. The difference in the results is statistically significant ($t_p=3,91> t_{th}=2,07$). When performing this test on the left leg at the beginning of the study, the gymnasts received a group average result of 5,3±0,20 points, at the end – 5,9±0,24 points. The difference in the results of the test exercise "Three rolls – pace on the left leg" is not statistically significant ($t_p=1,88<t_{th}=2,07$).
To assess the development of the coordination of movements in athletes 8–10 years old was used "Test-exercise to determine motor memory". Gymnasts showed the average result – 2,6±0,24 attempts (initial testing) and 3,8±0,18 attempts (re-testing). According to Student's criterion, the difference between these results is statistically significant, since $p<0,05$. The increase in the results shown by the gymnasts during the study is 46%.
As the materials of the research show, in the test "clapping with the palms at a given rhythm" athletes showed an average result of 2,2±0,14 tasks at the beginning of the study and 2,5±0,13 tasks at the end. Comparison of these results by the Student's criterion shows that the difference between the mean group values is statistically insignificant ($t_p=1,71<t_{th}=2,07$) (Table 1).
To assess the complex changes in the culture of performing competitive compositions by young gymnasts, a comparative analysis was conducted of the results shown by the gymnasts of the study group at competitions held in October 2017 and May 2018. The results are presented in Figure 1.

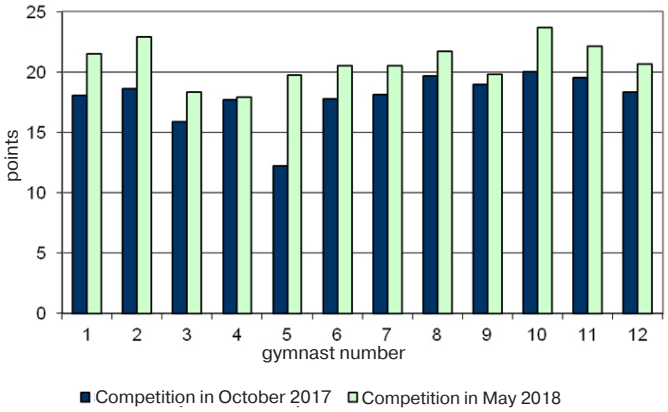

Figure 1. The results shown by young gymnasts in competitions in October 2017 (at the beginning of the experiment) and May 2018 (at the end of the experiment)

They testify that at the competitions that were held after the introduction of the technique, all athletes received the highest judicial scores for performing competitive compositions, which testifies to the effectiveness of the technique used by young gymnasts to improve competitive compositions through the use of non-traditional training tools in the training process.

Conclusions / Discussion

The results of the conducted research supplement the theoretical positions formulated in the works of I. A. Wiener [2], L. A. Karpenko, A. G. Rumba [6], A. Ya. Mullagildina [9], that rhythmic gymnastics belongs to those sports where an important role is played by the aesthetic meaning of the compositions and the manifestation of the artistic abilities of the athletes when performing competitive exercises. The results confirm the findings of experts [4; 6; 10; 13] that the modern stage of development of rhythmic gymnastics is characterized by an increase in the complexity of competitive programs, an increase in performance skills in strictly limited time parameters, which is determined by the rules of the competitions of the International Gymnastics Federation (FIG) [11].

The results of the whole complex of the research carried out confirm the conclusions of experts [2; 3; 4; 6; 10] that the aggravation of sports competition between the national teams of the world rhythmic gymnastics forces us to pay special attention to further improving the effectiveness of sports training and the search for additional funds that contribute to more effective mastery of motor skills and skills of young athletes. The effectiveness of the method of improving the performance of young gymnasts of competitive compositions through the use of non-traditional means of training in the training process is confirmed by the results of the study, namely, according to the results of individual multiathlon competitions in October 2017 and May 2018, gymnasts of the studied group improved their results by an average of 17,5%.

The results of the whole complex of the conducted research on the introduction of methods for improving the culture of movements of young gymnasts through the use of non-traditional means in the training process indicate its effectiveness. The developed technique not only increases the level of development of coordination abilities in young gymnasts, but also contributes to the formation of their main components of the culture of performing competitive compositions: coordination of movements with different parts of the body, purity of performance, amplitude, plasticity, expressiveness of movements and harmonious combination of movements with music.

Prospects for further research consist in introducing into the educational and training process of the children sports schools, clubs and specialized educational institutions of the developed method of enhancing the culture of young gymnasts performing competitive compositions through the use of non-traditional means of training for its further improvement.

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Relationship between power strength and anaerobic power index as a clear picture of the effect of strength training among young soccer elite players

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Purpose: *muscle contraction has both mechanical to produce movement and metabolic properties to produce energy. However, manipulation of strength training planes (horizontal or vertical) subject to be an important training strategy to develop soccer-specific power-based actions. Depending on mode of exercise and more important the energy demands.*

Material & Methods: *this cross-sectional study was conducted to inspect the relation between power strength and anaerobic power index, proper to mode of exercise (vertical vs horizontal) among young soccer elite players. To achieve this goal, we based on anaerobic capacity repeat sprint test power index for103 male players with mean age (18.55±0.48) years, involved in the Oran league competition division one. In addition to their strength in Vertical Jump (VJ) and Standing Long Jump Test (SLJ), conducted in the Omni sports complex of the institute physical education and sport Chlef.*

Results: *significant inverse correlations record between power strength and anaerobic power index in all comparisons practised. Support by the index of Max power anaerobic and fatigue as super predictors of players performance in horizontal plane. The opposite of vertical plane where the index of fatigue and Min power anaerobic are the super predictors.*

Conclusions: *our results confirmed that to have a clear picture of the effect of strength training on physical performance. Trainers must take in their consideration, the mode of exercise and their energy index power demands affirmed in present via the development of max power anaerobic to enhance not only minimal but also the index of fatigue requiring the good developments of neuromuscular function, in which max power anaerobic levels play a big part in maximizing scores not only in vertical plane but also in horizontal jump.*

Keywords: *youth training athletes, strength and conditioning, sports performance.*

Introduction

Coaching is the 'degrees of freedom' that might be expected in sports preparation and performance, given the complexity involved. Admitted as a multidimensional process to identify promotes talents [1]. Founded on critical predictors' factor of sports type game success permitting the athlete to compete at the highest level [2]. Suggested by sport-confidence model under three types (i.e., physical skills and training, cognitive efficiency, and resilience) [3]. Reported by Moe buekers, et al (2015) via a multidisciplinary approach to identify talented soccer [4].

Admitted via this research through physical demands of soccer. Suggesting from player the ability to recover from a high-level intensity limit of a neuromuscular function with regard to the strength/power training methods used [5]. Claims by soccer sciences study via adequate training look at aerobic and anaerobic program energy regimes demands [6]. Advocate in recent studies through the dominance of short actions of maximum intensity allied to power and speed as physical qualities of extreme relevance for the physical performance of the players [7]. More closely with their training program aerobic and anaerobic endurance associated with training responses (faster or slower) in relation to the specificity of abilities demands as well as the physical quality looked-for individuals growing at different stages of physiological development [2].

Recommend soccer players to should be careful with intensity training in line to effect of the high neuromuscular (excitability and unit recruitment) stress [7].

Claims by strength, fitness, and speed improvements [8] relative to muscle strength and neuromuscular coordination [9] more associated with muscular power [10] and force produced by the velocity in a given movement [11]. Especially in sports intermittent regimen that are taxed by a glycolytic metabolism [12] depending on the maximum strength and anaerobic power of the neuromuscular system as essential skills associate with ability of soccer players to perform complex multi-joint dynamic movements [13].

Well-maintained in this study as one of the most common ability to enhance players muscle explosiveness in complex tasks processes of coordination and control of change in environment player execution with and without [14] technical or tactical problems.

Requiring from players, more manoeuvres to maintaining body control and minimizing loss of power or speed [15]. As well as decision-making related to tone muscular solicitation [16].

In light of these findings, namely focusing on determinants of sports performance that allow, in a practical way, to moni-

tor the training, enhance the work of the coach, and, consequently, improve the athletic performance of the soccer players.

Upkeep by this study via the correlation between power strength and anaerobic power index as a clear picture of the effect of strength training on physical performance among young soccer elite players. Reported via the manipulation of training surfaces or planes as an important training strategy to develop soccer-specific power-based actions. At a high level of performance and well developments of neuromuscular function. Factors pertinent to uphold and/or develops both physiological and physical measures associated with the high-level performance of soccer players.

Aimed at present through the relation between power strength and anaerobic power index to inspect the need of players to increase their strength power-based vertical or horizontal jump achievement.

Material and Methods of the research

Participants

A cross-sectional study was piloted among 103 male Soccer players with mean (±SD) age of 18.55 (0.48) years, involved in the Oran league competition division one. Their mean (±SD) weight, height, body mass index, and some of the skinfolds were 66.86 (2.92) kg, 1,72 (1.02) m, 19.45 (0.51) kg·m^{-2}, 55.62 (4.45) mm. In addition to their strength, which was evaluated with Vertical jump (VJ) and Standing Long Jump Test (STJ), additional to their index anaerobic capacity based on Running-based Anaerobic Sprint Test (RAST). Which allows us to compare their performance in vertical and horizontal planes. Reported in similarities as indirect tests to esteem anaerobic power. All tests were practised after the end of pre-competitive phase. All participants are volunteers, first year's senior team. Table 1 describes the anthropometric characteristics and power performance and index of the sample. All tests were conducted in the Omni sports complex of the institute physical education and sport Chlef.

Anthropometric

Height (H) was measured to the nearest 0.1 cm with a portable stadiometer (Seca 213, Hamburg, Germany). Weight (W) was assessed to the nearest 0.1 kg with a Seca 635, Hamburg, Germany) instrument. All measures followed the rules of the International Society for the Advancement of Kinanthopometry [17].

Body composition

Eight skinfolds (triceps, subscapular, biceps, suprailiac, abdominal, supraspinal, thigh, and calf) were assessed twice (at 0.1 mm) with a Harpenden calliper (British Indicators, Ltd., London, UK). The procedure was performed by the pedagogical laboratory of our institute.

The sum of 6 (triceps, subscapular, abdominal, supraspinal, thigh, and calf) skinfolds (6SKF) calculated [18].

Running-based Anaerobic Sprint Test (RAST)

Developed to test a runner's anaerobic performance. It provides coaches with measurements of power and fatigue index. This test requires the athlete to undertake six 35-meter sprints with 10 seconds recovery between each sprint. Power output for each sprint is found using the following equations.

Power = Weight x Distance^2 / Time^3
Maximum power – the highest value
Minimum power – the lowest value
Fatigue Index – (Maximum power – Minimum power) / Total time for the 6 sprints

All the condition of the environmental test was adjusted to the regulations described by Federation International Roller Sports (FIRS) [19].

Standing Long Jump Test

Also called the Broad Jump, is a common and easy to administer test of explosive leg power. The subject attempts to jump as far as possible. A two-foot take-off) with swinging of the arms and bending of the knees [16; 20].

Statistical Analysis

All statistical analysis was computed with the Statistical Package MedCalc Version 18.11.2.

Mean and the standard deviation was performed regarding anthropometric and fitness characteristics. Regression analysis was used to predict the impact of a jump plane performance on the index of anaerobic power, according to RAST test validity.

Results of the research

All the relationships analysed between independent variables

Table 1

Anthropometric characteristics and power performance and index of sample

N=130	W, kg	H, cm	BMI	Max Power (RAST), watts	Min Power (RAST), watts	Fatigue Index (RAST), watts	VJ, cm	SLG, m	6SKF, cm
Mean	66,86	1,72	19,45	900,61	513,63	11,20	56,62	2,15	55,62
S.D.	5,92	0,78	0,51	81,12	42,62	1,75	5,89	1,89	4,45
Min	64,10	1,61	18,46	714,69	384,06	7,51	42,98	1,91	52,80
Max	74,00	1,77	20,65	1 108,36	609,09	14,81	68,02	2,65	59,06
Kurtosis	1,39	2,48	–0,40	0,02	–0,30	–0,83	–0,80	–0,80	–0,40
Skewness	0,17	0,51	0,01	0,30	–0,09	0,07	–0,03	–0,03	0,01
Variance	8,55	0,01	0,26	6 580,89	1 816,48	3,05	34,65	1,65	2,10
Median	66,80	1,70	19,54	895,60	516,07	10,98	55,68	2,02	55,89

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Table 1. Presents the average results obtained in the power (VJ and SLJ), power anaerobic index (Max Power (RAST), Min Power (RAST), and Fatigue Index (RAST)). As well as anthropometrics parameters (skinfolds (6SKF) and BMI).

Table 2
Regression analyses relating Vertical Jump with power anaerobic index and anthropometrics parameters studies

Dependent Y	Vertical Jump

Least squares multiple regression

Method	Forward
Enter variable if P<	0,05
Remove variable if P>	0,1

Sample size	103
Coefficient of determination R^2	0,9874
R^2-adjusted	0,9872
Multiple correlation coefficient	0,9937
Residual standard deviation	0,6669

Regression Equation

Independent variables	Coefficient	Std. Error	t	P	$r_{partial}$	$r_{semipartial}$	VIF
(Constant)	6,4333						
Fatigue Index (RAST)	2,3809	0,06425	37,056	<0,0001	0,9655	0,4157	2,885
Min Power (RAST)	0,04582	0,002632	17,412	<0,0001	0,8672	0,1953	2,885

Variables not included in the model
BMI, 6SKF Max Power (RAST)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square
Regression	2	3489,3185	1744,6593
Residual	100	44,4794	0,4448

F-ratio	3922,4023
Significance level	P<0,0001

Zero order and simple correlation coefficients

Variable	VJ	BMI	6SKF	Max Power	Fatigue Index
BMI	–0,6741				
6SKF	–0,8037	0,7767			
Max Power	0,3441	–0,2601	–0,2284		
Fatigue Index	0,9743	–0,6558	–0,7844	0,3374	
Min Power	0,9025	–0,6091	–0,7526	0,3483	0,8083

Residuals

Agostino-Pearson test for Normal distribution	accept Normality (P=0,1602)

and predictors are significant at P≤0.05. From the regression analyses, the program showed that Fatigue Index (RAST) Min Power (RAST) were able to explain the changes in vertical jump performance. The opposite of Standing Long Jump Test in Table 3 Were Max Power and Fatigue Index are the only predictors of the change in a player's performance under this test.

Conclusions / Discussion

Our results in all compresences practices are in conformity with the judgment report by Murtagh C.F., et al. (2018); that Strength training induces greater performance improvements in jump actions and these achievements varied according to the motor task [2]. Admitted by Portuguese experts in the association between vertical jumps and speed, acceleration in sprint seems to have great influence on CMJ performance [21–25]. Confirmed by Dragula L., et al., (2017) study as moderate correlations. Recorded by Wisluff U, et al., (2004) as strong correlations, spicily in half-squatting that increased sprint and jumping performance in soccer players [26]. Despite that, the central goal of strength/power training in a highly competitive sport is to improve the players' specific and relevant athletic activities inherent in their sport [10; 21–24]. As well as soccer activity involves both breaking and propulsive forces as distinct contraction modes and velocities

Table 3

Regression analyses relating Standing Long Jump Test with power anaerobic index and anthropometrics parameters studies

Dependent Y	Standing Long Jump Test

Least squares multiple regression

Method	Forward
Enter variable if P<	0,05
Remove variable if P>	0,1

Sample size	103
Coefficient of determination R^2	0,4009
R^2-adjusted	0,3890
Multiple correlation coefficient	0,6332
Residual standard deviation	0,1521

Regression Equation

Independent variables	Coefficient	Std. Error	t	P	$r_{partial}$	$r_{semipartial}$	VIF
(Constant)	1,2030						
Max Power	0,001612	0,0001972	8,174	<0,0001	0,6329	0,6326	1,128
Fatigue Index	–0,02826	0,009164	–3,084	0,0026	–0,2947	0,2387	1,128

Variables not included in the model
BMI, 6SKF, Min Power

Analysis of Variance

Source	DF	Sum of Squares	Mean Square
Regression	2	1,5479	0,7740
Residual	100	2,3128	0,02313

F-ratio	33,4641
Significance level	P<0,0001

Zero order and simple correlation coefficients

Variable	VTJ	BMI	6SKF	Max Power	Fatigue Index
BMI	0,01162				
6SKF	0,05112	0,7767			
Max Power	0,5865	–0,2601	–0,2284		
Fatigue Index	–0,02682	–0,6558	–0,7844	0,3374	
Min Power	0,09774	–0,6091	–0,7526	0,3483	0,8083

Residuals

Agostino-Pearson test for Normal distribution	accept Normality (P=0,1885)

that require all force-velocity potential of the neuromuscular system.

Our data based on VJ and their correlation with anaerobic power indicators. Confirmed that optimal levels of maximum strength depend on neuromuscular system ability force production [11]. Recorded in this study by mean of Fatigue and Min Power index as the only predictors of the change in vertical performance. In the benefits of over anaerobic power max developments to enhance the jump performance in all aspects and planes. Support by Max Power and Fatigue Index as the only predictors of the change in Standing Long Jump Test players performance.

Confirmed by its complexity manoeuvre that requires players to combine components of vertical leg power, horizontal leg power, and a complex motor scheme (involving rudimentary calculations of impulse and take-off angle) in combination with a full-body coordinated movement to jump to maximum potential [27]. In the opposite of the vertical jump, which request leg power to jump with maximum potential. Admitted by the impact of neuromuscular system ability force production in the achievement of greater power strength [14; 16]. Independently of a player's level, strength-related [28] to role of neuromuscular system ability force production as one of the most important factors [28] affecting maximal power pro-

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duction [30]. Affirmed by football literature via the initial state of the neuromuscular system (e.g. energy reserves, ion concentrations and the arrangement of contractile proteins) is altered as soon as exercise starts [31]. Supported by this study via Muscle contraction and its relation with metabolic properties to produce energy. Claims via exercise planes or surfaces (horizontal or vertical) that must be taken as a training strategy to develop soccer-specific power-based actions. Concluded via this study as a clear picture of the effect of strength training on physical performance. Confirmed by the study design at submaximal intensity, i.e. 70 to 80% of the maximal aerobic power. Revealed in similar to the inability to maintain the required force appears to coincide with the depletion of the leg extensors' glycogen reserves [32]. Support by this study in the superiority of the standing long jump than vertical jump, to give a better overall impression of an athlete's current abilities, according to Burr, et al (2008).

It was possible to designate inverse correlations between power anaerobic index with the performance in vertical jumps or horizontal jump. Despite this relation, suggest that jumps are an easy and good prediction sports training tool in the benefits of over anaerobic power max developments to enhance the jump performance in all aspects and planes specially intermittent sports. Demanding from players and coaches to understanding the role of neuromuscular system ability force production as one of the most important factors affecting maximal power production. Supported by Muscle contraction and its relation with metabolic properties to produce energy. Claims through exercise planes or surfaces (horizontal or vertical) that must be taken as a training strategy to develop soccer-specific power-based actions. Support by similarities in standing long jump distance that may give a better overall impression of an athlete's current power abilities (max power relative to fatigue index) than Vertical jump (index fatigue relative to Min power). Predict in this study as a clear picture of the effect of strength training on the power index to manipulation training planes (horizontal or vertical). Recommended as an important training strategy to develop soccer-specific power-based actions among the young soccer elite.

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Effectiveness of the use of aquaaerobics in the process of sectional classes in swimming students 18–19 years

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Purpose: *evaluate the effectiveness of the use of aqua aerobics in the sectional swimming lessons program for students aged 18–19 years to improve their overall physical condition.*

Material & Methods: *the study involved students aged 18–19 years (n=46). Evaluation of the effectiveness of aqua aerobics in the process of sectional swimming lessons was carried out on the basis of the results of a comparative analysis of the characteristics of the dynamics of the functional state of the cardiovascular system, external respiration system, the level of functional, general and special physical preparedness of students of the control and experimental groups during the school year.*

Results: *it is shown that the introduction of aqua aerobics into the sectional swimming lessons program for students aged 18–19 years has contributed to a significant improvement in the functional status of the cardiorespiratory system of their body, the level of functional and special physical fitness. At the end of the school year, students of the experimental group were characterized by significantly higher, compared with the control group, the rate of improvement of all indicators of physical condition by 5–14%.*

Conclusions: *the obtained results testified to the high efficiency of using aqua aerobics in the sectional swimming lessons program for students aged 18–19 years in a higher education institution setting.*

Keywords: *functional state, functional preparedness, special physical preparedness, students aged 18–19 years, sectional classes, swimming, aqua aerobics.*

Introduction

Modern living conditions are characterized by a significant complication of the socio-economic and environmental situation in society, reflected in a significant deterioration in the health and physical preparedness of various segments of the population, in particular, students [1; 8; 9; 12; 21].

In connection with the above, today the role of physical culture and sports in increasing the general physical condition of students and forming an adequate form of adaptation to adverse environmental factors significantly increases. At the same time, the last controversial reforms in the system of physical education of students of higher educational institutions, which envisage a significant reduction in the time of compulsory physical education classes and reorientation solely on optional sectional classes in various sports, require the development of new programs of these classes in accordance with modern requirements and motivational student characteristics.

Studies of many experts have proved the high efficiency of swimming lessons in improving the general physical condition and level of health of various groups of the population, in particular, students [5; 13; 18; 22; 23]. At the same time, changes in the system of physical education of students need to improve sectional swimming lessons, in particular, through the use of the most accessible, emotional and popular types of physical exercises, which include aqua aerobics [2; 4; 10; 24; 26].

An analysis of the scientific and methodological literature on this issue allowed us to state a certain limitation of experimental studies in this direction, which became the prerequisites for conducting this research.

Purpose of the study: evaluate the effectiveness of the use of aqua aerobics in the sectional swimming lessons program for students aged 18–19 years to improve their overall physical condition.

Material and Methods of the research

The study involved 46 second-year students of Zaporizhzhya National University, which were divided into control (n=24) and experimental (n=22) groups. The students of the control group were engaged in the traditional program of sectional swimming lessons, and the students of the experimental group - in the program of sectional swimming lessons with the inclusion of aqua aerobics. Physical exercises from aqua aerobics were used as part of general physical training to improve basic physical qualities that are most important for the chosen sport (swimming) (strength, endurance, flexibility, coordination). When planning each aqua aerobics class, the opinion of leading experts in the field of physical education and sport was taken into account [11; 12; 19] regarding the fact that in one class it is possible to use funds aimed at developing no more than two physical qualities. It was suggested that the following combinations be used in one session: coordination and strength exercises; strength and flexibility exercises; exercises to develop solely endurance, strength, speed-strength abilities..

According to the data presented in the framework of the experimental program proposed by us, in the first and second

classes of 3, 6 and 9 weeks, exercises on the development of general endurance alone were used; in the first and second classes of 4 and 10 weeks, exercises were used to develop speed-strength abilities exclusively; in both classes, 1, 2 and 8 weeks – for the development of strength and flexibility, and within 5, 7 and 11 weeks – for the development of strength and coordination.

The assessment of the effectiveness of the use of aqua aerobics in the course of sectional swimming exercises was conducted on the basis of comparative analysis of the features of the dynamics of the functional state of the cardiovascular system, the system of external respiration, the level of functional, general and special physical preparedness of students of control and experimental groups during the school year.

The main features of the experimental program consisted in using within the program elements of aqua aerobics, which were selected for the corresponding development of basic physical qualities (strength, speed, agility, coordination, strength, speed-strength endurance, etc.). It should be noted that, similarly to the traditional program of ZNU, in the framework of the experimental program in the process of sectional swimming lessons, the two most accessible swimming styles (crawl and breaststroke) were used, and young people with an initial level of physical condition not lower than the average were introduced to the classes.

Testing was conducted at the beginning (September) and at the end (June) of the school year.

To assess the level of the functional state of the cardiovascular system (LFScvs, points) and the respiratory system (LFSrs, points), we used traditional physiological methods and the computer program "SSHS-integral" [16]. According to the examination algorithm, the tested person is measured in a state of relative rest, the heart rate, systolic and diastolic blood pressure, lung capacity, breathing time during inhalation and exhalation are recorded, and the length and body weight values are determined. After entering the values of these indicators into the active window of the "SSHS-integral" program, the values of the integral indicators (LFScvs and LFSrs) are automatically calculated with their division into functional levels: "low", "below average", "average", "above average", "high".

To assess the level of functional preparedness in the study, a computer program for rapid assessment of the level of general functional preparedness "SSHS" was used. The examination algorithm in the framework of this program provided for the implementation of the standard submaximal veloergometric test PWC_{170}, as well as measuring the length (cm) and weight (kg) of the body being examined. The program carried out an automatic calculation of the integral index – the level of functional preparedness of the organism (LFP, points) with the distribution into functional classes "low", "below average", "average", "above average", "high" [16].

In order to assess the level of special physical fitness, the students tested the special high-speed students' capabilities (they determined the time to overcome the distance of 25 m in the free style, the reference time to overcome the distance of 50 m and the average time on the interval of 50 m in overcoming the distance of 400 m free style), special stamina for adapted to the aqueous medium by the Cooper test, the special flexibility of the methods of A. D. Vikulov [3], V. Platonov [19] and Yu. V. Menghin [17] and special technical preparation according to the method of L. P. Makarenko [14]. On the basis of the obtained data using the modified SCOLIPE scale, the level of special physical preparedness of students was calculated (SPPz, points).

Statistical processing of the results of the study was carried out using the packages of standard programs "STATISTICA 7.0" and EXEL with the calculation of the following indicators: arithmetic mean ($\bar{X}$), mean deviation (σ), error arithmetic mean (S).

Results of the research

The results of the ascertaining examination of students of the control and experimental groups at the beginning of the school year showed that there were no significant differences in the values of all the indicators of their overall physical condition used in the study (Table 1).

It was shown that the level of the functional state of the cardiovascular system (70,74±2,19 points in the control group and 73,16±2,26 points in the experimental group) and the respiratory system (respectively 69,21±0,80 points) and 71,41±1,16 points) for the representatives of both groups answered the functional class "above average", the level of functional readi-

Table 1

Indicators of the physical condition of students 18–19 years of control and experimental groups at the beginning of the experiment ($\bar{X}$±S)

Indicators	Control group (n=24)		Experimental group (n=22)	
	At the beginning	At the end	At the beginning	At the end
LFScvs, points	70,74±2,19 above average	76,93±2,38* above average	73,16±2,26 above average	83,53±1,8**•• above average
LFSrs, points	69,21±0,80 above average	71,23±0,84 above average	71,41±1,16 above average	86,55±1,4***••• above average
LFP, points	57,19±3,45 average	62,71±3,25 average	58,59±3,17 average	72,27±3,08***••• above average
SPPz, points	47,81±1,92 below average	52,43±1,79* average	48,25±1,84 below average	59,61±1,78***•• average

Remark. ** – p<0,05; ** – p<0,01; *** – p<0,001 compared with the beginning of the study; •• – p<0,01; ••• – p<0,001 compared with the control group.*

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ness (respectively 57,19±3,45 points and 58,59±3,17 points) were considered as average, and special physical preparedness (47,81±1,92 points and 48,25±1,84 points) as below average.

The data presented testified to the relative homogeneity of students from the control and experimental groups at the beginning of the study, which is of great importance for further objective interpretation of the research results.

The results of the final testing allowed us to state the high efficiency of our proposed experimental sectional swimming lesson program using aqua aerobics.

According to the results of Table 1, at the end of the school year, the students of the control group were characterized by a significant improvement only in the level of the functional state of the cardiovascular system (76,93±2,38 points) and the level of their special physical preparedness (up to 52,43±1,79 points), which was already considered as average.

On the contrary, among the students of the experimental group there was a significant improvement in all indicators, namely, the level of the functional state of the cardiovascular system to 83,53±1,8 points, the respiratory system 86,55±1,4 points, the level of functional readiness to 72,27±3,08 points and the functional class are above the average, and the level of special physical preparedness to 59,61±1,78 points.

It should also be noted that the values of all the studied parameters of the students of the experimental group at the end of the study were significantly better compared with the representatives of the control group.

A weighty confirmation of the effectiveness of the experimental sectional swimming lesson program was also the results of a comparative analysis of the values of relative changes in the indices of the general physical condition of students from the control and experimental groups at the end of the study (Figure 1).

It was shown that at the end of the study for the students of the experimental group, the rate of improvement of the functional state of the cardiovascular system (by 5,4%), the system of external respiration (by 18,3%), the level of functional preparedness (by 13,6%) and level of special physical preparedness (by 13,8%).

Thus, the obtained results testified to the higher efficiency of the experimental program of sectional swimming lessons for students 18–19 years in the context of the establishment of higher education.

Conclusions / Discussion

According to the results of the analysis of the problem of optimizing the general physical condition of students in the course of sectional swimming exercises in the conditions of the establishment of higher education, the need for further improvement of the program of these classes through the introduction of means of accessible and popular among the student youth of types of physical exercises, coincides with the data of studies of other authors [6; 7; 15; 20; 25].

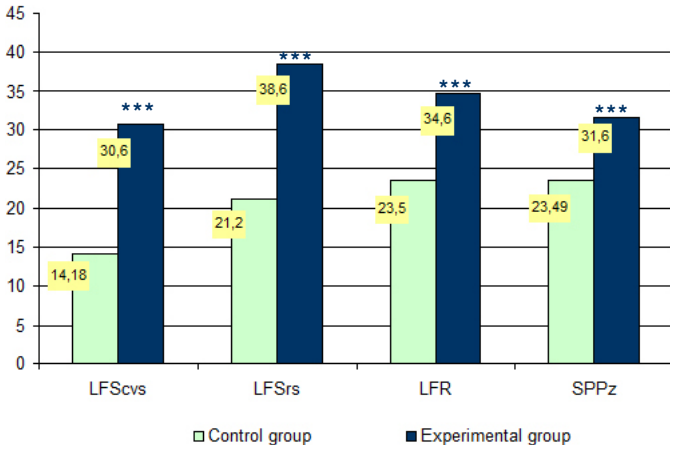

Figure 1. Values of the relative changes in the physical condition of students of the control and experimental groups at the end of the study (in% to baseline values): *LFScvs – level of the functional state of the cardiovascular system; LFSrs – the level of the functional state of the external respiration system; LFP – the level of functional preparedness; SPPz – general level of special physical preparedness; *** – p<0,001 001 compared with the control group.*

It should be noted that for the first time, integral quantitative indicators of the level of functional and special physical preparedness, the functional state of the cardiovascular system and the respiratory system, which include the main structural components, were used to determine and assess the general level of the physical condition of students. These indicators can be considered as objective criteria for evaluating the effectiveness of the sectional classes program for university students.

The results presented showed a pronounced optimization of the functional state of the cardiorespiratory system of the examined students, an improvement in their functional and special physical preparedness, and confirmed the high effectiveness of the proposed sectional swimming program using aqua aerobics.

Prospects for further research in this direction are to further study the dynamics of the general level of the physical condition of students in the process of sectional swimming lessons in a higher education institution.

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