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CONTENT

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Indicators of the speed movement in juvenile in rowing on kayaks

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Purpose: *to study the indicators of the physical quality of the speed and its constituent elements.*

Material & Methods: *juvenile were examined in the age groups 11–12 years, 13–14 years, 15–16 years, 17–18 years, various sports qualifications, specializing in rowing on kayaks. According to the method of measurement of the effect of the training action developed by us, the tempo, time and speed of single movement, the frequency of movements were determined, and sensorimotor responses to sound and light stimuli were simulated in modeling the conditions of training and competitive activity.*

Results: *the conducted researches characterize the individual psycho-physiological characteristics of the athlete's body. For the purposeful study and development of the physical quality of the speed in the training process, it is possible to use the proposed method for studying the effect of the training action. Formation and improvement of motor abilities in specific age ranges is carried out in connection with high rates of development of morphological and functional indicators in sensitive periods. The studied indicators of the physical quality of the rapidity and its constituent elements depend on the age, the level of general physical and functional readiness.*

Conclusion: *for the improvement of motor qualities and the formation of rapidity of movements, the age periods under study are the most favorable prerequisites. As a result of the training process, the tempo, time, speed, frequency of movements, time of sensorimotor reactions to sound and light stimuli change.*

Keywords: *speed, pace, time and speed of one movement, the frequency of movements, the time of sensorimotor reactions to sound and light stimuli.*

Introduction

Speed characteristics of movements determine the ability of a person to perform actions in the minimum period for these conditions. Thus, quickness is a person's specific ability for emergency motor reactions and high speed of movements performed in the absence of significant external resistance, complex coordination of the muscles, and does not require large energy expenditure. Improving the speed of response to the actions of a partner or an opponent in professional activities and sports, as well as studying the speed of movement as a person's physical quality, the means and methods of its development are of great importance [1; 2].

In motor activity, elementary forms of manifestation of speed abilities can be in various combinations and in combination with other physical qualities and technical actions. In this case, there is a complex manifestation of speed abilities. These include: the speed of the implementation of integral motor actions, the ability to gain maximum speed and ability to maintain it for as long as possible. However, the speed of their implementation in various sports only indirectly characterizes the speed of a person, because it is caused not only by the level of development of speed, but also by other factors, in particular, the technique of possessing an action, coordination abilities, motivation, volitional qualities [3; 4].

Speed and speed of movements are caused by a number of factors: the state of the central nervous system and the neuromuscular apparatus; morphological features of muscle tissue; the strength of the muscles and their ability to quickly move from contraction to relaxation; energy reserves in the muscle; amplitude of movements and ability to coordinate movements during high-speed work; biological rhythm of vital functions of the organism; age and sex; genetic predisposition [5; 6].

The speed of the reaction depends on the rate of occurrence of excitation in the receptor (visual, auditory, tactile, etc.) involved in the perception of the signal; transfer of excitation to the central nervous system and its analysis; the transition of signal information along the neural pathways; formation and conduct of an efferent signal from the central nervous system to the muscle; stimulation of the muscle and its contractile activity. One of the manifestations of the physical quality of speed is the speed of the reaction, which has great importance in sports. Often the result of wrestling depends on how timely and rationally the athlete reacts to changes in the competitive situation or performs the starting action [7; 8].

The frequency of movements characterizes the rate of transition of the motor nerve centers from the state of excitation to the state of inhibition and vice versa, that is, the lability of the nervous processes. Thus, the speed manifested in integral motor actions is affected by: the frequency of neuromuscular impulses, the speed of the transition of muscles from the tension phase to the relaxation phase, the rate of alternation

of these phases, the degree of inclusion in the process of the movement of rapidly contracting muscle fibers and their synchronous operation [3; 8; 9].

Human speed abilities are very specific, and as a rule, there is no direct transfer of speed to other movements among trained athletes. A small transfer can only be for physically poorly trained people. Therefore, in order to increase the speed of performing certain specialized movements, it is necessary to train primarily the speed at which these actions are performed. In the training session, aimed at increasing the speed of voluntary movements, the general tendency is the desire to exceed the maximum speed when performing exercises. When performing a series of movements with the maximum frequency of the moving limb (body part), kinetic energy is first reported, which is then inhibited by the antagonist muscles, and the same segment is given back acceleration, etc. With increasing frequency of movements, muscle activity can become so short-lived, that the muscles at any time will not be able to completely reduce and relax during short periods of time. Therefore, the development of speed abilities is due not only to the rapidity of contraction of working muscles, but also to the speed of their relaxation. Highly qualified athletes, as a rule, characterize the ability to reduce the time of voluntary relaxation of working muscles in movements with the limiting frequency [4; 6; 10].

Purpose of the study: to study the indicators of the physical quality of the speed and its constituent elements.

Material and Methods of the research

Young men, students of the sports school, physical education colleges and university students, specializing in rowing in kayaks aged 11–12 (21 persons, without sports category), 13–14 years (20 people (2 sports category)) were examined, 15–16 years (20 people, 2 and 1 sport categories) and 17–18 years (25 people, first-timers and candidates for master of sports).

The sensorimotor responses to sound and light stimuli were investigated, and the tempo, time and speed of one movement, the frequency of movements, which were studied in three periods of the test and recorded in an automatic mode, were determined by the method of measuring the effect of the training action developed by us. The athletes were tasked to make the movements with the leading hand as fast as possible and accurately between the targets located at a distance of 30 cm from each other, and try to get into their centers by a special rod. The first test period – 15 s – shows the starting speed, i.e. the beginning of work with the optimal functional state of the organism, the second – 60 s – in the process of long-term operation, the remote speed, the third – 15 s – the ability of the organism at the end of testing to maintain high tempo and speed movements, i.e., speed endurance, the total result for the three periods of the study characterizes the speed capabilities. The methodology of the research was published in detail in the journal "*Slobozans`kij naukovo-sportivnij visnik*", 2015, No. 4 (48), pp. 19-25 [11].

Results of the research and their discussion

In the test for measuring the effect of the training action in the age group 11–12 years (Table 1) in the first period, young athletes maintained a tempo of 28,5±0,99 movements, a maximum figure of 31 movements (more than an average of 1,5 movements – 8,77%) and the minimum 23 movements (less than the average – 5,5 motions – 23,91%), while the time of one movement averaged 0,526 s, maximum – 0,483 s (deviation from the average value by 0,43 s – 8,9%), minimum – 0,652 s (deviation from the average by 0,126 s – 23,95%); the speed of one movement corresponded to 0,570 $m \cdot s^{-1}$, the maximum figure was 0,621 $m \cdot s^{-1}$, that is more than the average 0,051 $m \cdot s^{-1}$ – 8,95%, the minimum – 0,461 $m \cdot s^{-1}$, which is less than the average by 0,109 $m \cdot s^{-1}$ – 23,64%; the frequency of movements was, on average, 1,9 Hz, maximum – 2,06 Hz (more than the average value of 0,16 Hz – 8,42%), minimum – 1,53 Hz (less than the average – on 0,37 Hz – 24,18%).

Table 1

Indicators of physical quality of speed (boys 11–12 years, rowing on kayaks)

		Indicators	M±m	M_{max}	M_{min}
effect of training action	First period	rate (number of movements)	28,5±0,99	31	23
		time of one motion (s)	0,526	0,483	0,652
		speed of one motion ($m \cdot s^{-1}$)	0,570	0,621	0,461
		frequency of movements (Hz)	1,90	2,06	1,53
	Second period	rate * (number of movements)	138±12,37 (34,5±4,09)	159 (39,75)	107 (26,75)
		time of one motion (s)	0,435	0,377	0,560
		speed of one motion ($m \cdot s^{-1}$)	0,689	0,795	0,536
		frequency of movements (Hz)	2,30	2,65	1,78
	Third period	rate (number of movements)	34±1,359	39	28
		time of one motion (s)	0,441	0,385	0,536
		speed of one motion ($m \cdot s^{-1}$)	0,681	0,779	0,559
		frequency of movements (Hz)	2,27	2,60	1,87
	Totally	rate (number of movements)	200,5±4,91 (33,42±3,02)	229 (38,16)	158 (26,33)
		time of one motion (s)	0,449	0,393	0,569
		speed of one motion ($m \cdot s^{-1}$)	0,668	0,763	0,527
		frequency of movements (Hz)	2,23	2,54	1,75
Time of sensorimotor reaction					
		sound (s)	0,207±0,006	0,236	0,185
		light (s)	0,232±0,01	0,272	0,189

Remark. ** – in parentheses the data given to a single time indicator of 15 s are indicated, in particular, 138±12,37 (34,5±4,09).*

In the second test period, the tempo was 34,5±4,09 movements, a large deviation from the average indicates a different functional fitness of young athletes, and this is confirmed by fluctuations in the maximum indicator – 39,75 movements (deviation from the average – by 15,22%) and the minimum – 26,75 movements (deviation from the average – by 28,97%); the time of one movement averaged 0,435 s, the maximum indicator was 0,377 s (less than the average by 15,38%), the minimum – 0,560 s (more than the average – for 28,74%); speed of one motion corresponded to 0,689 $m \cdot s^{-1}$, with a maximum speed of 0,795 $m \cdot s^{-1}$ (more than the average by 15,38%) and a minimum speed of 0,536 $m \cdot s^{-1}$ (less than the average by 28,54%); the average frequency of movements was 2,3 Hz, the maximum frequency was 2.65 Hz (an increase of 15,22% compared with the average), the minimum frequency was 1,78 Hz (a decrease from the average on 29,21%).

In the third period of the test, measuring the effect of the training action in the group of athletes aged 11–12 years, the tempo was 34±1,359 movements, the maximum figure was 39 movements, which is 14,71% more than the average, the minimum 28 movements (less than 21–43%); the time of one movement is 0,441 s, the best result is 0,385 s, which is less than the average by 14,55%, the minimum is 0,536 s, the average is 21,54%; the speed of one movement on the average corresponded to 0,681 $m \cdot s^{-1}$, the maximum indicator was 0,779 $m \cdot s^{-1}$ (the average is 14,39%), the minimum was 0,559 $m \cdot s^{-1}$ (less than the average by 21,54%), the average frequency of movements was 2,27 Hz, the maximum result was 2,6 Hz, the average frequency was 14,53%, the minimum frequency was 1,87 Hz, – on 21,39%.

Totally, for three test periods, the tempo was 33,42±3,02 movements, maximum – 38,16 movements, which is 14,18% higher than the average, and 26,33 movements, which is 26,93% less than the average; the time of one movement on the average is 0,449 s, the best result is 0,393 s (less than average – 14,25%), the minimum – 0,569 s (more than the average – 26,73%); the speed of one movement was 0,668 $m \cdot s^{-1}$ on average, 0,763 $m \cdot s^{-1}$ at the maximum (14,22% higher than the average value), and at a minimum – 0,527 $m \cdot s^{-1}$ (less than the average – by 26,76%); the average frequency of movements is 2,23 Hz, the maximum figure is 2,54 Hz, which is 13,91% more than the average, and the minimum frequency is 1,75 Hz, which is less than the average – on 27,43%.

The rate of occurrence and conduction of excitation in the visual and auditory analyzers was determined by the speed of a simple sensorimotor reaction over the time interval from the moment of the appearance of the signal to the onset of motion. The time of sensorimotor reaction to a sound stimulus equaled on the average 0,207±0,006 s, the maximum value was 0,236 s, the deviation from the average was 0,029 s or 14,01%, the minimum was 0,185 s, the deviation from the average was 0,022 s or 11,89%. The time of sensorimotor reaction to the light stimulus averaged 0,232±0,01 s and was within the maximum – 0,272 s, the deviation from the mean value by 0,04 s (17,24%) and the minimum – 0,189 s, the deviation – 0,043 s (22,75%).

When studying the indicators studied, athletes aged 13–14 years, specializing in rowing on kayaks, were noted the following results (Table 2).

In the first period of the measurement of the effect of the training action, the tempo was an average of 31±1,24 movements, with a maximum result of 36 movements, which is more than the average for 5 movements (16,13%) and the minimum – 23 movements, which is less than the average – by 8 movements (34,78%); time of one movement is 0,448 s, the maximum is 0,417 s with a deviation from the mean by 0,067 s (16,07%) and the minimum is 0,652 s, the average is by 0,168 s (34,71%); the speed of one motion averaged 0,619 $m \cdot s^{-1}$, a maximum of 0,719 $m \cdot s^{-1}$, which is more than the average of 0,100 $m \cdot s^{-1}$ (16,16%) and a minimum of 0,461 $m \cdot s^{-1}$ the average – by 0,158 $m \cdot s^{-1}$ (34,27%); the frequency of movements

Table 2

Indicators of physical quality of speed (boys 13–12 years, rowing on kayaks)

		Indicators	M±m	M_{max}	M_{min}
effect of training action	First period	rate (number of movements)	31±1,24	36	23
		time of one motion (s)	0,484	0,417	0,652
		speed of one motion ($m \cdot s^{-1}$)	0,619	0,719	0,461
		frequency of movements (Hz)	2,06	2,40	1,53
	Second period	rate * (number of movements)	133±5,53 (33,25±1,38)	156 (39)	98 (24,5)
		time of one motion (s)	0,451	0,385	0,612
		speed of one motion ($m \cdot s^{-1}$)	0,665	0,779	0,491
		frequency of movements (Hz)	2,22	2,60	1,63
	Third period	rate (number of movements)	34±1,53	41	25
		time of one motion (s)	0,441	0,366	0,601
		speed of one motion ($m \cdot s^{-1}$)	0,681	0,819	0,499
		frequency of movements (Hz)	2,27	2,73	1,67
	Totally	rate (number of movements)	198±2,57 (33±0,43)	233 (38,83)	146 (24,33)
		time of one motion (s)	0,455	0,386	0,616
		speed of one motion ($m \cdot s^{-1}$)	0,659	0,777	0,487
		frequency of movements (Hz)	2,2	2,58	1,62
Time of sensorimotor reaction					
		sound (s)	0,182±0,007	0,249	0,167
		light (s)	0,216±0,015	0,269	0,158

Remark. ** – in parentheses the data given to a single time indicator of 15 s are indicated, in particular, 133±5,53 (33,25±1,38).*

is average – 2,06 Hz, maximum – 2,4 Hz, more than average – 0,34 Hz (16,51%), minimum – 1,53 Hz (less than the average – at 0,53 Hz (34,64%)).

In the second period of the test, the tempo was 33,25±1,38 movements, maximum 39 movements, which is more than the average by 5,75 movements (17,29%) and minimally – 24,5 movements, which is less than the average – by 8,75 movements (35,71%), one movement time – 0,451 s, the best result – 0,385 s, less than the average of 0,066 s (17,14%), the worst one – 0,12 s, more than the average of 0,161 s (35,69%); the speed of one movement averaged 0,665 $m \cdot s^{-1}$ at aximum value of 0,79 $m \cdot s^{-1}$ (more than the mean of 0,14 $m \cdot s^{-1}$ or 17,14%) and a minimum of 0,491 $m \cdot s^{-1}$ (less than the average for 0,174 $m \cdot s^{-1}$ or 35,44%); frequency of movements – 2,22 Hz, maximum – 2,6 Hz (more than average – 0,38 Hz or 17,12%), minimum – 1,63 Hz (less than the average – at 0,59 Hz or 36,19%).

In the third period of the test, the following was observed: average tempo – 34±1,53 movements, maximum – 41 movements, more for 7 movements (20,59%) and minimum – 25 movements, less for 9 movements (36,00%); the time of one movement is 0,441 s, the best result is 0,366 s, the average is 0,075 s (20,49%), the worst is 0,601 s, the average is 0,160 s (36,28%); the speed of one movement is 0.681 $m \cdot s^{-1}$, the maximum speed is 0,819 $m \cdot s^{-1}$, the average is 0,138 $m \cdot s^{-1}$ (20,26%) and the minimum speed is 0,499 $m \cdot s^{-1}$ – by 0,182 $m \cdot s^{-1}$ (36.47%); frequency of movements – 2,27 Hz, maximum – 2,73 Hz, more than average indicator 0,46 Hz (20,26%) minimum – 1,67 Hz, less than the average – at 0,60 Hz (35,93%).

In the overall test score, the pace averaged 33±0,43 movements, a maximum of 38,83 movements, more than the average of 5,83 movements (17,67%) and a minimum of 24,33 movements, less than the average of 8,67 movements (35,64%); the time of one movement is 0,455 s on average, the best result is 0,386 s, the average is 0,069 s (17,88%) and the worst is 0,616 s, the average is 0,161 s (38,38%); the speed of one movement averaged 0,659 $m \cdot s^{-1}$, the maximum speed was 0,777 $m \cdot s^{-1}$, the average speed was 0,118 $m \cdot s^{-1}$ (17,91%) and the minimum speed was 0,487 $m \cdot s^{-1}$, on 0,172 $m \cdot s^{-1}$ (35,32%); the frequency of movements on the average is 2,2 Hz, maximum is 2,58 Hz, more than the average value by 0,38 Hz (17,27%) and minimally – 1,62 Hz, less than the average at 0,58 Hz (35,81%).

When measuring sensorimotor reactions in athletes aged 13–14 years, specializing in rowing on kayaks, the following results were noted. The mean response time to the sound stimulus was in the range of 0,182±0,007 $m \cdot s^{-1}$, with a better index of 0,167 s (deviation from the average – 0,015 s or 8,98%) and worse – 0,249 s (deviation from the average by 0,067 s or 36,81%). The sensorimotor response time to the light signal averaged 0,216±0,015 s, with a minimum result of 0,158 s, which is better than the average by 0,058 s (36,71%) and the maximum – 0,269 s, which is more than the average, i.e., the response rate is less on 0,053 s (24,54%).

In the group of 15–16-year-old athletes engaged in kayak rowing, the following data were obtained in the test for measuring the effect of the training action (Table 3).

In the first test period, the average rate was 32±2,05 movements, maximum – 37 movements, which is more than the average value by 5 movements or 15,63% and minimally – 23 movements, which is less than the average – by 9 movements or 39,13%; the time of one motion on the average is 0,468 s, the minimum time is 0,405 s, which is better than the average result by 0,063 s (15,56%) and the maximum time is 0,652 s, which is worse than the average by 0,184 s (39,32%); the speed of one movement reached an average of 0,641 $m \cdot s^{-1}$, a maximum of 0,741 $m \cdot s^{-1}$, more than the average of 0,1 $m \cdot s^{-1}$ (15,60%), a minimum of 0,461 $m \cdot s^{-1}$, less than the average – by 0,18 $m \cdot s^{-1}$ (39,05%); the frequency of movements on the

Table 3

Indicators of physical quality of speed (boys 15–16 years, rowing on kayaks)

		Indicators	M±m	M_{max}	M_{min}
effect of training action	First period	rate (number of movements)	32±2,05	37	23
		time of one motion (s)	0,468	0,405	0,652
		speed of one motion ($m \cdot s^{-1}$)	0,641	0,741	0,461
		frequency of movements (Hz)	2,13	2,47	1,53
	Second period	rate* (number of movements)	142±6,22 (35,5±1,56)	156 (39)	105 (26,25)
		time of one motion (s)	0,423	0,385	0,571
		speed of one motion ($m \cdot s^{-1}$)	0,709	0,779	0,525
		frequency of movements (Hz)	2,37	2,60	1,75
	Third period	rate (number of movements)	37±3,08	41	27
		time of one motion (s)	0,405	0,366	0,556
		speed of one motion ($m \cdot s^{-1}$)	0,741	0,819	0,539
		frequency of movements (Hz)	2,47	2,73	1,80
	Totally	rate (number of movements)	211±3,78 (35,17±1,26)	234 (39)	155 (28,83)
		time of one motion (s)	0,427	0,385	0,581
		speed of one motion ($m \cdot s^{-1}$)	0,703	0,779	0,516
		frequency of movements (Hz)	2,34	2,6	1,72
Time of sensorimotor reaction					
		sound (s)	0,170±0,01	0,250	0,150
		light (s)	0,194±0,006	0,225	0,170

Remark. ** – in parentheses the data given to a single time indicator of 15 s are indicated, in particular, 142±6,22 (35,5±1,56).*

average is 2,13 Hz, the maximum is 2,47 Hz, is more than the average value by 0,34 Hz (15,96%), the minimum is 1,53 Hz, – on 0,6 Hz (39,22%).

In the second period of the test, the average tempo was determined to be – 35,5±1,56 movements, maximum – 39 movements, more than the average value for 3,5 movements (9,86%) and minimum – 26,25 movements, less than average – for 9,25 movements (35,24%); the time of one movement is 0,423 s, the best indicator is 0,385 s, the average is 0,038 s (9,87%), the worst is 0,571 s, the average is 0,148 s (34,99%); the speed of one movement is 0,709 m·s^{-1}, the maximum is 0,779 m·s^{-1}, the average is 0,07 m·s^{-1} (9,87%), the minimum is 0,525 m·s^{-1}, by 0,184 m·s^{-1} (35,05%); the frequency of movements on the average is 2,37 Hz, the maximum is 2,6 Hz, the average is 0,23 Hz (9,71%) and the minimum is 1,75 Hz, less than the average – on 0,62 Hz (35,43%).

In the third period of the test, the following results were noted: the pace was on the average 37±3,08 movements, the maximum index was 41, more than the average 4 movements (10,81%) and the minimum – 27 movements, less than the average – for 10 movements (37,04%); the time of one movement is 0,405 s on average, the best result is 0,366 s, the average is 0,039 s (10,66%), the worst is 0,556 s, the average is 0,151 s (37,28 %); the speed of one movement averaged 0,741 m·s^{-1}, a maximum of 0,819 m·s^{-1}, more than the average value of 0,078 m·s^{-1} (10,53%) and a minimum of 0,539 m·s^{-1}, by 0,202 m·s^{-1} (37,48%); the frequency of movements was observed on the average – 2,47 Hz, maximum – 2,73 Hz, more than the average value by 0,26 Hz (10,53%) and minimum – 1,8 Hz, less than the average – on 0,67 Hz (37,22%).

The total results for the three periods of the measurement of the effect of the training action were as follows: tempo 35,17±1,26 movements, maximum 39 movements, more than the average of 3,83 movements (10,89%), and minimally 25,83 movements, less than the average – by 9,34 movements (36,16%); the time of one movement is 0,427 s, the best result is 0,385 s, the average is 0,04 s (10,91%), the worst is 0,581 s, the average is 0,154 seconds (36,06%); the speed of one movement was noted on the average 0,703 m·s^{-1}, maximum – 0,779 m·s^{-1}, more than the average value of 0,076 m·s^{-1} (10.81%) and minimum – 0,516 m·s^{-1}, – by 0,187 m·s^{-1} (36,24%); the frequency of movements was an average of 2,34 Hz, a maximum of 2,6 Hz, more than the average of 0,26 Hz (11,11%) and minimal – 1,72 Hz, less than the average – on 0,62 Hz (36,05%).

The manifestation of the physical quality of speed is the speed of sensorimotor reactions to sound and light stimuli. In the group of 15–16-year-old athletes, the response to sound was an average of 0,170±0,01 s, the best figure was 0,150 s, less than the average – by 0,02 s (13,33%) and the worst – 0,250 s, 0,08 s (47,06%); the response to light is 0,194±0,006 s, the minimum is 0,159 s, better than the average by 0,035 s (22,01%) and the maximum is 0,225 s, less than the average – on 0,031 s (15,98%).

In athletes aged 17–18, specializing in rowing on kayaks (Table 4), the following results were observed in the test for measuring the effect of the training action. In the first test period, the average rate of movement was 31,7±0,68, maximum – 39 movements, more than the average by 7,3 movements (23,09%) and minimally – 24 movements, less than the average – by 7,7 movements 32,08%); the average time of one movement is 0,473 s, with the best result – 0,385 s, less than average – 0,088 s (22,86%) and worse – 0,625 s, more than average – 0,152 s (32,14%); the speed of one movement averaged 0,634 m·s^{-1}, a maximum of 0,779 m·s^{-1}, more than the average value of 0,145 m·s^{-1} (22,87%); minimum – 0,480 m·s^{-1}, less than the average – by 0,154 m·s^{-1} (32,08%); the average frequency of movements was equal to 2,11 Hz, maximum – 2,60 Hz, more than average – on 0,49 Hz (23,22%) and minimal – 1,60 Hz, less than the average – on 0,51 Hz (31,88%).

Table 4

Indicators of physical quality of speed (boys 17–18 years, rowing on kayaks)

		Indicators	M±m	M_{max}	M_{min}
effect of training action	First period	rate (number of movements)	31,7±0,68	39	24
		time of one motion (s)	0,473	0,385	0,625
		speed of one motion (m·s^{-1})	0,634	0,779	0,480
		frequency of movements (Hz)	2,11	2,60	1,60
	Second period	rate * (number of movements)	136±5,79 (34±1,45)	164 (41)	96 (24)
		time of one motion (s)	0,441	0,366	0,625
		speed of one motion (m·s^{-1})	0,681	0,819	0,480
		frequency of movements (Hz)	2,26	2,73	1,60
	Third period	rate (number of movements)	36,5±1,34	42	26
		time of one motion (s)	0,411	0,357	0,576
		speed of one motion (m·s^{-1})	0,729	0,841	0,521
		frequency of movements (Hz)	2,43	2,80	1,73
	Totally	rate (number of movements)	204,0±2,61 (34±0,87)	245 (40,83)	147 (24,5)
		time of one motion (s)	0,441	0,367	0,612
		speed of one motion (m·s^{-1})	0,681	0,817	0,491
		frequency of movements (Hz)	2,27	2,72	1,63
Time of sensorimotor reaction					
		sound (s)	0,166±0,009	0,211	0,132
		light (s)	0,201±0,006	0,223	0,178

Remark. ** – in parentheses the data given to a single time indicator of 15 s are indicated, in particular, 136±5,79 (34±1,45).*

In the second period, the average was observed: a tempo of 34±1,45 movements, a maximum of 41 movements, more than an average of 7 movements (20.59%) and a minimum of 24 movements, less than an average of 10 movements (41,67%); the time of one movement is 0,441 s, the best result is 0,366 s, less than average – 0,075 s (20,49%) and the worst – 0,625 s, more than average – 0,184 s (41,72%); the speed of one movement is 0,681 $m \cdot s^{-1}$, the maximum is 0,819 $m \cdot s^{-1}$, more than the average of 0,138 $m \cdot s^{-1}$ (20.26%) and the minimum is 0,480 $m \cdot s^{-1}$, 0,201 $m \cdot s^{-1}$ (41,88%); the frequency of movements is 2,26 Hz, the maximum value is 2,73 Hz, the average is 0,47 Hz (20,80%), the minimum – 1,60 Hz, less than the average – on 0,66 Hz (41,25%).

In the third period, the following results were noted. The average rate of movement was 36,5±1,34, maximum – 42 movements, more than average – 5,5 movements (15,07%) and minimal – 26 movements, less than average – 10,5 movements (40,38%); the time of one movement was 0,411 s, the best time 0,357 s, the average time 0,054 s (15,13%) and the worst time 0,576 s, the average time 0,165 s (40,15%); the speed of one movement was 0,729 $m \cdot s^{-1}$, the maximum result was 0,841 $m \cdot s^{-1}$, the average was 0,112 $m \cdot s^{-1}$ (15,36%) and the minimum was 0,521 $m \cdot s^{-1}$, on 0,208 $m \cdot s^{-1}$ (39,92%); the frequency of movements – was noted at 2,43 Hz, the maximum was 2,8 Hz, more than the average at 0,37 Hz (15,23%) and the minimum – 1,73 Hz, less than the average – on 0,7 Hz (40,46%).

In the total score of the test for measuring the effect of the training action, athletes aged 17–18 years had the following results: average tempo 34±0,87 movements, maximum 40,83 movements, more than average 6,83 movements (20,09%), minimum – 24,5 movements, less than average – by 9,5 movements (38,78%); the average time of one movement was 0.441 s, the best indicator was 0,367 s, the average index was 0,074 s (20,16%), the worst was 0,612 s, the average was 0,171 s (38,78%); the average speed of one motion was 0,681 $m \cdot s^{-1}$, the maximum speed was 0,817 $m \cdot s^{-1}$, the average speed was 0,136 $m \cdot s^{-1}$ (19.97%), the minimum speed was 0,491 $m \cdot s^{-1}$, by 0,190 $m \cdot s^{-1}$ (38,69%); the frequency of movements corresponded to an average of 2,27 Hz, the maximum result was 2,72 Hz, the average was 0,45 Hz (19,82%), the minimum – 1,63 Hz, less than the average – on 0,64 Hz (39,26%).

The time of sensorimotor reactions to the sound stimulus was determined on the average by 0,166±0,009 s, the best figure was 0,132 s, the average index was 0,034 s (25,76%), the worst was 0,211 s, the average was 0,045 s (27,11%); to the light stimulus – an average of 0,201 ± 0,006 s, a minimum of 0,178 s, less than the average of 0,023 s (12,92%), a maximum of 0,223 s, greater than the mean – on 0,022 s (10,95%).

Studied indicators of the physical quality of the rapidity and its constituent elements depend on the age, the level of general physical and functional preparedness. The physiological mechanism of manifestation of rapidity is due to the speed characteristics of the nervous processes, is a multifunctional property of the central nervous system and peripheral neuromuscular apparatus.

For the effective manifestation of complex forms of rapidity, in addition to a certain level of the state of the nervous system, it is necessary: sufficient speed-strength fitness of the motor apparatus and perfection of the motor skills of the exercises and actions performed.

Conclusions

The proposed method for studying the effect of a training action is effective and adequate for determining the physical quality of the speed and its constituent elements: the rate of movement, time and speed of a single movement, the frequency of movements; as well as the study of strength and mobility of nervous processes, functional endurance and psychomotor performance of athletes.

Surveys of young athletes made it possible to identify significant differences in the studied quality of rapidity, as well as the functional and psychophysiological state of kayak rowers, differing in age and sports qualification, which makes it possible to analyze and, accordingly, adjust the development of the starting reaction, remote speed, speed endurance and the whole complex speed abilities.

The obtained measurement results characterize potential opportunities for increasing the efficiency of the training process and can be used to select and evaluate the prospects of athletes in various sports.

Prospects for further research. It is planned to carry out a comparative analysis of the level of physical development and functional readiness of athletes specializing in rowing sports, with the aim of creating an effective method of selection, improving sports training and improving the level of sports qualification.

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Taking into account the indicators of physical health and physical readiness of students in the development of the program of sectional classes in Thai boxing

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Purpose: *assess the level of physical health and physical preparedness of students 17–19 years to develop a program of sectional classes in Thai boxing.*

Material & Methods: *analysis of scientific and methodological literature, pedagogical observation, pedagogical experiment, anthropometric, physiological methods of research, pedagogical testing of physical preparedness, express assessment of physical health by the method of G. L. Apanasenko, methods of mathematical statistics. The study involved 77 young students aged 17–19 years.*

Results: *obtained data during the experiment showed a predominantly low and below average level of physical health, as well as the lag of some physical qualities from age standards.*

Conclusion: *the evaluation of physical health and physical preparedness indicators of 17–19 years old boys testifies to the need to develop and implement training programs aimed at increasing the level of physical health and the development of physical qualities.*

Keywords: *students, physical health, physical readiness, sectional occupations.*

Introduction

Physical education plays an important role in the preparation of a physically strong, hardened, healthy young generation, ready for high-performance work. At present, health is considered not only as a state of the organism, but also as a qualitative category that determines the operability, efficiency and reliability of a future professional. Definition of health is a necessary component of the educational process for physical education with the purpose of making changes and adjusting physical training [4].

In order to be able to solve this problem, the system of physical education of student youth should provide for the introduction of new effective methods that promote the development of psychophysical qualities, health promotion, increase in efficiency, functional capabilities of the cardiovascular, respiratory, nervous and other systems [3; 7].

According to specialists [5; 6], the traditional form of conducting physical education classes at the university does not help to increase students' interest in such activities, and, as a result, to improve their physical condition. Investigations of a number of authors [2, 8; 9; 10], a rather high efficiency of the sectional form of work with students has been proved. Recently in the youth environment various kinds of single combats are in great demand. Thai boxing is gaining popularity, which has a variety of effects on the body of those involved. That is why the development of programs for sectional classes in Thai boxing with student youth will have important theoretical and practical significance.

Relationship of research with scientific programs, plans, themes. The work is carried out according to the Consolidated Plan of Research Work in the Field of Physical Culture and Sports of the Ministry of Education and Science, Youth and Sports of Ukraine for 2011–2015. On the theme 3.6 "Scientific and theoretical basis of innovative technologies of physical education of different population groups" (state registration number 0111U001169) and according to the Consolidated Plan of research work in the field of physical culture and sports of the Ministry of Education and Science of Ukraine for 2016–2020 on the theme "Scientific and theoretical basis for improving the process of physical education that distinguish the game of n population" (number of state registration 0116U003010).

Purpose of the study: assess the level of physical health and physical fitness of students 17–19 years to develop a program of sectional classes in Thai boxing.

Material and Methods of the research

The study involved 77 male students aged 17–19 years, trained in 1–2 courses of the State Higher Educational Institution "Pridneprovsk State Academy of Civil Engineering and Architecture" in the specialties "Industrial and Civil Construction", "Enterprise Economics". Among the examined, 17-year-olds were found – 16 people, 18-year-olds – 36 people, and 19-year-olds – 25 people. The average age of the examined was 18,12 years. All the examined persons were referred to the main medical group due to their state of health.

In the course of the research, the following methods were used: analysis of scientific and methodological literature, pedagogical observation, pedagogical experiment, anthropometric, physiological methods of research, pedagogical testing of physical fitness, express assessment of physical health by G. L. Apanasenko's method, methods of mathematical statistics. The pedagogical experiment was conducted in the form of ascertaining and was intended to determine the level of physical health and physical readiness of students aged 17–19. The parameters of anthropometry (length, body weight) and the functional state of the body of students (VC,

HR, BP) were used to calculate the indices of physical health according to the method of G. L. Apanasenko. Pedagogical testing of physical preparedness included the determination of the results of tests for strength, speed, endurance, flexibility, speed-strength and coordination abilities. On the basis of the data obtained, indices of physical readiness were calculated by the method of T. Yu. Krutsevich.

Results of the research and their discussion

For the development of the program of sectional classes in Thai boxing in the conditions of a higher educational institution, we conducted a determination of the level of physical health and testing of physical preparedness of students.

To assess physical health, we used the method of G. L. Apanasenko, which involves calculating the mass-growth, strength, life indices, the indices of Robinson and Ruthie.

The average statistical results of each of the indexes for rapid screening of physical health for young men aged 17–19 are presented in Table 1.

According to the results of our study, the mass-growth index of young men corresponds to the average level with a value of 412,38 g·cm^{-1}(0 points). The life index has a value of 51,02 ml·kg^{-1} and corresponds to a lower than average (1 point). The Robinson index was 80,55 c. u. and refers to an above-average (3 points). To restore the heart rate after 20 sit-ups for 30 s, the boys spent an average of 2 minutes 11 seconds, which corresponds to below average (1 point). The force index has a low level (0 points) with a result of 56,34%. The overall assessment of the level of physical health of students corresponds to below the average level and is 5,08 points.

Table 1

Indicators of physical health of students 17–19 years (n=77) by the method of G. L. Apanasenko

Indicators	$\bar{X}$	σ	V	m
Mass-growth index, g·cm^{-1}	412,38	27,89	6,76	3,18
Life index, ml·kg^{-1}	51,02	4,63	9,11	0,53
Robinson index, c. u.	80,55	5,70	7,08	0,65
Recovery time of heart rate after 20 sit-ups in 30 s, min, s	2,11	0,65	30,62	0,07
Strength index,%	56,34	5,71	10,14	0,65
Total points	5,08	2,53	49,78	0,29

The general assessment of the level of health of students according to the method of G. L. Apanasenko allows distribution of the examined young men into three groups according to the levels of somatic health (Fig. 1): low (45,45% of students); lower than the average (48,05% of students) and the average level (6,5% of students). A young man of 17–19 years old with a higher average and high level of physical health was not found by G. L. Apanasenko's method.

This distribution allows you to take into account the level of physical health in the selection of means and methods of physical training, as well as differentiate the physical load in the program of sectional classes in Thai boxing.

To assess the physical fitness of students aged 17–19 years, motor tests were selected, characterizing the development of speed, endurance, strength, flexibility, speed-strength and

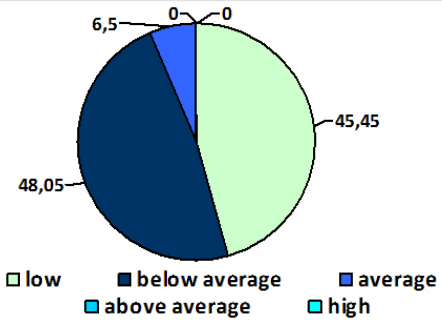

Figure 1. Distribution of students 17–19 years (n=7) according to the levels of physical health by the method of G. L. Apanasenko, %

coordination abilities. These are, respectively, the exercises: running 100 m, running 12 min, hand strength, push-ups, lifting the trunk into the seat in 1 min, torso forward from the sitting position, standing long jump and shuttle run 4x9m. The results of testing are presented in Table 2.

The results of the "100 m run" testify that the young men's speed is developed at a level above the average. The running speed was 14,34 s. Endurance also corresponds to a level above the average. For 12 min, the young men ran an average of 2,571,43 m. The car dynamometry index corresponds to a low level for young men of this age (41 kg), and the results of the force tests coincide with the lower average level of development of this quality. The students push-ups 37,99 times, lifting the trunk in a sitting in one minute – 43,52 times. Speed-power capabilities are developed at an average level. The "long jump" test was 215,25 cm. The average level of development also has agility and flexibility. The result of the "shuttle race 4x9 m" – 9,81 s, "torso forward from the sitting position" – 12,10 cm.

Table 2

Indicators of physical preparedness of students 17–19 years (n=77)

Indicators	$\bar{X}$	σ	V	m
Running 100 m, s	14,34	0,59	4,09	0,07
Running 12 min, m	2571,43	251,85	9,79	28,70
Hand dynamometry, kg	41,00	3,10	7,56	0,35
Push-ups, times	37,99	4,18	11,01	0,48
Standing long jump, cm	215,25	20,48	9,51	2,33
Shuttle Run 4x9 m, s	9,81	0,53	5,37	0,06
Lifting the trunk in the saddle for 1 min, once	43,52	5,36	12,33	0,61
Torsion of the trunk forward from the sitting position, cm	12,10	3,35	27,71	0,38

In order to determine the correspondence of the results of motor tests to the level of students' health, we calculated indices of physical preparedness by the method of T. Yu. Krutsevich, which are presented in Table 3.

The result of the Ruthie index was 10,49 conv. units, which corresponds to below average and is equal to 1 point for the system of rapid assessment of the level of physical preparedness. The force index corresponds to a low level with a result of 56,34% (0 points by the rating system). The result of the speed index is 3,94 c. u., which refers to the above average (3 points).

Speed-strength index scored 2 points on the express-assess-

Table 3
Indicators of physical readiness indices (by methodology T. Yu. Krutsevich) students 17–19 years old (n=77)

Indicators	$\bar{X}$	σ	V	m
Index Ruthie, c. u.	10,49	2,56	24,39	0,29
Strength index,%	56,34	5,71	10,14	0,65
Velocity index, c. u.	3,94	0,20	5,08	0,02
Speed-strength index, c. u.	1,22	0,13	10,38	0,01
Total points	6,35	1,82	28,65	0,21

ment system with a result of 1,22 c. u. and corresponds to the average level. The total score was 6,35 points, on the average is equal to the average level.

The percentage distribution of students in the levels of physical preparedness, respectively, the indices of rapid assessment also showed that the largest number of boys 17–19 years of age have an average level of physical fitness (74,03%). Approximately the same number of young men have a lower average and higher average level of physical fitness (12,98% and 11,7% respectively). 1,29% of students have a low level of physical fitness. Not identified a single student with a high level. The results are shown in Figure 2.

Thus, the results of the motor tests and the calculation of the indices of the physical readiness of the students showed that the leading physical qualities in young men aged 17–19 years are speed and endurance. Students showed an above-average level of development of these physical qualities. The most lag behind the young men is strength. Test results are below the average level, and the power index is low. At a sufficient (average) level, the young men have developed speed-strength abilities, agility and flexibility. When developing a program of sectional classes using Thai boxing means with students, it is necessary to pay attention to the development of physical qualities, namely, to select exercises for the education of strength, speed-strength abilities, coordination,

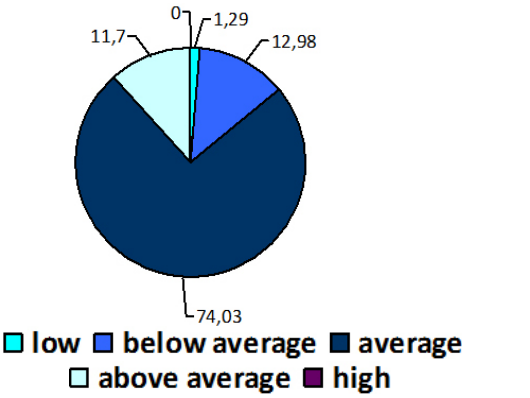

Figure 2. Distribution of students 17–19 years (n=77) according to the levels of physical readiness by the method of T. Yu. Krutsevich, %

and flexibility.

Conclusions

The results of the assessment of the indicators of physical health and physical preparedness of young men aged 17–19 testify to the need to develop and implement training programs aimed at improving these indicators. The data obtained during the experiment showed predominantly low and below average physical health, as well as the lag of some physical qualities from age standards. One of the ways to solve this problem is to develop a program of sectional classes in Thai boxing, taking into account the levels of physical health of students, which will allow selecting and differentiating the means of physical culture for increasing the functional indicators and directed development of physical qualities.

Prospects for further research in this area are the development of a program of sectional classes using Thai boxing for students, depending on the levels of physical health.

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Development of a technique for preventing visual fatigue in students while working on a personal computer

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Prevention of visual fatigue among students of higher educational institutions will contribute to their improvement, increase of labor productivity and, as a result, to the improvement of the success of mastering the educational material.

Purpose: *make a rational algorithm for preventing visual fatigue in students who spend most of their time at the computer.*

Material & Methods: *analysis of scientific papers; polls, questioning, testing of students on the basis of the physics and technology faculty of Dniprovsky National University named after Oles Honchar.*

Results: *the methodology for the prevention of visual fatigue involves the proper organization of the working space, the observance of a certain mode of work at the computer, as well as the performance of various sets of exercises for restoring vision. The implementation of the methodology contributed to improving the quality of sight in students.*

Conclusion: *systematic implementation of this technique will allow both to improve the vision lost during work at the computer, and to maintain it at a consistently high level.*

Keywords: *students, visual fatigue, improving vision, health, therapeutic exercises.*

Introduction

A personal computer (PC) has become an integral part of the life of a modern person, however, most people do not think at all about the harm of long and continuous work at the computer, as well as the negative impact that the PC, in particular.

Unfortunately, practically in all schools and higher educational institutions students, students and teachers systematically neglect the elementary rules of working at the computer.

Thus, in the information developed in the United States and China, according to statistics for 2016, the number of people with myopia is estimated at 40% and 70% respectively (given the fact that 50 years ago, there were 10 such people in China, 20%) [6]. In Ukraine, short-sightedness manifests itself in every fourth inhabitant.

Purpose of the study: to make the most useful recommendations for the prevention of visual fatigue and for restoring vision

Material and Methods of the research

Methods of research – use of information provided by students of the Physics and Technology Faculty of the Dnepropetrovsk National University named after Oles Honchar during their questioning and interviews.

Results of the research and their discussion

In each semester of the curriculum of the Faculty of Physics and Technology, it is assumed that there are on average two subjects closely associated with the use of personal computers.

Theoretically, this amounts to 4 hours of lecture classes and about 10 hours allocated for self-study at home. Given the lack of some necessary literature in libraries, the need to make calculations using computer aids (calculating, term papers, theses), compiling abstracts and writing articles, the time for working with a PC when doing independent work increases to 20 hours per week.

Surveys and questioning of senior students of the Faculty of Physics and Technology allowed to obtain the following results: 87% of students use PC more than 5 hours a day, of which about 2 hours are spent for homework and any calculations. More than 65% of students have such complaints:

- decreased visual acuity;
- slow refocusing of vision;
- fatigue in reading;
- burning and heaviness in the eyes;
- feeling of "sand" under the centuries;
- redness of eyeballs [8; 9].

The number of those who carefully performs exercises for the eyes, is very low – about 10%.

There are several reasons for inaction in relation to one's own health:

1. Unawareness of the need to perform exercises for the eyes and the correct organization of the working space.

2. Ignorance of the correct methodology and sequence of ex-

ercises.

3. Lack of time and forgetfulness.

4. Disregard for one's own health and lack of regular eye control from an oculist.

To begin with, we will define several general provisions, following which it is possible to significantly delay the onset of myopia (provided there are no special exercises aimed at relieving tension in the eyes):

1. Compulsory 1–2-minute breaks every 30 minutes
2. When reading from the screen, you need to blink when moving to a new line, and after each paragraph – to look at the deleted object and hold it for 2–3 seconds
3. Use monitors with a refresh rate of at least 75 Hz;
4. Place the monitor screen at a distance of about 70 cm from the observer, provided that the top edge of the monitor is 10 cm below the horizontal line of sight;
5. Lighting should be located at a distance of 35–45 cm above the monitor. As a lamp, it is recommended to use "yellow" luminescent power of 40–60 W. Also, lighting should not create glare on the screen and be excessively bright.
6. The brightness ratio between the working surfaces should not exceed 3:1–5: 1, and between the working surfaces and the surfaces of walls and equipment 10:1.
7. Free area for a working place for an adult person should be at least 6 m^2, and the distance between adjacent walls – at least 1,2 m.
8. Used chairs should allow for height adjustment of about 300-400 mm, and also have armrests.

For the depreciation of the eyes of the eyes, it is recommended to use the system of E. S. Avetisov [1], including three groups of exercises:

First group. Exercises of the first group help to increase blood flow in the eyeball area and accelerate the circulation of intraocular fluid.

Exercise 1. To begin, you need to close and unlock the eyelids 6–8 times. At the same time in each position you need to do a three- or five-second pause.

Exercise 2. Quickly blink seconds 15. Stop and massage your fingers with closed eyelids.

Exercise 3. Now, 4 times, tighten the eyeballs through closed eyelids. To press it is necessary slightly and no more than 3 seconds, stopping on short respites.

Exercise 4. With your index finger, touch the brow. Imagine that you need to overcome the resistance of the surrounding muscles.

Second group. This group of exercises is aimed at strengthening the oculomotor muscles.

Exercise 1. Without moving your head, move your eyes from the ceiling to the floor 8–12 times. Be sure to focus the look at the top and bottom points.

Exercise 2. Look to the right, then on the diagonal, raise your eyes up, and on the same diagonal, lower your eyes to the left corner below. Do everything in the opposite direction. Do not move your head. You need to do this up to 12 times.

Exercise 3. Move the view from the right fixed point to the left and back. Also do 12 repetitions.

Exercise 4. Turn your eyes clockwise and counterclockwise, not losing sight of all that you see. In total, you need to do 12 repetitions.

Third group of gymnastics exercises for the eyes is aimed at training focusing and accommodation.

Exercise 1. Select the farthest point on the horizon. Pull out your hand and point forward your index finger. 12 times move your vision from this far point to the tip of your finger.

Exercise 2. Pull out your arm and point your index finger forward. Then touch the tip of your nose with your index finger. The whole path that the elongated hand will pass does not remove the eye from the finger, constantly focusing its attention on it. This must be repeated 10 times.

Exercise 3. Similar to the previous one, only in this case it is necessary to follow the hand with one or the other eye. Each of them has 8-10 repetitions. The eye, does not participate in focusing, cover with the palm of your hand, accordingly changing the hand that stretches towards the nose.

Exercise 4. Draw a point on the transparent glass (any window is suitable, but the degree of visibility plays an important role). Focus your eyes on it, and then focus on some street object. Again, focus on the point, and then on the object from the street. This task should be performed for about 7 minutes.

You can also use the method M. D. Corbett or W. Bates (solarization, palming, etc.) [3; 2].

There are several ways to test your vision at home. The first (Amsler's method [4]) is carried out with the aid of a conventional notebook with a letter to the cell. It is necessary to select a square with 16x16 cells, in the center of which carefully turn the handle point. Then you need to close one eye with your hand, look at the drawn point with the other eye. If you can see all four grid angles with each eye, without leaving a view from the point, as well as all the lines of the grid you see are straight, without bends and bends, then you have passed the test and your organs of vision are healthy. Otherwise, you should immediately contact your doctor [10].

The second method is even simpler. It is necessary to compare the blackness of any letter or symbol both at a point close to you and at a distance, both with good and low light. With an excellent star, black color does not change at all - it does not depend on the actions you have taken. If the black looks differently black in the above actions, it means that you need to make an appointment with an ophthalmologist, since your vision is imperfect.

Let's consider some more modern methods of preventive maintenance of deterioration of sight, and also, actually, correction of sight.

For those people who do not have time for the above exercises, perhaps the only way out is to adapt the eyes to the computer,

which can be done with a special optical correction. To select appropriate glasses for each user in modern clinics, special computer tests simulating a screen image are developed. One can distinguish the following types of glasses that are qualitatively different from the standard ones: some are offered with progressive lenses in which the clear vision zone corresponds to the movement of the eye when working with the display, others assume the possibility of focusing the eyes both on the screen and on paper with text, recruitment. Some specialists offer a special color for lenses, for example, the Institute of Biochemical Physics of the Russian Academy of Sciences in conjunction with the Moscow Eye Diseases Institute named after Helmholtz developed a coating containing several narrow bandwidths in the region of the primary colors of the spectrum, which, as a result, significantly increases the contrast of the image. In general, the use of glasses with the above-described coatings in intensive PC users (designers of space technology or programmers) reduced fatigue and improved the performance of the eye muscles compared to conventional glasses, or in the absence of approximately 80%. Thus, special glasses increase the color contrast of the image, make the picture on the retina more clear, reduce the dispersion of the image on the monitor, improve the accommodation capacity, cut out the hard part of the spectrum, adjust the radiation spectrum to the most comfortable for perception with the eyes.

For those people who have already developed myopia, there are several modern methods of treatment.

For active users of PCs, which are students, is the most convenient method - the installation of special free programs such as Eyes Relaxing and Focusing. This type of software is an eye simulator designed to protect long-term users of the PC from its harmful effects with a run time of more than 2 hours. Such a program will notify the user about the need to take a break, as well as show special exercises, which in essence are training for the eyes. Thus, the problems of regular breaks are solved, as well as uncertainties in the choice of a set of exercises. It is worth noting the possibility of adding your own exercises in the settings of the program.

The next method is called NeuroVision [5] – "perceptual training". This method is a process that consists in performing a certain sequence of visual exercises, leading to an improvement in the visual perception of objects. This effect is based on changes in neural connections in the brain.

"NeuroVision" – A special educational software package is available on the Internet that is developed individually for each client. It is designed to form new or re-form the old interneuronal connections in the cortical substance of the brain. Despite the fact that this method is used to improve visual acuity and contrast sensitivity in adults with mild degrees of myopia, it does not affect the accommodation of the eye. The advantages of this method of treatment are:

- applicability in a broad age group - for children aged 9 years and older, including adults.
- absence of surgical intervention and, as a consequence, rehabilitation period;
- exclusion of medications;
- safety of the method;
- adjustment of software in accordance with the characteristics of each patient.

Actually, the technique itself is to create a doctor-ophthalmologist some list of exercises for each patient that need to be performed in 30 minutes. The implementation of these exercises is carried out at home using a computer program that trains the perception and efficiency of processing information coming from the organs of vision, the brain. The result is the facilitation of reading small print both near and at a distance. Increased visual acuity.

Another way involves the use of special glasses-simulators, which are glasses with black opaque lenses, where a large number of small holes are made. Such glasses-simulators pass only coherent rays, which have the same wavelength and synchronously reflect the maxima and minima of the intensity of light. As a result of their use, vision can improve by 10%.

The penultimate method is to use the utility for smartphones Eye Relax and the like. Such small programs that run in the background, remind the user about the need to take a break after working with a computer or, in fact, on the phone. Also in the settings you can activate the appearance of the message before the break, and the time remaining is conveniently monitored using a special progress bar in the smartphone message panel.

The latter method is an unconventional practice – Chinese medicine. For example, a set of eye exercises "Qi Qong", which were developed in 1950 in China. They are based on the assumption that massage of various acupuncture points around the eyes improves blood flow, relaxes muscles and reduces eye strain.

Conclusions

In this article, the symptoms of visual impairment in students as a result of a continuous hours of work for a PC were found. The reasons why students neglect the method of healthy handling of PCs have been established. Based on the data analyzed, both general and more specialized recommendations for the prevention and recovery of vision in active users of PCs were given. Thus, we can distinguish several basic provisions, guided by which everyone can prevent the deterioration of one's own vision due to prolonged work at the computer:

1. A healthy lifestyle.
2. Organization of the working space.
3. Regular breaks.
4. Using relaxing exercises
5. Regular visits to an ophthalmologist.

Prospects for further research. The given researches have perspective character, after all illuminate an opportunity of the prevention of problems of sight, and also, at their presence, ways and methods of non-operative rehabilitation and convalescence.

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Quality of life of veterans of sports with osteochondrosis of the lumbosacral spine

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Purpose: *to establish the effect of a comprehensive program of physical rehabilitation on the quality of life of wrestlers – veterans of sports with osteochondrosis of the lumbosacral spine in the training motor regime.*

Material & Methods: *34 athletes-veterans at the age of 36–45 years, a kind of struggle – judo and sambo-wrestling took part in the study. Sports qualification of athletes: MS – 25 people, MSIG – 9 people. The test was carried out on the verbal assessment scale of pain, the degree of vertebro-neurological disorders was assessed, the standard of living for the Oswestrovsky questionnaire was determined.*

Results: *after application of the proposed comprehensive physical rehabilitation program for wrestlers – veterans of sports of the MG in 68% of cases, complaints were absent, the degree of vertebro-neurological disorders decreased, the results of the questionnaire on the Oswestrovsky questionnaire showed a statistically significant decrease in complaints of pain in various spheres of life.*

Conclusion: *the positive influence of the developed program of physical rehabilitation on the quality of life of wrestlers – veterans of sports are proved.*

Keywords: *quality of life, wrestlers – veterans of sport, rehabilitation, Oswestrovsky questionnaire.*

Introduction

Osteochondrosis of the spine is a multifactorial disease characterized by a dystrophic lesion of the vertebral motor segments, mainly of their anterior parts, and turns out to be polymorphic neurological syndromes [1]. Osteochondrosis is marked by a systemic lesion of connective tissue, develops against the background of existing congenital or acquired functional, mainly metabolic insufficiency.

Among the most common diseases among veterans of sport, a significant place is occupied by osteochondrosis of the spine, primarily this can be explained by an increase in the volume of loads associated with the intensity of training loads in the past. Osteochondrosis, as a clinical form of the disease in sports veterans, is most often caused by macro- and microtraumas of the spinal tissues, namely when doing sports on the lumbar spine account for 60% of injuries [2; 3].

Until now, there is no generally accepted point of view on the nasological nature of osteochondrosis of the spine. There are terminological difficulties in identifying its clinical manifestations, largely due to their complexity and diversity, as well as the multidisciplinary problem.

In the clinic of lumbosacral spine osteochondrosis, several syndromes are distinguished, the leading one of which is pain syndrome. Pain, as the first sign of the disease and a signal of trouble, causes a whole series of subconscious acts, compensate for violations, and, first of all, biomechanical (motor) order. The initial stage of osteochondrosis has preclinical (quasi-pathetic) signs and active athletes often do not give them attention. In the future, after that I leave the sport, there are complaints about moderate pain in the lower back, arise or intensify with movement, tilt forward, physical activity, long stay in one position. The pain irradiates into the buttocks, thigh, groin and shin. Veterans of sports note the severity, stiffness in the lumbar spine. Disease progresses slowly, degenerative changes appear in new segments of the spine and cover other vertebrae. Periods of process activation are observed more often and are becoming more and more prolonged. Increased pain in this category of patients is often provoked by psychogenic factors, and neurotic syndromes, anxiety and depressive disorders reduce the quality of life of veterans of sports.

A number of authors believe that the accumulated materials on the origin of the osteochondrosis of the spine make it possible to analyze its etiology within the framework of the multifactorial model [4; 5]. At present, this theory is recognized as the most adequate for understanding the origin of chronic human diseases, and also cites a number of new theoretically grounded approaches to prevention and rehabilitation [6]. In recent years, non-pharmacological methods have been increasingly used in the treatment of dystrophic diseases of the spine and their reflex manifestations [7], however, the question of what kind of actions and their combinations is more rational to use depending on the clinical manifestations of osteochondrosis, the proper attention to psychotherapy, and the special significance of psychological factors in the elimination of chronic back pain are still debatable. The use of a complex of physical rehabilitation, including physiotherapy, massage, post-isometric relaxation, physiotherapy, hydrokinetic therapy, traction methods of treatment can significantly improve the functional state of veteran athletes with osteochondrosis of the lumbosacral spine and improve their quality of life. All of the above has determined the relevance and purpose of this work.

Relationship of research with scientific programs, plans, themes. The work was carried out in accordance with priority thematic area No. 76.35 "Medical and Biological Substantiation for Conducting Rehabilitation Measures and Assigning Physical Rehabilitation to Persons of Different Age of

Fitness". Number of state registration – 0116U004081.

Purpose of the study: to establish the effect of a comprehensive program of physical rehabilitation on the quality of life of wrestlers – veterans of sports with osteochondrosis of the lumbosacral spine in the training motor regime.

Material and Methods of the research

The study was carried out on the basis of the problem laboratory of the KhSAPC. When organizing the study, the following methods were used: analysis of literary sources; collection of anamnesis, complaints; visual inspection; palpation; verbal assessment of the pain scale; questionnaire on the Oswestrovsky questionnaire; determination of the degree of affection of vertebro-neurological syndromes; methods of mathematical statistics. The data obtained were processed by the method of variational statistics with S. N. Lapach, A. V. Chubenko, P. N. Babich (2000) with the calculation of the arithmetic mean – $\bar{X}$, its error – m, the Student's reliability test-t (according to the Student's formula), the degree of probability – p (according to the tables of D. D. Donskoy).

Under our supervision there were 34 veterans of sports at the age of 36–45 years, a kind of struggle – judo and sambo. Sports qualification of athletes: MS – 25 people, MSID – 9 people.

A differentiated approach to psychotherapy of this category of patients provides for the selection of clinical and psychological effects, depending on the degree of manifestation of psychoemotional disadaptation of veteran athletes. This approach implies the need for psychodiagnostic research before starting treatment. Evaluation of the effectiveness of treatment and recovery measures begin with the definition of the degree of regression of pain syndrome [8]. The simplest test for quantifying the perception of pain is the verbal assessment scale [9]. Assessment of the dynamics of pain by using the percentage scale is as follows: the patient is asked to take the intensity of pain for 100% and indicate how much his personal pain.

Given that the nature and magnitude of pain is a subjective indicator and depends on many factors, in our work we used the definition of the degree of expression of vertebro-neurological syndromes. This survey was conducted with the arrival of veteran athletes for rehabilitation and in dynamics.

Evaluation of the effectiveness of physical rehabilitation involves determining not only the dynamics of clinical syndromes, but also the functionality of a veteran athlete in his daily life. An adequate means of rehabilitation, a valid and reliable tool is the Oswestry Low Back Pain Disability Questionnaire (English), which includes ten sections describing various spheres of the patient's life. In each section, six descriptions of the possible condition of the patient are given, of which the first one is estimated at 0 points, each sixth is 5 points (the patient should not know about the evaluation system of testing). Integral evaluation of the effectiveness of rehabilitation can serve as the nature of the course of the disease, as well as the patient's assessment of the quality of his life [10; 11].

Results of the research and their discussion

All the athletes were divided into two groups – the main group – MG (19 people) and the control group – CG (15 people). Both groups were homogeneous by sex, age and clinical manifestations of the disease. The average age of the disease in the main group was 5,3±1,5 years, in the control group it was 5,2±1,4 years (p>0,05). Periods of exacerbation of the disease were observed 2-3 times a year in both groups.

To the use of rehabilitation measures in wrestlers veterans of both groups, there were complaints of recurrent pain in the lumbar region and the sacrum, which irradiated on the back of the thigh and gluteal region, intensified in the morning after sleep or after heavy physical work.

In determining the magnitude of pain after the verbal assessment scale of pain, MG and CG athletes rated it at 42,16±0,66% and 43,13±0,69%, respectively. Vertebroboneurologic disorders were assessed in the MG at a level of 6,16±0,29 points, in the CG at a level of 6,33±0,31 points. In determining the level for the Oswestrovskiy questionnaire – for the veterans of the CG it was estimated at 32,93±0,54% and in the exhaust gas – 33,68±0,46%.

To solve the set goals and objectives, a comprehensive program of physical rehabilitation for MG athletes was developed, including hydrokinetic therapy, traction, post-isometric relaxation, therapeutic massage. The proposed comprehensive physical rehabilitation program was aimed at reducing pain and alleviating the symptoms of the disease, improving the quality of life of veteran athletes. As fault tolerance, exercises in the water provide changes in the immune, lymphatic, circulatory systems, help in the treatment of neurological disorders, contribute to improving the quality of life. The wrestlers veterans of the CG were engaged in the generally accepted methodology. Considering the fact that athletes have a different rehabilitation process than non-athletes because there is a stage of sports rehabilitation, physical exercises typical for wrestlers (at the beginning of the motor regime – 15–20% of all exercises, and at the end of the motor mode – up to 50–70%). At the same time, physical imitative exercises were the same for MG and CG athletes.

After 21 days of application of the comprehensive physical rehabilitation program, 68% of the veterans of the MG had no complaints, while the CG wrestlers had only 40%. The results of testing on the verbal assessment scale of pain in fighters – veterans of sports MG and CG statistically significant improved, in the exhaust gas t=13,96; p<0,01, in CG t=8,08 p<0,01, a statistically significant decrease in the magnitude of pain in OG was observed when comparing the dynamics of the indices between groups (t=3,19, p<0,05). The dynamics of testing on the verbal assessment scale of pain is shown in Figure 1.

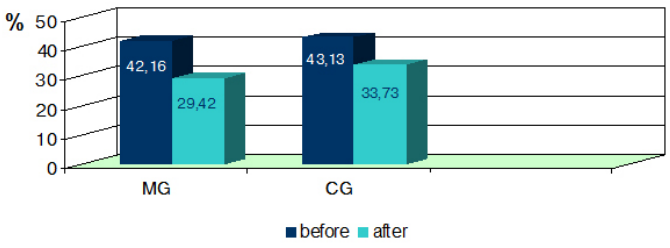

Figure 1. Dynamics of the reduction in the magnitude of pain behind the verbal scoring scale among wrestlers – veterans of sports MG (n=19) and CG (n=15)

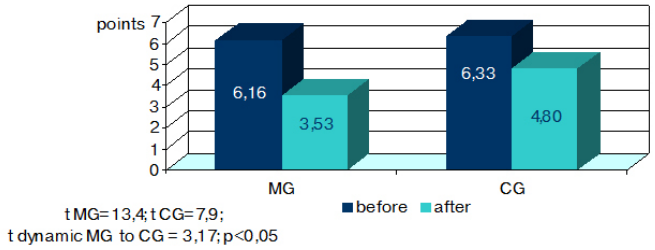

Figure 2. Dynamics of the degree of vertebro-neurological disorders in wrestlers - veterans of sports MG (n=19) and CG (n=15)

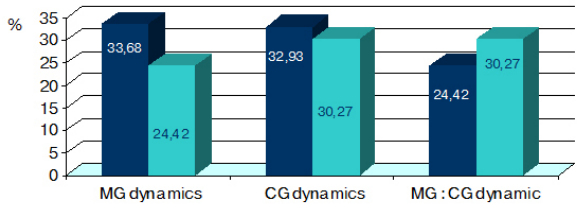

Figure 3. Dynamics of questionnaires on Oswestrovsky questionnaire from wrestlers - veterans of sports MG (n=19) and CG (n=15)

Degree of vertebro-neurological disorders after physical rehabilitation was estimated in the fighters of the MG – by 3,53±0,24 points, in the CG by 4,80±0,32 points (Figure 2). Results of the questionnaire on the Oswestrovsky questionnaire showed a statistically significant decrease in complaints of pain in various spheres of life, for veteran athletes of the MG decreased by 9,26%, in the CG by 2,66%. When comparing the index between the groups, there was a statistically significant dynamics ($t=7,36$; $p<0,05$) (Figure 3).

Thus, after the application of a comprehensive program of physical rehabilitation, the wrestlers veterans of sports of the MG reduced the phenomena of discomfort and psychogenic symptoms, increased activity and physical performance, and improved the quality of life. When comparing the dynamics of the indices between the groups of veterans of sports MG, there were statistically significant changes in comparison with the indices of veterans of the CG.

Conclusions

1. Lead syndrome in wrestlers – veterans of sports with lumbosacral spine osteochondrosis is a pain syndrome that affects the quality of life.

2. It is proved that the application of a comprehensive program of physical rehabilitation, which includes exercises in water, reduced the degree of vertebro-neurological disorders, complaints in various spheres of life, improved the quality of life of wrestlers – veterans of sports.

3. An integral assessment of the effectiveness of physical rehabilitation can be the use of questionnaires on the Oswestrovsky questionnaire and the definition of the degree of affection of vertebro-neurological syndromes.

Prospects for further research are related to the assessment of the dynamics of physical performance in wrestlers – veterans of sports with osteochondrosis of the lumbosacral spine after the application of a comprehensive program of physical rehabilitation in the training motor regime.

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Research and analysis of the level of physical preparedness of Oles Honchar Dnipro National University students

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Purpose: *to study and analyze the level of physical preparedness of Oles Honchar Dnipro National University students.*

Material & Methods: *the level of physical readiness of students was determined with the help of tests and standards for the annual assessment of the physical preparedness of the population of Ukraine, the results of which determine the level of development of the basic physical qualities: strength, endurance, speed, flexibility, agility. Students performed 5 types of tests.*

Results: *obtained results made it possible to compile the dynamics of the level of physical preparedness of students: high, decent, medium, low, and also an appropriate assessment of the physical state: excellent, good, satisfactory, unsatisfactory.*

Conclusion: *these data suggest that the majority of students are middle and low level of physical preparedness. In connection with the results suggested a set of exercises to improve the physical preparedness of students.*

Keywords: *level of physical preparedness, state tests, physical education, students, complex of exercises.*

Introduction

Physical education is an indispensable component of all educational systems. The search for ways and means to improve the physical education of students is and is one of the current problems at present. In the successful solution of this problem, all structures of society are interested [1].

Students are the most vulnerable segment of youth, because they face a number of difficulties that are associated with the increase in the workload, low mobile activity, and relative freedom of student life. Students are the main labor reserve of our country; therefore the state of their health is the guarantee of the health of the whole nation.

Physical education of students lags behind foreign analogues in quality, there is a decrease in students' interest in physical education classes. All of the above affects the level of physical preparedness of students, their health and quality of life.

Any conscious and purposeful activity of the person assumes the account of its results. One of the forms of such an accounting is standards. They play an important role in upbringing, which determines its direction and the desired level of physical and sports training. An objective assessment of the physical preparation of students is conducted on the basis of the Cabinet of Ministers of Ukraine Decree No. 1045 of December 9, 2015 "On Approving the Procedure for Conducting the Annual Assessment of the Physical Preparedness of the Population of Ukraine" [5].

At the heart of this testing is, first of all, the diagnosis of the physical preparedness of students with the subsequent use of pedagogical measures.

Thus, an assessment of the physical and functional preparedness of university students is an actual problem.

Relationship of research with scientific programs, plans, themes. Many scientific works have been devoted to the study of the level of physical readiness. It was determined that the problem of the physical condition and preparedness of students attracted the attention of scientific researchers.

Physical preparedness is the most important factor determining a person's health and working capacity, his success in mastering professional skills and skills, productivity of physical and mental labor [3].

The analysis of scientific and methodological literature made it possible to conclude that in the practice of the pedagogy of physical culture and sports, there is enough research to assess the overall physical preparedness of students. However, despite the experience, according to the studies of S. M. Kanishevsky, E. A. Zakharin, E. I. Ivanova, V. L. Karpman, N. A. Gudkov, the unsatisfactory state of health of student youth, as well as theoretical and methodological skills students of higher educational institutions. An important problem is the strengthening of this trend. We can say that at present the branch of physical education in universities is in decline, despite the law of Ukraine "On Physical Culture and Sport", GOSTs, as well as various instructions and orders that control the activities of educational institutions for physical performance.

Many authors who studied the problem of physical preparedness of students and conducted an assessment of state tests, expressed concern, because the level of development of physical fitness does not meet the standards.

Most students experience a lack of development of general professional qualities. One of the main reasons that negatively affects the development of the functions of the body is a sedentary regime, because when physical activity increases the nonspecific resistance of the organism to the negative effects of cooling, overheating, irradiation, the amount of information [4].

The results of the research of scientists indicate a significant number of students with poor health and unsatisfactory phys-

ical fitness, as well as an increase in the contingent, falls into special medical groups during the training process [6].

However, physical education in higher education institutions should promote health and development of motor abilities. To solve these problems, it is necessary to investigate the level of physical preparedness of students and, based on the results obtained, taking into account individual characteristics, to conduct effective physical education classes.

Purpose of the study: to study and analyze the level of physical preparedness of Oles Honchar Dnipro National University students.

Material and Methods of the research

Methods of testing, theoretical analysis and generalization of literary sources were used.

The study involved 250 students aged 17–21 years who studied at the I–V courses of the historical, chemical, biological faculty of Dnipropetrovsk National University O. Gonchar.

Results of the research and their discussion

In connection with scientific and technical progress in teaching, the system for assessing and controlling the level of physical preparedness of students in the university has changed. In particular, the Cabinet of Ministers of Ukraine introduced an obligatory annual assessment of the physical preparedness of the population of Ukraine [2].

In our study, an assessment was made of the level of physical preparedness based on the results of the State testing.

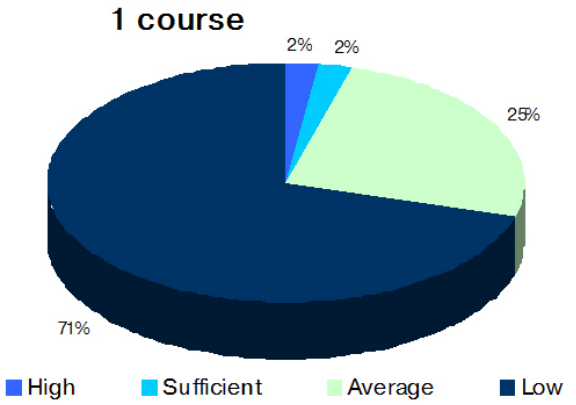

Figure 1. Assessment of the level of physical preparedness of students of 1 course

In Fig. 1 it can be seen that the level of physical preparedness of the students of the first year is very low. This suggests that this group of subjects has a large training load and low motor activity, and also indicates that during schooling, much attention was paid to physical education.

Among the second-year students there is no high and sufficient level of preparedness, the low and average ones prevail – about 63% and 37% respectively.

Among third-year students, a predominantly small percentage of subjects correspond to high and sufficient levels (approximately 16% and 11%, respectively). As in the 1st and 2nd

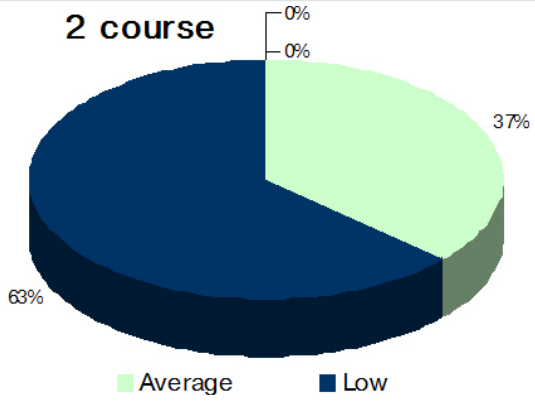

Figure 2. Assessment of the level of physical preparedness of students of 2 course

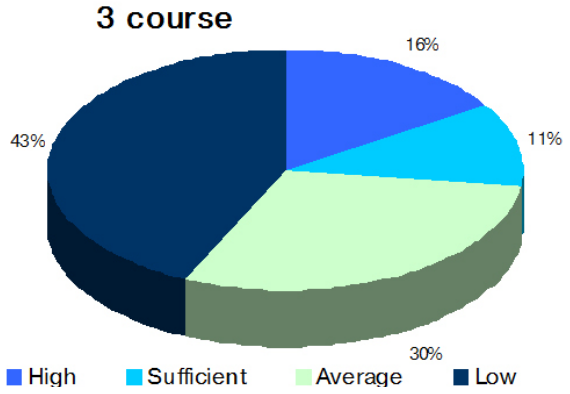

Figure 3. Assessment of the level of physical preparedness of students of 3 course

courses, the average and low levels of physical fitness prevail, but the result of the 3rd year students is generally better, because their physical education classes are more systematic and regular.

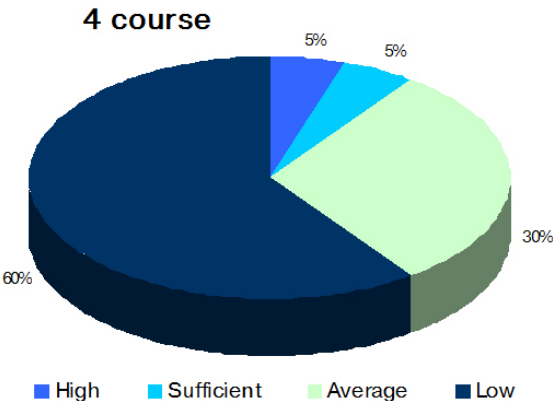

Figure 4. Assessment of the level of physical preparedness of students of 4 course

In Fig. 4 shows that only 10% of 4-year students have a high and sufficient level of physical fitness, and the remaining 90% does not meet the state testing standards.

Students of the 5th year also have a very low level of physical readiness, which is due to both the training load and the interest in physical education.

So, according to our study, it is determined that the best physical training is in the 3rd and 4th year (Fig. 6). However, it has been found that more than 40% of the subjects have a low

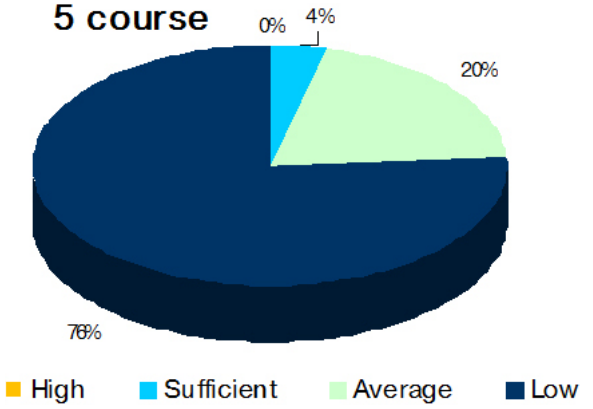

Figure 5. Assessment of the level of physical preparedness of students of 5 course

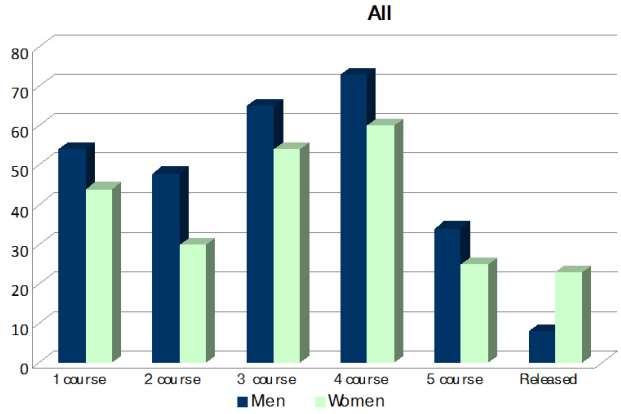

Figure 6. Assessment of the level of physical preparedness of students of 1–5 course

level of training, but no more than 16% – high. Comparing the results of the students who passed the tests, according to the gender distribution, there was a tendency: young men have a higher level of physical fitness than girls who, in turn, have low and average levels of physical fitness. All this testifies to the fact that young people are not physically prepared to meet the standards of the State testing.

So, it was found out that students of Dnipropetrovsk National University O. Gonchar are at risk, so new training programs should be used to improve physical fitness.

According to the results of the study it was found out that the students of the senior courses have better physical preparation, and the students of the first and second courses are rather low. This is due to the lack of hours of physical education in the educational process. With an increase in the number of physical education classes, the teacher has the opportunity to provide more theoretical and practical knowledge of students, as well as apply various techniques for improving physical condition, including stretching, skipping, and cardio training.

These types of training are useful for affecting a person's physical condition, and also do not require additional expensive equipment. Thanks to the use of skipping in the system of physical fitness and health improvement, there are positive changes in the morphological and functional indices of physical development, the functional capabilities of the respiratory system are expanding, and the adaptation of the cardiorespiratory system to the dosed load is increasing.

However, for self-study students lack experience and insufficient theoretical and practical knowledge to master these techniques. Therefore, it is recommended to engage with the teacher to monitor the process of classes and correct dosing of the load in accordance with the student's physical condition.

So, we offer a set of exercises with cardio workouts, which includes five exercises: "sit-ups with jumps", "pulling up the legs to the chest", "lunge with a jump", "squeeze strap" and "going straight to the ground with a leap" [7] .

"Squats with jumps": stand upright, feet shoulder width apart, straighten your back. Perform a deep squat. Hips should be parallel to the floor line. Jump up. Gently land in the squat position and immediately repeat the jump. Do 15–20 reps.

"Pulling the legs to the chest": take the emphasis lying on the arms outstretched, legs on the width of the pelvis, hands just slightly wider than the shoulders. Pull the knee of the right leg to the left elbow, return to the starting position. Then similarly with the other leg. Do 15–20 repetitions.

"Lunge with a jump": stand upright, feet to the width of shoulders, straighten your back. Lunge with your right foot forward. Sit down, deep down, knee forward. Pushed off the floor and jump, change the position of the legs in the air and land in a lunge with your left foot in front. Do 10–15 reps.

"Strap with pressing": take the emphasis lying on the elbows, keep a straight line from the shoulders to the ankles. Climb to the position of push-ups on the arms outstretched, do not bend in the lower back. Hold in the upper point and return to the starting position. Do 15–20 reps.

"Going straight to the ground with a jump": stand upright, feet shoulder width apart. Deep seated, put your hands in front of you. Then make a leap backward, making an emphasis lying. In this position, keep the straight line of the body. With the next sharp movement, go back to the squat position and immediately jump up. Do 10–15 reps.

Conclusions

According to the results of the analysis of scientific and methodological literature, as well as the results of testing students, we can state that more than 40% of students have intermediate and low levels of physical fitness. Therefore, students fall under the risk group. This is due to the insufficient number of physical education classes, which means that students have insufficient theoretical and practical knowledge in the field of physical training.

The data obtained create conditions for the development of new programs, depending on the level of preparation.

Recommended techniques for skipping, stretching and cardio. Also, a set of exercises with cardio training.

Prospects for further research in this direction. In accordance with the Resolution of the Cabinet of Ministers of Ukraine of December 9, 2015 No. 1045 "On Approval of the Procedure for Conducting the Annual Assessment of the Physical Preparedness of the Population of Ukraine", a further study of the level of physical preparedness of students.

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Topical issues of physical therapy for gunshot lesions of the diaphysis of the shoulder

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Purpose: *to consider the features of physical therapy for gunshot lesions of the diaphysis of the shoulder.*

Material & Methods: *theoretical analysis and generalization of modern scientific and methodological literature data on the features of the use of rehabilitation equipment for gunshot shoulder injuries.*

Results: *the peculiarities of the application of physical therapy devices after gunshot lesions of the shoulder diaphysis are determined, the features of the application of kinesitherapy, therapeutic massage and physiotherapeutic treatment at different periods of the pathological process.*

Conclusion: *physical therapy is an integral part of the medical rehabilitation of the wounded with gunshot injuries of the shoulder and depends on the amount of damage to the muscular apparatus, the immobilization method, the severity of the general condition of the wounded and the period of the pathological process and rehabilitation measures.*

Keywords: *gunshot shoulder injury, physical therapy, rehabilitation measures.*

Introduction

The problem of rehabilitation of combatants is especially urgent today, when the antiterrorist operation (ATO) of the Ukrainian armed forces continues in the eastern regions. The scale of this phenomenon in Ukrainian society requires active study of the specifics of military operations and the structure of sanitary losses, and the creation of special centers throughout the country to provide social, psychological and medical assistance to participants in the antiterrorist operation, and especially those who received combat injuries that led to disability [1; 3].

It is assumed that during the war with the use of modern means of destroying all more or less serious injuries, the main place will be occupied by soft tissue injuries (44–46%). The proportion of injuries to the pelvic bones, upper and lower extremities (including damage to the vessels and nerves) will be up to 28%. About 8% of the wounded have injuries with damage to the internal organs and lumbar spine. 5% of the injury (equivalent gravity) will be divided between damage to the face (including the eyes) and the chest (including the thoracic spine). Traumas of the skull and brain account for 4%, and the neck and cervical spine – 1% [6].

The wounds of the extremities prevailed in all military conflicts, because this is one of the least protected anatomical sites. They averaged 64% of all damage. Among them, internal joint fractures are observed in 17,1% of the affected, damage to large blood vessels with gunshot injuries of large joints of the upper limbs reaches 3%, lower limbs – 4,5%. With respect to peripheral nerves, the more often they are damaged in injuries of large joints of the upper extremities, whose frequency is 11–13%.

At present, the frequency of severe damage to soft tissues and bones increases, which leads to a frequent development of infectious complications (32%) (gunshot gland 18%), a high percentage of slowed consolidation and false joints (12%) and the formation of common bone defects (up to 15%) [5].

The treatment and rehabilitation of servicemen and civilians who have received gunshot wounds to the limbs is one of the main problems of military field surgery, remains relevant, both for the military medical service of the armed forces and for the national health system. Armed conflicts on the territory of Ukraine, the activation of criminal structures and the associated increase in crime, the widespread use of firearms and explosive ordnance among civilians have led to numerous injuries in peacetime.

During the time that has passed since the end of the Second World War, there has been a significant evolution of firearms and ammunition. As a result, the scale and severity of tissue destruction increased dramatically, and the number of multiple and combined injuries increased at times. Traumatic illness, which develops in response to modern combat trauma, is usually characterized by a long and complex course with high rates of mortality or disability. These circumstances encourage the development of new approaches to the treatment and physical therapy of the wounded at the stages of medical evacuation and treatment [14].

Relationship of research with scientific programs, plans, themes. The work was carried out in accordance with the priority thematic area 76.35. "Medico-biological justification for the implementation of rehabilitation measures and the appointment of physical rehabilitation to young people of varying degrees of fitness." Number of state registration – 0116U004081.

Purpose of the study: to consider the features of physical therapy for gunshot lesions of the diaphysis of the shoulder.

Material and Methods of the research

Methods of research: theoretical analysis and generalization of modern scientific and methodological literature data on the

features of the use of rehabilitation equipment for gunshot limb injuries.

Results of the research and their discussion

Restorative treatment of the wounded with gunshot limbs injuries includes medical, social and professional rehabilitation. To be rehabilitated are those persons who, as a result of traumatic injury of limbs and surgical intervention, physiological functions and the ability for military professional activity have significantly decreased or temporarily lost. At the same time, the basic general principles of rehabilitation – consistency and consistency – are fully preserved in relation to particular types of pathology.

Medical rehabilitation combines surgical and medicament methods, balneotherapy and climatotherapy, physiotherapy exercises, physiotherapy, therapeutic massage [2; 12].

At the hospital stage, rehabilitation of patients after traumatic injury of the limbs is not autonomous, but in close interaction with the treatment process, supplementing the treatment and increasing its effectiveness. In turn, a full-fledged surgical treatment, including such measures as early diagnosis of the disease, adequate preoperative preparation, qualitatively and rationally performed surgical intervention, the correct use of medicines in the postoperative period, allows using rehabilitation methods already at the earliest stages of the treatment process. So, treatment and rehabilitation are closely related, mutually complementary and should not be contrasted, therefore, the development of methods for physical rehabilitation is carried out taking into account the content of postoperative treatment of patients, and the implementation of rehabilitation measures is an integral part of the entire treatment and recovery process. The tasks of the hospital stage of rehabilitation of patients with gunshot limb injuries are: development for each patient of an individual program of rehabilitation activities and ensuring its continuity at the following stages; the implementation of an adequate mode of motor activity with a consistent increase in load; sanation of chronic foci of infection and treatment of concomitant diseases; the formation of an optimal psychological response to the consequences of trauma, as well as the system of the following rehabilitation measures [8; 9].

When developing individual rehabilitation programs, systematic monitoring of the adequacy and effectiveness of interventions and, if necessary, appropriate correction of rehabilitation programs are needed. Common criteria for the adequacy of physical rehabilitation in the early postoperative period is the improvement of the patient's well-being, gradual normalization of the performance of the cardiovascular and respiratory systems. In the functional-training period, the effectiveness of rehabilitation is assessed by the results of functional tests individually for various injuries. The sanatorium stage of rehabilitation with gunshot traumatic injuries of limbs is conducted in general or specialized branches of sanatoriums of the Ministry of Defense of Ukraine or in specially organized rehabilitation centers. Servicemen are sent to this stage, which, after treatment, are subject to long-term rehabilitation using special methods. On an outpatient-polyclinic stage, dispensary supervision is carried out for servicemen who have suffered traumatic injury to the limbs; measures are being taken to maintain efficiency, increase nonspecific immunity, prevent secondary and late complications, and gradually enter military professional activities [10; 12].

The duration of medical rehabilitation of servicemen in the firearms of limbs varies from several weeks to several months and depends on the severity of the injury, the complications, concomitant diseases, the patient's age, and the quality of the treatment. Timeliness of rehabilitation largely depends on reducing the number of postoperative complications. Rehabilitation activities end when the patient is provided with comprehensive assistance in achieving maximum physical usefulness and ability for military professional activity [12].

Thus, the main *objectives and principles of rehabilitation:*

• fastest start of rehabilitation activities, prevention of persistent dysfunctions of the body;

• continuity of rehabilitation, complements therapeutic interventions, including surgical interventions;

• continuity of rehabilitation in functional recovery;

• comprehensive nature of rehabilitation activities under the guidance of an orthopedic traumatologist;

• individualization of the rehab program, depending on the specifics of the injured and the pathological process;

• application of rehabilitation in the wounded team to accelerate the restoration of functions;

• return of a rehab to socially useful work, restoration of labor and combat ability [13].

The effectiveness of rehabilitation measures depends to a large extent on the correctness of the determination of the indications, the period and the scheme of their use in the overall treatment process.

Groups of the wounded are identified with injuries of the upper or lower extremity that enter the rehabilitation center for stage or final rehabilitation. The course of the pathological process and rehabilitation measures for the wounded is divided into *5 periods*.

Up to the *1st period*, the phase of traumatic inflammation in the case of soft tissue injury and bone fractures lasting 10–15 days is included. The main objectives of the rehabilitation of the first period are anesthesia, elimination of edema, resorption of hemorrhages and hematomas, healing of wounds of soft tissues. Treatment is carried out in the hospital.

Second period is characterized by the transformation of soft-tissue scarring and the formation of primary bone callus in fractures, it lasts from the 15th to 30–60th day. The tasks of rehabilitation are anesthesia, stimulation of callus formation, prevention of functional disorders, muscular atrophy.

Third period is the formation of the callus, its term from the 30th to 90–120 days. Rehabilitation tasks: strengthening the processes of mineralization of the callus, improving the trophism of the tissues, preventing complications, movement disorders in the joints, muscular atrophy, anatomical and functional restoration of the affected limb.

4th period is the stage of residual phenomena, the consequences of injuries in the formation of bone callus at the site of fracture and significant functional disorders of the limbs. Rehabilitation activities in this period should be aimed at restoring the function of the muscular system, movements in the joints and improving the supporting function.

5th period is determined by the results of injuries – false joints, bone defects and other conditions requiring long-term specialized orthopedic and traumatological treatment. The objectives of rehabilitation in this period is to stimulate the general protective functions of the body, improve local microcirculation and lymph flow, prevent edema, muscle atrophy, contracture and osteoporosis, stimulate reparative processes in damaged tissues.

In the 1st period, rehabilitation measures are carried out with the immobilization of the damaged limb with non-removable gypsum dressings or external fixation devices. In the 2nd and 5th periods, removable immobilization means or external fixation devices are used. In the 3rd and 4th periods immobilization of the limbs is not used. This determines the volume and intensity of physical therapy [6; 12].

Medical rehabilitation is carried out on the basis of the rehabilitation department, deployed in a hospital or in a rehabilitation center. It is carried out by the forces and means of medical personnel under the direct supervision and control of doctors and heads of hospitals, hospitals, medical and rehabilitation centers [15].

Physical therapy after gunshot lesions of the diaphysis of the shoulder.

Gypsum dressing is the main method of immobilization with gunshot fractures of the diaphysis of the humerus without the displacement of bone fragments and the limited nature of soft tissue damage in 65-70% of the wounded. In case of damage in the upper third (above the site of attachment of the deltoid muscle) – on the branch line (with the curved elbow joint to 90° and the shoulder extension up to 40–45) in the middle and lower third – by the thoracobranchy bandage [7; 11].

When the fragments are displaced, especially with a large damage to the soft tissues, extra-osseous through bone osteosynthesis is used by G. A. Ilizarov's devices or by spinal-rod compression-distraction apparatuses [12].

Immobilization with splinter firing fractures of the diaphysis of the humerus and soft tissue damage lasts 2,5–3 months. [7; 11].

Therapeutic physical trainingtherapeutic physical training is assigned to a wounded person with a diaphyseal fracture of the humerus, taking into account the localization of the fracture, the degree of soft tissue damage, the treatment method, the severity of the patient's general condition for five periods of the pathological process and rehabilitation measures [4; 12].

In the first period – in the first 10–15 days (3–4 days after surgery and absence of complications), taking into account the presence of degenerative-inflammatory processes between the clastic space for the purpose of resorption of hemorrhages and hematomas, acceleration of healing of wounds of soft tissues, reduction of edema of tissues in the site of injury, activation of blood, lymph circulation and metabolic processes, it is recommended to use passive, active-passive and active finger movements during kinesitherapy – when using immobilization of gypsum viscous or passive, active-passive and active movement in the joints of the fingers of the affected limb and wrist joint – immobilization Ilizarov, a short-term (up to 3–5) isometric tension arm and shoulder muscles [7; 11].

During the day it is recommended to carry out "treatment by position": the damaged limb is added to the withdrawn and elevated position, which helps to reduce edema, pain and prevent stiffness in the shoulder joint. Exercises are performed from the initial "lying" and "sitting" positions at a slow pace, the number of repetitions and the amplitude of movements are determined individually depending on the severity of damage to bone and muscle tissues, until a painful sensation appears in the wound, on average 4–6 times.

The exercises include exercises for healthy limbs and trunk, corrective exercises for the spine, static and dynamic breathing exercises, therapeutic walking in the ward and the corridor. It is recommended to take classes in therapeutic gymnastics for 10–15 minutes and independently 2–3 times a day for 5–10 minutes.

During this period, the following physiotherapy procedures are used: for anesthesia – diadynamic therapy in the fracture region, to improve the trophism of damaged tissues use UHF, magnetotherapy [16].

In the 2nd period – from the 15th to the 30th and the 60th day, active movements of the injured upper limb with fingers are used to anesthetize, accelerate the transformation of soft tissue scar, stimulate the formation of the primary bone callus, prevent functional disorders and muscle atrophy – when using immobilization with a cast bandage or active movements in the joints of the fingers and the wrist joint of the affected limb – when immobilized with Ilizarov apparatus, the isometric tension of the shoulder muscles (up to 5–7 s), Ideomotor exercises for the affected limb. It seems advisable to continue "treatment by position". Physical exercises are performed from the initial positions "sitting" and "standing" at a slow and medium tempo, the number of repetitions and the amplitude of movements are determined individually – until a painful sensation occurs in the lesion, an average of 6–8 times.

The exercises include exercises for healthy limbs and trunk, corrective exercises for the spine, dynamic breathing exercises, therapeutic walking in the ward and the corridor. It is recommended that TG sessions be performed for 15–25 minutes and 3–4 times a day for 10–15 minutes [7; 11; 12].

In the third period – from the 60th to the 90th day, rehabilitation measures are used to accelerate the formation of bone callus, strengthen the processes of mineralization of the bone callus, improve trophism of tissues, prevent the prevention of muscular atrophy and functional recovery of the affected limb in gymnastics classes using active movement with the fingers of the injured upper limb – when using immobilization with a plaster cast or active movements in the joints of the fingers and the wrist joint of the affected limb – when immobilized by the Ilizarov apparatus, isometric tension of the shoulder muscles (up to 6–8 s), ideomotor exercises for the affected limb, "treatment by position". Physical exercises are

performed from the initial positions "sitting" and "standing" at an average pace, the number of repetitions is 8-10 times, the amplitude is complete. The exercises include exercises for healthy limbs and trunks, corrective exercises for the spine, dynamic breathing exercises, therapeutic walking along the corridor and the park area of the hospital or hospital. Occupations of TG are recommended to be carried out for 25–35 min and independently 4–5 times a day for 15–20 min.

In the second half of the third period after the removal of immobilization, it is recommended to expand the volume of special physical exercises for the affected limb. Apply active-passive (with the help of a healthy arm) and active exercises for all joints of the affected limb. Widely used flapping movements in the shoulder and elbow joints from the initial position "standing with the torso tilted forward," tapping and bringing the shoulder and movement in the elbow joint, supination and pronation, moving the brush in different planes, compressing, opposing the fingers. To facilitate the movements of the injured hand at the beginning of the period, it is recommended

Physical exercises recommended for gunshot injuries of the shoulder muscles in the 4th period

No. i/o	Name of the muscle	Action of muscle
	Anterior muscle group of the shoulder	
	Biceps muscle	*Bends the arm at the elbow joint and provides supination of the forearm involved in the recoil and bringing the arm*
		Physical exercises
1	B.p. – sitting on a chair, the injured arm is lowered down. Flexion-extension of the arm in the elbow joint	
2	B.p. – sitting on a chair, a damaged arm is lowered down, in the hand a dumbbell is 2–4 kg. Flexion-extension of the arm in the elbow joint	
3	B.p. – standing, arms lowered. Circular movements in the shoulder joint forward, then back. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
4	B.p. – standing, arms lowered. Simultaneous lifting of straight arms through the sides to a 90 degree angle. In the second half of the period - the same thing, in the hands of a dumbbell 2–4 kg	
5	B.p. – standing, straight arms extended forward parallel to the floor. The cultivation of straight arms to the sides (at the beginning of the period – slowly, then – jerks). In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
6	B.p. – standing, feet shoulder width apart, the body tilted forward. Flight movements in the shoulder joint of a damaged limb in various directions. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
7	B.p. – sitting on a chair, hands are extended forward. Pronation-supination of the forearm. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
	Coracobrachialis muscle	*Raises an arm and leads to the midline*
		Physical exercises
1	B.p. – standing, arms lowered. Simultaneous rising of direct hands forward to a 90 degree angle. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
2	B.p. – lying on the floor, straight arms are divorced to the sides. Simultaneous lifting of direct hands in front of you, making cotton with palms	
3	B.p. – lying on the floor, straight arms are divorced to the sides, in the hands of dumbbells 2–4 kg. Simultaneous lifting of hands in front of you	
4	B.p. – sitting on a chair, straight arms split into the sides. Circular movements with the hands forward and backwards	
	Brachial muscle	*Flexes the forearm*
		Physical exercises
1	B.p. – sitting on a chair, the injured arm is lowered down. Flexion-extension of the arm in the elbow joint. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
2	B.p. – sitting on a chair, a damaged arm is lowered down, in the hand a dumbbell is 2–4 kg. Flexion-extension of the arm in the elbow joint In the second half of the period - the same, in the hands of a dumbbell 2–4 kg	
	Back muscle group of the shoulder	
	Triceps muscle	*Due to the long head, the hand moves backwards and brings the shoulder to the trunk; the whole muscle participates in the extension of the forearm*
		Physical exercises
1	B.p. – standing, arms bent at the elbow joints, are brought to the trunk, the hands – into a fist (boxer stand). Imitation of boxing – striking an imaginary opponent with his right and left hand. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
2	B.p. – standing, feet shoulder width apart, the body tilted forward, arms lowered. The cultivation of straight arms in the sides. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
3	B.p. – emphasis lying. “Push-ups” – unbending hands in the elbow joints, lifting the trunk above the floor, the back is straight	
4	B.p. – sitting on a chair, arms bent at the elbow joints are wound behind the back. Straightening your hands in the elbow joints, lift them up. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
5	B.p. – standing, straight arms diluted to the side, in the hands of the end of the rubber band, the middle of the tape is fixed on the crossbar of the gymnastic wall. Bringing straight arms to the body	
	Ulnar muscle	*Extends the forearm in the elbow joint*
1	B.p. – sitting, arms bent at the elbow joints in front of him. Circular movements in the elbow joints	
2	B.p. – sitting on a chair, arms bent at the elbow joints are wound behind the back. Straightening your hands in the elbow joints, lift them up. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
3	B.p. – standing, arms bent at the elbow joints, are brought to the trunk, the hands – into a fist (boxer stand). Imitation of boxing – striking an imaginary opponent with his right and left hand. In the second half of the period – the same, in the hands of a dumbbell 2–4 kg	
4	B.p. – emphasis lying. “Push-ups” – unbending hands in the elbow joints, lifting the trunk above the floor, the back is straight	

to use lightweight starting positions: sitting on a chair at a table with a smooth surface, forearm arms on the table. All exercises are performed with limited amplitude, at an average rate of 6–8 times [12].

In the 4th period – the stage of residual effects, the consequences of injuries in the formation of bone callus at the site of fracture and significant functional disorders of the limbs – from 90 to 120 days rehabilitation activities should be aimed at restoring the function of the muscular system, joint movements and improving the supporting function. In the exercises of therapeutic gymnastics, physical exercises for healthy extremities and trunks with full amplitude from the initial positions "standing" and "walking" are used, the number of repetitions of each exercise is 10–14 times. The emphasis is on exercises aimed at correcting posture, difficult-coordination exercises and therapeutic walking.

In order to restore mobility in the joints and the strength of the muscles of the injured limb, it is recommended to use special physical exercises for the injured limb. Active and active-passive (with the help of a healthy arm) exercises for all joints of the affected limb. Widely used flapping movements in the shoulder and elbow joints from the starting position "standing with the torso bending forward," rotational movements, retraction and reduction of the shoulder and movement in the elbow joint, supination and pronation of the forearm, movement of the hand in various planes, compression, opposition of the fingers. All exercises are performed with a full amplitude, at an average rate, 8-10-14 times (8–10 times at the beginning of the period) [7; 11].

Physical exercises are applied taking into account the amount of injury and the subsequent surgical treatment of the musculoskeletal system of the limb, as well as the physiological and biomechanical properties of the affected muscles (Table) [4; 17; 18].

The complex of therapeutic gymnastics necessarily includes exercises for the restoration of self-service. During the exercises you can use gymnastic sticks, balls, block devices, at the end of the period – rubber bands, simulators, dumbbells, expanders. Self-study is recommended up to 4–6 times a day. A good effect is given in the pool or in the bath, where the exercises are performed in warm water. Apply walking in the park zone hospital. The duration of TG increases to 30-40 min.

Gymnastic exercises necessarily alternate with breathing exercises and methods of relaxation of muscle groups involved in training.

In the second half of the fourth period, the number of forceful exercises increases (resistance exercises, weight training in the gym), exercises are introduced that require complex, precise coordination of movements. Often use elements of sports games, especially with the ball (throws, transfer, catching the ball, etc.). Applied hydrokinetic therapy in warm water with active movements of the affected limb, swimming. Great attention is paid to exercises that promote professional and household rehabilitation.

At this stage, massage the muscles of the shoulder girdle and upper limbs, first of all, the so-called suction massage above the injury site, while using the methods of stroking and squeezing. Then, the muscles of the affected limb are massaged, intermittent stroking is performed in the fracture region, when shock bone consolidation is slowed down, shock techniques are used [7; 11].

For physical therapy, which were used in the first three periods, added electrical stimulation of weakened muscles, electrophoresis, phonophoresis, salt baths and microwave therapy [12].

In the presence of the fifth period of the course of the pathological process, which is determined by the complications of trauma – false joints, bone defects, local microcirculation and lymphatic drainage, the presence of edema, muscular atrophy, contracture and osteoporosis, requiring long-term specialized orthopedic and traumatic treatment, physical therapy is prescribed using appropriate means during the entire period of rehabilitation.

Conclusions

1. The treatment and rehabilitation of servicemen and civilians who received gunshot wounds to the limbs is one of the main problems of military field surgery, remain relevant, both for the military medical service of the armed forces and for the national health system.
2. Restorative treatment of the wounded with gunshot limb injuries includes medical, social and professional rehabilitation; medical rehabilitation combines surgical and medicament methods, balneotherapy and climatotherapy, physiotherapy exercises, physiotherapy, therapeutic massage.
3. The objectives of the hospital stage of rehabilitation of patients with gunshot limb injuries are: development for each patient of an individual program of rehabilitation activities and ensuring its continuity in the following stages; the implementation of an adequate mode of motor activity with a consistent increase in load; sanation of chronic foci of infection and treatment of concomitant diseases; the formation of an optimal psychological response to the consequences of trauma, as well as the system of the following rehabilitation measures.
4. Physical therapy is an integral part of the medical rehabilitation of the wounded with gunshot injuries of the shoulder and depends on the amount of damage to the muscular apparatus, the immobilization method, the severity of the general condition of the wounded and the period of the pathological process and rehabilitation measures.

The prospect of further research is the study of the features of physical therapy after gunshot lesions of the lower limb at the stages of medical rehabilitation.

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Perfection of the functional readiness of high-qualified athletes in the process of preparation for international competitions

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Purpose: *to evaluate the effectiveness of using the program of building the training process in the preparatory period of the annual macrocycle for improving the functional fitness of the athletes of the Ukrainian national track and field team in preparation for major international competitions.*

Material & Methods: *in the study participated highly qualified athletes aged 19–23 years, specializing in running for short distances (n=10) and have a sporting title MSU and MSIG.*

Results: *it is shown that the introduction in the preparatory period of this program, taking into account the dynamics of the components of the functional fitness of the athletes and the nature of their correlation with the model characteristics, contributed to a significant improvement in all indicators of the functional preparedness of the examined athletes. At the end of the preparatory period, the deviation of these indicators from the model values was only 2–6%.*

Conclusion: *the obtained results testified to the positive impact of the program on the overall level of fitness of high-qualified athletes in the process of preparation for major international competitions.*

Keywords: *functional preparedness, macrocycle, Olympic cycle, short-distance running, preparatory period, athletes.*

Introduction

The concept of further development of national sports and a clear strategy for the preparation for the Olympic Games are among the key areas in the system of Olympic training for Ukrainian high-class athletes. Leading experts indicate that the results of the Games Olympiad indicate a stable and fairly high position of Ukrainian athletes in the international arena. The emergence of new, even higher levels of sporting achievements makes higher demands on the overall preparedness of athletes and their individual components in the system of long-term sports improvement, especially at the stage of maximum realization of individual opportunities [4; 7].

In athletics, especially in cross-country sports, a high level of physical and functional preparedness plays a decisive role in achieving high sports results. According to the leading coaches of the national team of Ukraine in track and field athletics, special attention should be given to improving these components of the preparedness of high-qualified athletes in the process of preparing for major international competitions.

Analysis of the data of the scientific literature and practical coaching experience made it possible to determine that the questions of theoretical and methodical aspects of the construction of four-year cycles of training highly qualified athletes for the Olympic Games were studied [1; 7], problems and prospects for managing sports training for athletes of high qualification [5; 9], the organization of a strictly balanced system of training and competitive loads [8], the use of innovative technology to improve the training process [4; 10], recreation facilities, rehabilitation, promotion of efficiency and mobilization of functional reserves [3; 10].

Despite the certain efficiency of the presented approaches, a study and generalization of the experience of training highly qualified athletes for international start-ups – the Olympic Games, world championships, Europe, etc., may be a promising direction in this issue [2; 6].

One of the perspective approaches to improving the functional fitness of athletes is the orientation of the training process on the group and individual model characteristics of the competitive activity and preparedness of world-class athletes.

Relationship of research with scientific programs, plans, themes. The work was carried out within the framework of the state budget theme "Development of modern approaches to improving the system of restorative measures among athletes", State Registration No. 1/15, IP 0115U000819 for 2015–2016. And within the thematic plan of the Research Institute of Zaporozhye National University "Modern technologies for the training of athletes of various specialization and qualifications in Olympic sports", No. of state registration – 0116U004848.

Purpose of the study: evaluation of the effectiveness of using the program of building the training process in the preparatory period of the annual macrocycle for improving the functional fitness of the athletes of the Ukrainian national track and field team in preparation for the XXX Summer Olympic Games in London.

Material and Methods of the research

The study involved highly qualified athletes aged 19–23 years who specialized in running for short distances (n=10) and had the sporting title of MSU and MSIG. Five athletes were part of the national team of Ukraine in track and field athletics.

Organization of the study. Assessment of the effectiveness of the program for building a training process aimed at improv-

ing the functional fitness of athletes was conducted on the basis of testing results in the process of preparing the team for the Olympic Games 2012 in London.

The main features of the experimental program consisted in the redistribution of the volume of the training load of various orientations within the framework of the structural elements (micro, mesocycles) of the fourth macrocycle, namely the increase in the volume of the training load aimed at the development of power, speed, speed training, special speed endurance sprinters, and also increase the volume of exercises aimed at technical training (start, start-up acceleration), use of a significant running and jumping new exercises with weighting (weight 5–20 kg), the variability of training systems of different directions.

The testing was carried out at the beginning of the spring-summer (March) and at the end (June) of the preparatory period of the annual macrocycle preparation.

To assess the level of functional preparedness and its components in the study, a computer program for rapid assessment of the level of overall fitness for athletes was used. The algorithm of the survey within the framework of this program provided for the performance of the standard submaximal ergometric test PWC_{170}, as well as measurements of the length (cm) and the weight (kg) of the body of the athletes. The program carried out an automatic calculation of the value of total physical performance ($rPWC_{170}$), the value of aerobic capacity ($VO2_{max}$), the values of alactic and lactate capacity and capacity, anaerobic exchange threshold (AET), heart rate at the threshold of anaerobic metabolism (HR_{aet}), total metabolic capacity (TMC), reserve capacity (RC), economy of the energy supply system for muscular activity (ESS) and the general level of functional preparedness (LFP) of the athlete's body. All the quantitative values used in the program were calculated and distributed to functional levels: "low", "below average", "average", "above average", "high" [3].

In order to obtain the most objective information about the current level of general preparedness of the athletes participating in the study, model characteristics of the indicators of the functional readiness of the leading athletes of the world teams in track and field athletics (USA, Jamaica, Germany, France, Belarus, Great Britain) were won and prize-winners of the largest international competitions in the period from 2006 to 2011 (n=14). The statistical processing of the results of the study was carried out using standard STATISTICA 7.0 and EXEL packages with the following parameters: arithmetic mean (X), mean deviation (σ), arithmetic mean error (S).

Results of the research and their discussion

The results of the testing of female athletes of Ukraine, conducted at the beginning of the spring-summer preparatory period of the fourth macrocycle, indicated a somewhat lower level of functional preparedness of the female athletes and very significant deviations in the parameters of their functional readiness from the model characteristics (Table 1).

In Table 1 shows that the physical fitness and aerobic abilities of athletes were significantly lower compared to the model characteristics, respectively, by 14,35±1,20% and 8,39±1,60%, respectively. These indicators corresponded to

Table 1

Indicators of the functional preparedness of female athletes of the Ukrainian national team at the beginning and after the end of the study, $\bar{X}$±S

Indicators	Model characteristics	Ukrainian team (Start)	Ukrainian team (Completion)
$rPWC_{170}$, kgm·min^{-1}·kg^{-1}	25,18±0,30	21,57±0,20 (A)••• (14,35±1,20%)	23,90±0,23 (A/A)** (5,09±1,26%)
VO_{2max}, ml·min^{-1}·kg^{-1}	67,70±0,27	62,02±0,34 (H)••• (8,39±1,60%)	64,51±0,35 (H)*** (4,72±1,64%)
Alactic power, W·kg^{-1}	11,36±0,15	9,99±0,17 (H)••• (12,06±1,51%)	10,92±0,29 (H) (3,88±2,15%)
Alactic capacity, conventional units	65,47±0,47	60,91±0,25 (H)••• (6,97±1,13%)	62,92±0,76 (H)** (3,91±1,19%)
Lactate power, W·kg^{-1}	8,69±0,15	7,95±0,06 (H)••• (8,53±1,08%)	8,50±0,15 (H) (2,15±1,44%)
Lactate capacity, conventional units	55,26±0,54	50,27±0,27 (H)••• (9,03±1,12%)	52,52±0,45 (H)*** (4,96±1,30%)
AET, %	63,93±0,47	59,83±0,25 (A)••• (6,41±1,13%)	62,82±0,56 (A/A) (1,74±1,55%)
HRaet, beats·min^{-1}	173,94±0,83	164,45±0,81 (A)••• (5,46±1,40%)	168,60±1,07 (A/A)*** (3,07±1,63%)
TMC, conventional units	237,10±2,42	210,39±1,43 (A/A)••• (11,27±1,16%)	224,74±2,61 (H)** (5,21±1,47%)
RC, points	87,83±1,76	75,57±0,37 (A/A)••• (13,96±1,02%)	82,56±1,05 (H)** (5,99±1,17%)
ESS, points	84,35±0,80	74,08±0,25 (A/A)••• (12,18±1,05%)	80,64±1,27 (A/A)* (4,41±1,87%)
LFP, points	91,44±0,70	76,88±0,17 (A/A)••• (15,92±1,03%)	89,13±1,09 (H) (2,53±1,84%)

Remark. *H – high, A/A – above average, A – average functional levels; ••• – p<0.001 in comparison with the model indicators at the beginning of the study, * – p<0,05; ** – p<0,01; *** – p<0,001 in comparison with the model indicators at the end of the study, the tubs indicate% of the deviation from the model characteristics at the beginning and at the conclusion of the study.*

the "average" and "high" functional levels. Significantly lower values of alactic and lactate power (respectively, in comparison with model characteristics) were registered. 12,06±1,51% i 8,53±1,08%), values of alactic and lactate capacity (respectively on 6,97±1,13% and 9,03±1,12%). These components corresponded to a "high" functional class. The values of the deviation of the anaerobic exchange threshold and the heart rate at the AET level corresponded to the "average" level and had significantly lower deviations from the model values (respectively, by 6,41±1,13% and 5,46±1,40%). Higher values of deviations from the model values were registered among the indicators of the total metabolic capacity, the reserve capacity of the organism, the energy efficiency of the power supply system for muscle activity (by 11,27±1,16%, 13,96±1,02%, 12,18±1,05%), answered "above average" level.

Taking into account the presented data, the integral value of the level of functional readiness (by 15,92±1,03%), which corresponded to "above the average level", was significantly lower, as compared with the model characteristics.

The presented data testified to a "lag" behind the model values of the level of functional readiness and its structural components at the beginning of the study from 5% to 15%. Thus, such a dynamics of changes characterized the level of functional preparedness of Ukrainian team athletes as insufficient to achieve high results in the Olympic Games and provided an opportunity, on the basis of determining and reducing the threshold of deviation from the "model", further improving the overall level of training by introducing into the training process an experimental program for building a training process in the fourth macrocycle of the Olympic cycle of training.

The results of the final testing made it possible to ascertain the high efficiency of the proposed program for constructing the training process.

At the beginning of the summer competition period, athletes were noted, firstly, probably improving the physical performance (by 10,82±1,52% compared to the beginning of the preparatory period), aerobic performance (on 4,01±1,44%), values of alactic and lactate power (respectively on 9,30±1,95% and 6,97±2,73%), values of alactic and lactate capacity (respectively on 3,29±3,20% and 4,47±1,93%), anaerobic exchange threshold (by 4,99±2,46%), the heart rate at the level of AET (by 2,52±1,65%). Within 6-9% there was an increase in the values of the total metabolic capacity (by 6,82±2,08%), reserve capacity (by 9,25±3,01%), energy efficiency of muscular activity (на 8,85±5,17%).

Such a dynamics of positive changes in these indicators by the end of the study contributed to a significant increase in the overall level of functional fitness of the athletes 15,93±6,46%.

Secondly, it should be noted that, based on the results of the final testing, there were qualitative changes in indicators characterizing the level of functional fitness of athletes, most of the indicators corresponded to a high level of functioning, compared to the beginning of the preparatory period.

To confirm the positive effect of the program for building the training process that was implemented, a comparative analysis of the deviation from the model values of preparedness indicators for athletes was made at the beginning and at the end of the spring-summer preparatory period of the fourth macrocycle (Table 1).

It is shown that after the preparatory period, the lagging behind the model values of the physical fitness level and aerobic productivity was registered significantly lower, compared to the beginning of the preparatory period, and amounted to only 4–5% (Figure 1).

Figure 1. The values of the deviations of the indicators of the functional fitness of the athletes from their model characteristics at the beginning and at the end of the preparatory period of the fourth macrocycle (%):
1 – relative aerobic capacity ($rPWC_{170}$), 2 – maximum oxygen consumption, 3 – alactic power, 4 –alactate capacity, 5 – lactate capacity, 6 – lactate capacity, 7 – anaerobic exchange threshold, 8 – heart rate at the anaerobic exchange threshold, 9 – total metabolic capacity, 10 – reserve opportunities, 11 – economy of the energy supply system, 12 – level of functional readiness.

The values of the deviation for the indicators of alactic and lactate power were from 2% to 4%, for alactic and lactate containers – from 4% to 5%, the values of the threshold of anaerobic exchange and the frequency of heart rate at the level of AET – 2–3%, the values of total metabolic capacity – 5%, reserve capacity of the body – 6%, energy efficiency of the system of energy supply of muscle activity – 4%. The value of the deviation from the model value of the integral index of the general level of functional readiness was 2,5%.

On the whole, the results of a comparative analysis of deviation values made it possible to state that the athletes of the Ukrainian national team had a degree of deviation from the model values of the functional readiness indicators at the end of the spring-summer preparatory period and was only 2–6%. Thus, the received results testified to the positive impact of the program on the overall level of preparedness of high-qualified female athletes in the process of preparation for major international competitions.

Conclusions

Based on the results of the analysis of the problem of optimizing the general level of preparedness of high-qualified female athletes who specialize in running at 100 m and 200 m, the need for further improvement of the training process is shown in connection with the fact that now the level of development of world achievements in athletics raises the increased requirements for further approaches on the improvement of the national system of Olympic preparation, coincides with the data of the studies of other authors [2; 9; 16].

It should be noted that for the determination and evaluation of the overall level of preparedness for female athletes in our

study, the integral quantitative indicator of the level of functional preparedness was first used, which includes the components of the basic structural elements of the functional fitness of the organism of high-class athletes. This indicator is one of the main integral criteria for assessing and predicting the effectiveness of sports training.

The presented results testified to the expressed optimization of the level of functional readiness of the female athletes of the national team of Ukraine and confirmed the high efficiency of the program of building the training process in the system of preparation for major international competitions.

More convincing evidence of this was also the bronze awards of Ukrainian female athletes at the XXX Summer Olympic Games in London in the 4x100 m relay race and the establishment of a national record.

Prospects for further research in this area are to further study the dynamics of the level of functional preparedness of the female athletes, specializing in running for short distances.

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Influence of special physical preparedness of athletes on biomechanical characteristics of performing basic exercises in acrobatic rock'n'roll

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Purpose: *to reveal the effect of special physical preparedness of athletes on the biomechanical characteristics of the performance of the kick-step component of the main course in acrobatic rock'n'roll.*

Material & Methods: *following research methods were used: theoretical analysis and generalization of data from special scientific and methodological literature; pedagogical observation; biomechanical computer analysis; video of the final of the category Juvenile of the Ukrainian championship (2017) from acrobatic rock'n'roll.*

Results: *a biomechanical analysis of the performance of the kick-step component of the main course; the amplitude of the performance of the kick-step component of the main move of the Juvenile category in acrobatic rock'n'roll.*

Conclusion: *the level of special physical preparedness of the Juvenile category athletes is determined; based on the biomechanical analysis of the performance of kick-step athletes in the main course, changes in the angle of the knee and hip joints of the legs at the beginning, middle and end of the competition program.*

Keywords: *main move, kick-step, athletes, acrobatic rock'n'roll, juvenile category, biomechanical characteristics (analysis), special physical readiness.*

Introduction

Increasingly, the popularity of acrobatic rock'n'roll in the world is growing. Recently, the countries of the continents of Asia and South America joined the development of this sport [12]. Admirers of acrobatic rock and roll: amateurs, professionals dream to be in the Charter of the Olympic movement. The World Confederation of Rock'n'Roll and the national federations of acrobatic rock and roll countries are making efforts to bring the requirements for the execution of competitive programs in line with mathematical statistics to determine the best sports couples not only in the basic class category (M-class), but also categories "B-class", "juniors", "juveniles" [4; 5; 7; 8]. Based on the WRRC Regulation [12] and its requirements, it is determined that one of the main components in the performance of the competitive program is the special physical fitness of the athletes [5; 6; 9; 11]. The special physical fitness of the juvenile category is based on the basic exercises, which include the main move (kick-ball-chench, kick-step + kick-step [10]).

The analysis of scientific and methodological literature revealed the lack of consideration of the issue in this direction and highlighted the problems of the special physical fitness of the Juvenile category in acrobatic rock and roll, which determined the relevance of this study.

Relationship of research with scientific programs, plans, themes. The work is carried out in accordance with the Consolidated Plan of Research in the Field of Physical Culture and Sports for 2016–2020. On the topic: "Psychosensory regulation of motor activity of athletes of situational sports" (№ 0116U008943).

Purpose of the study: to reveal influence of special physical readiness of sportsmen on biomechanical characteristics of performance of base exercises in an acrobatic rock'n'roll.

Objectives of the study:

1. To study sources of special scientific and methodological literature on the research problem.

2. Determine the biomechanical characteristics of the implementation of the kik-step component of the main course in acrobatic rock and roll.

3. Determine the level of special physical fitness and its influence on changes in the parameters of the knee and hip joints in the implementation of the main step kick-step component in the continuation of the competition program.

Material and Methods of the research

Research methods: theoretical analysis and generalization of data from special scientific and methodological literature, video shooting, biomechanical computer analysis, methods of mathematical statistics. The study involved 14 sportsmen (7 sports pairs of the Juvenile category) of the finals of the Ukrainian Championship in acrobatic rock and roll of 2017.

Results of the research and their discussion

The essence of the study is to determine the biomechanical characteristics of the performance of the component of kick-step exercises, the main course of the left and right foot partner, the partner of the sports pair of acrobatic rock and roll in the beginning, in the middle and at the end of the competition program. The biomechanical computer analysis of the finalists of the Ukrainian championship in acrobatic rock and

roll showed the problems of performing the basic exercises of acrobatic rock and roll by the Juvenile category (the preliminary basic training stage). Changes in the amplitude of the *kick-step* component of the basic exercise "Main course" in the beginning, in the middle, and at the end of the competitive program of sports pairs gives us a description of the level of special physical fitness of athletes at this stage of preparation. The graphics of the component of the basic acrobatic rock and roll exercise by the partners and partners of the sports pairs are almost identical, according to this; we consider it expedient to show the results of the study of one sports pair of the Juvenile category (Figures 1–6).

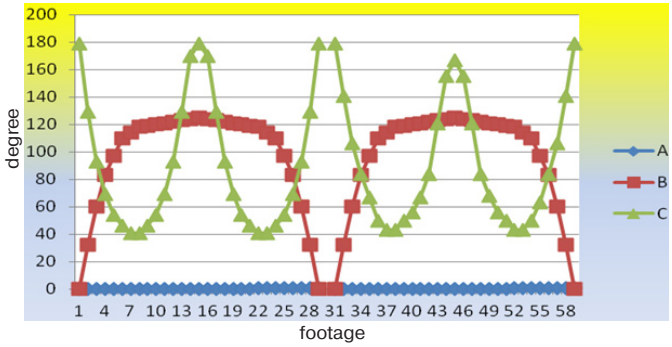


Figure 1. Changes in the parameters of the knee and hip joint angle of the male partner's left and right legs in the performance of the kick-step of the main course at the beginning of the competition program:
A *– t (time) one footage = 0,022 s;*
B *– parameters of the angle of the hip joint of the left leg at the time of changing the parameters of the angle of the knee joint (footage 1–28), the parameters of the angle of the hip joint of the right leg at the time of changing the parameters of the angle of the knee joint (footage 30–58);*
C *– trajectory of changing the parameters of the angle of the knee joint of the left leg (footage 1–28), right leg (footage 30–58).*

Reflected in Fig. 1 biomechanical characteristics (changes in the angle of the hip and knee joints at the beginning of the competition program) show the percentage to the maximum opening of the knee joint angle of the left leg 100% ($\varphi_{l.l.}$ – 180°); right leg 92,7% ($\varphi_{r.l.}$ – 167°). The percentage of the opening level of the angle of the hip joint of the left leg is 69,4% ($\varphi_{l.l.}$ – 125°), right leg is 68.8% ($\varphi_{r.l.}$ –124°). One of the main parameters of the performance of the kick-step component is the initial (first) phase of the knee joint angle change. During the raising of the thigh, the angle of the hip joint changes in the direction of increase, and the angle of the knee joint decreases. Raising the hip of the leg goes to the optimal height (individual performance) in the first phase. In the second phase, the angle of the knee joint is increased to the optimum opening. From the parameters of changing the angle of the knee joint in the second phase of both legs depends on the evaluation of the performance of the athlete's components and the whole of the main course. In Figure 1 shows the minimum parameters of the angles of the knee joints of the left (41°) and right (43°) legs. In this case, we have such calculations of the path (*S*) of the CM legs (shin, foot) segments along the segment:

$S_{l.l.}$=3,14·r·139/180; $S_{r.l.}$=3,14·r·124/180.

The execution time of the kick-step component of the exercise "main move" is constant and equal to 0.618 seconds (t = 0,618 s). So, we obtained two equal time intervals for changing the parameters of the angle of the knee joint (t=0,309 s). For equal parts of the time of the kick-step and right-foot component, the biomechanical characteristics of the CM of the legs (shin, foot), the speed (V), acceleration (a) depend directly on the path characteristic (S). According to this calculation, the characteristics of the path (S) of the CM leg links, we observe that when the component is executed by the right foot, the partner of the sports pair applies a less effort (F) than in the left-foot performance of the component. The authors, P. Kizim, N. Bateeva (2017) [10], indicate that the energy characteristics of the legs of the athlete in the performance of the kick component depend on the mechanical work and kinetic energy. In this case, the energy expenditure of the male and female partner, of the sports pair for the performance of the kick-step component, is directly proportional to the biomechanical characteristics of the left and right legs, the energy costs of the internal friction of the musculoskeletal system by the male partner, the female partner, and the energy costs of the male partner's body, the partner in the environment [1; 2; 3].

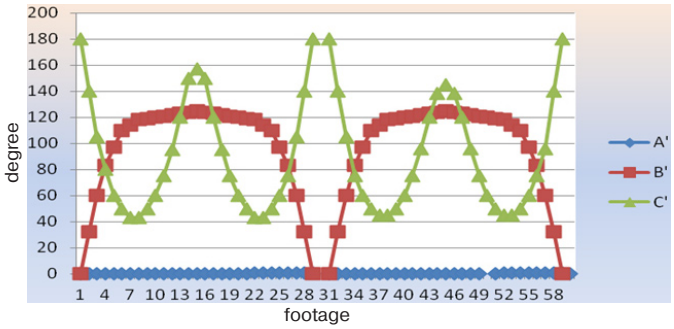


Figure 2. Changes in the parameters of the knee and hip joint angle of the male partner's left and right legs in the performance of the kick-step of the main course at the middle of the competition program:
A' *– t (time) one footage = 0,022 s;*
B' *– parameters of the angle of the hip joint of the left leg at the time of changing the parameters of the angle of the knee joint (footage 1–28), the parameters of the angle of the hip joint of the right leg at the time of changing the parameters of the angle of the knee joint (footage 30–58);*
C *– trajectory of changing the parameters of the angle of the knee joint of the left leg (footage 1–28), right leg (footage 30–58).*

The biomechanical analysis of the performance of the kick-step component (Fig. 2) showed the following results: the percentage to the maximum opening of the knee joint angle of the left foot 87,2% ($\varphi_{l.f.}$ – 157°); right leg 80,5% ($\varphi_{r.f.}$ – 145°); percentage to the maximum opening of the knee joint angle of the left leg is 69,4% ($\varphi_{l.f.}$ – 125°), right leg is 68,8% ($\varphi_{l.f.}$ – 124°); minimum parameters of the knee joint angles of the left (43˚) and right (45˚) legs. In this case, we have such calculations of the characteristics of the path (S) of the CM legs (shin, foot) segments along the segment:

$S_{l.f.}$=3,14·r·114/180; $S_{r.f.}$=3,14·r·100/180.

On the basis of the obtained calculation of the characteristics of the path (S), we observe that the partner of the sports pair applies a greater effort (F) to the performance of the component with the left foot than doing the component with the right foot.

The biomechanical analysis of the performance of the kick-step component (Fig. 2) showed the following results: the percentage to the maximum opening of the knee joint angle of the left foot 83,3% ($\varphi_{l.l.}$ – 150°); right leg 78,8% ($\varphi_{r.l.}$ – 142°); percentage to the maximum opening of the knee joint angle

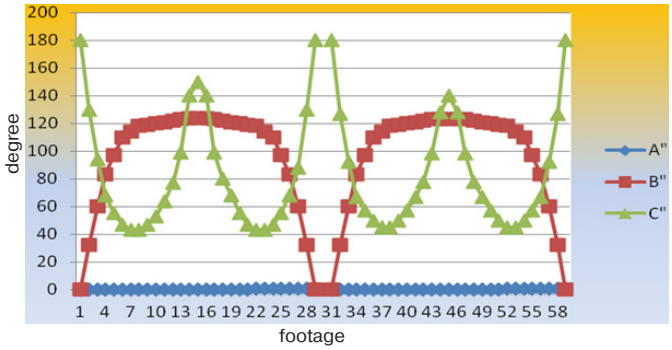


Figure 3. Changes in the parameters of the knee and hip joint angle of the male partner's left and right legs in the performance of the kick-step of the main course at the end of the competition program:
A" *– t (time) one footage = 0,022 s;*
B" *– parameters of the angle of the hip joint of the left leg at the time of changing the parameters of the angle of the knee joint (footage 1–28), the parameters of the angle of the hip joint of the right leg at the time of changing the parameters of the angle of the knee joint (footage 30–58);*
C *– trajectory of changing the parameters of the angle of the knee joint of the left leg (footage 1–28), right leg (footage 30–58).*

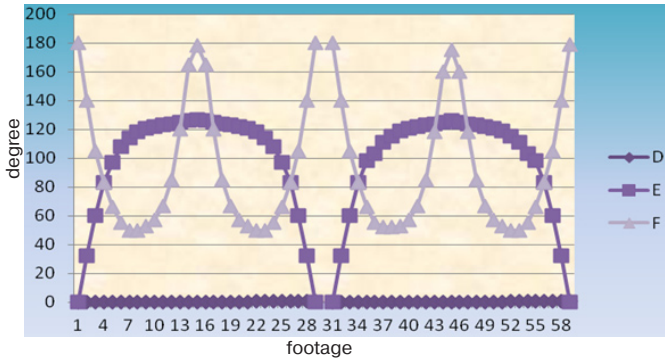


Figure 4. Changes in the parameters of the knee and hip joint angle of the female partner's left and right legs in the performance of the kick-step of the main course at the beginning of the competition program:
D *– t (time) one footage = 0,022 s;*
E *– parameters of the angle of the hip joint of the left leg at the time of changing the parameters of the angle of the knee joint (footage 1–28), the parameters of the angle of the hip joint of the right leg at the time of changing the parameters of the angle of the knee joint (footage 30–58);*
F *– trajectory of changing the parameters of the angle of the knee joint of the left leg (footage 1–28), right leg (footage 30–58).*

of the left leg is 68,8% ($\varphi_{l.l.}$ – 124°), right leg is 68,3% ($\varphi_{r.l..}$ – 123°); minimum parameters of the angles of the knee joints are left (43°) and right (45°) legs. In this case, we have the following calculations of the characteristics of the path (S) of the CM units of the foot (legs, feet) by segment minimal parameters of the angles of the knee joints of the left (43) and right (45) legs. In this case, we have such calculations of the characteristics of the path (S) of the CM units of the foot (legs, feet) by segment:

$S_{l.l.}$=3,14·r·107/180; $S_{r.l.}$=3,14·r·97/180.

From the calculation of the path characteristic (S), it is seen that for the component to be executed with the left foot, the partner of the sports pair applies a greater effort (F) than to the component with the right foot.

According to the calculations of the biomechanical characteristics of the male partner's performance of the sports pair of the kick-step component during the competitive program, their numerical value dominates in the direction of lowering the parameters. In percentage terms such results are shown:

– maximum opening of the knee joint angle of the left foot 100% ($\varphi_{l.l.}$ – 180°), 87% ($\varphi_{l.l.}$ – 157°), 83,3% ($\varphi_{l.l.}$ – 150°); right leg 92,7% ($\varphi_{r.l..}$ – 167°), 80,5% ($\varphi_{.l..}$ – 145°), 78,8% ($\varphi_{r.l..}$ – 142°).

Decrease in parameters of the knee joint angle of the male partner's left leg occurred on 16,7% ($\varphi_{l.l.}$ – 30°).

Decrease in parameters of the knee joint angle of the male partner's right leg occurred on 17,7% ($\varphi_{r.l..}$ – 25°).

Compared with the kick-step execution model, according to the WRRC Rules, the decrease in the parameters of the knee joint angle of the right leg of the male partner occurred on 21,1% ($\varphi_{r.l..}$ – 38°).

Biomechanical analysis of the performance of the kick-step component of the female partner sports pair (Figure 4) showed the following results: percentage of the maximum opening angle of the knee joints of the right leg 98,8% ($\varphi_{r.l..}$ – 178°); left leg 97,2% ($\varphi_{l.l.}$ – 175°); the percentage of the opening of the right angle of the hip joint of the right foot is 70,5% ($\varphi_{r.l..}$ – 127°), left leg is 70,0% ($\varphi_{l.l.}$ – 126°); minimum knee joint angles of the right (50°) and left (52°) feet. In this case, we have such calculations of the characteristics of the path (S) of the CM legs (shin, foot) segments along the segment:

$S_{r.l..}$=3,14·r·128/180, $S_{l.l.}$=3,14·r·123/180.

According to the calculation of the path characteristic (S), it is observed that for the component to be executed by the right foot, the female partner of the sports pair applies a greater effort (F) than to performing the component with the left foot.
Biomechanical analysis of the performance of the kick-step component of the female partner sports pair (Figure 5)

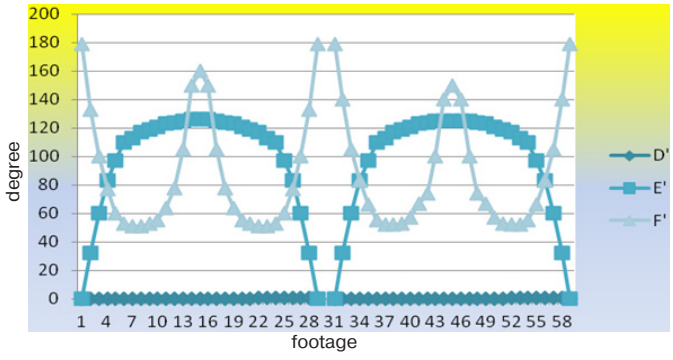


Figure 5. Changes in the parameters of the knee and hip joint angle of the female partner's left and right legs in the performance of the kick-step of the main course at the middle of the competition program:
D' *– t (time) one footage = 0,022 s;*
E' *– parameters of the angle of the hip joint of the left leg at the time of changing the parameters of the angle of the knee joint (footage 1–28), the parameters of the angle of the hip joint of the right leg at the time of changing the parameters of the angle of the knee joint (footage 30–58);*
F' *– trajectory of changing the parameters of the angle of the knee joint of the left leg (footage 1–28), right leg (footage 30–58).*

showed the following results: percentage of the maximum opening angle of the knee joints of the right leg 88,8% ($\varphi_{r.l..}$ – 160°); left leg 83,3% ($\varphi_{l.l.}$ – 150°); the percentage of the opening of the right angle of the hip joint of the right foot is 70,0% ($\varphi_{r.l..}$ – 126°), left leg is 69,4% ($\varphi_{.l.}$ – 125°); minimum knee joint angles of the right (51°) and left (52°) feet. In this case, we have such calculations of the characteristics of the path (S) of the CM legs (shin, foot) segments along the segment:

$S_{r.l..}$=3,14·r·109/180, $S_{l.l.}$=3,14·r·98/180.

According to the calculation of the path characteristic (S), it is observed that for the component to be executed by the right foot, the female partner of the sports pair applies a greater effort (F) than to performing the component with the left foot.

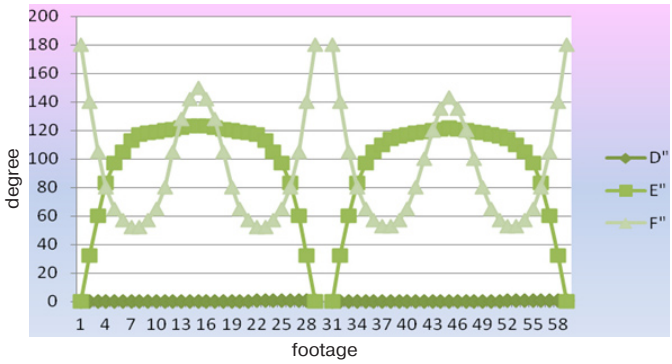


Figure 6. Changes in the parameters of the knee and hip joint angle of the female partner's left and right legs in the performance of the kick-step of the main course at the end of the competition program:
D" *– t (time) one footage = 0,022 s;*
E" *– parameters of the angle of the hip joint of the left leg at the time of changing the parameters of the angle of the knee joint (footage 1–28), the parameters of the angle of the hip joint of the right leg at the time of changing the parameters of the angle of the knee joint (footage 30–58);*
F" *– trajectory of changing the parameters of the angle of the knee joint of the left leg (footage 1–28), right leg (footage 30–58).*

Biomechanical analysis of the performance of the kick-step component of the female partner sports pair (Figure 6) showed the following results: percentage of the maximum opening angle of the knee joints of the right leg 83,3% ($\varphi_{r.l..}$ – 150°); left leg 79,4% ($\varphi_{rl.l.}$ – 143°); the percentage of the opening of the right angle of the hip joint of the right foot is 68,3% ($\varphi_{rr.l..}$ – 123°), left leg is 67,7% ($\varphi_{rl.l.}$ – 122°); minimum knee joint angles of the right (52°) and left (53°) feet. In this case, we have such calculations of the characteristics of the path (S) of the CM legs (shin, foot) segments along the segment:

$S_{r.l..}$=3,14·r·98/180, $S_{l.l.}$=3,14·r·90/180.

According to the calculation of the path characteristic (S), it is observed that for the component to be executed by the right foot, the female partner of the sports pair applies a greater effort (F) than to performing the component with the left foot.

According to the calculations of the biomechanical characteristics of the female partner's performance of the sports pair of the kick-step component during the competitive program, their numerical value dominates in the direction of lowering the parameters. In percentage terms such results are shown:

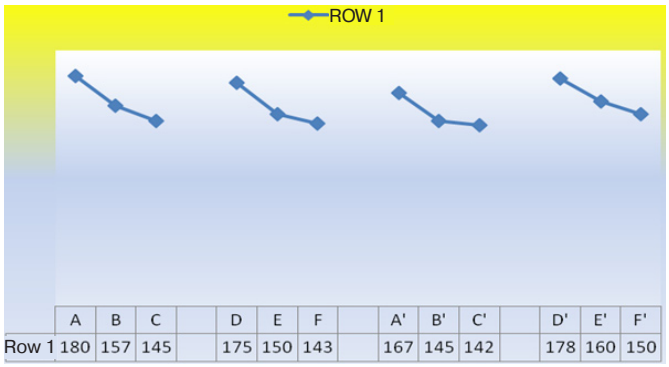
– maximum opening of the knee joint angle of the right foot 98,8% ($\varphi_{rr.l..}$ – 178°), 88,8% ($\varphi_{rr.l..}$ – 160°), 83,3% ($\varphi_{rr.l..}$ – 150°); left foot 97,2% ($\varphi_{rl.l.}$ – 175°), 83,3% ($\varphi_{rl.l.}$ – 150°), 79,4% ($\varphi_{rl.l.}$ – 143°).

Decrease in parameters of the knee joint angle of the female partner's right leg occurred on 15,7% ($\varphi_{rr.l..}$ – 28°).

Decrease in parameters of the knee joint angle of the female partner's left leg occurred on 18,3% ($\varphi_{rl.l.}$ – 32°).

Compared with the kick-step execution model, according to the WRRC Rules, the decrease in the parameters of the knee joint angle of the right leg of the female partner occurred on 16,6% ($\varphi_{rr.l..}$ – 30°); decrease in the parameters of the knee joint angle of the left leg of the female partner occurred on 20,5% ($\varphi_{rl.l.}$ – 37°).

In this study, a decrease in the amplitude of the performance of the kick-step component by the male partner and female partner in the middle and at the end of the competition program is revealed in comparison with its beginning (Figure 7).



	A	B	C		D	E	F		A'	B'	C'		D'	E'	F'
Row 1	180	157	145		175	150	143		167	145	142		178	160	150

Figure 7. Parameters of the angles of the knee joints of the male partner and female partner:
A – parameters of the angles of the knee joints left leg of the male partner at the beginning of the competition program; B – parameters of the angles of the knee joints left leg of the male partner at the middle of the competition program; C – parameters of the angles of the knee joints left leg of the male partner at the end of the competition program; D – parameters of the angles of the knee joints right leg of the male partner at the middle of the competition program; F – parameters of the angles of the knee joints right leg of the male partner at the end of the competition program; A' – parameters of the angles of the knee joints left leg of the female partner at the beginning of the competition program; B' – parameters of the angles of the knee joints left leg of the female partner at the middle of the competition program; C' – parameters of the angles of the knee joints left leg of the female partner at the end of the competition program; D' – parameters of the angles of the knee joints right leg of the female partner at the beginning of the competition program; E' – parameters of the angles of the knee joints right leg of the female partner at the middle of the competition program; F' – parameters of the angles of the knee joints right leg of the female partner at the end of the competition program.

The curve of the performance characteristics of the kick-step component of the base exercise, the main move shows a decrease in the parameters of the angles of the knee joints of athletes of the sports pair during the competition program.

Investigation of the performance of the kick-step component revealed the dependence of the increment of the applied forces (*dF*) with the increase of the knee joint extension angle ($d\varphi$) on the degree of fatigue of athletes of the sports pair at the beginning, in the middle and at the end of the competition

program.

Conclusions

The biomechanical analysis of the basic exercises performed by the Juvenile category in acrobatic rock'n'roll allowed us to state that there is a problem in the training process in the preparation of this category of athletes. Obtained results of biomechanical characteristics indicate the level of functional preparedness of athletes. In this case, at the stage of preliminary basic training in acrobatic rock'n'roll, the dominant functional training is the special physical preparedness of a partner and a partner of a sports couple. The dependence of the increment of the applied forces (dF) with the increase of the knee joint extension angle ($d\varphi$) on the degree of fatigue of the athletes of the sports pair at the beginning, in the middle and at the end of the competition program determined their level of special physical readiness and its influence on changes in the parameters of the knee and hip joint angles in performing the kick-step component of the main stroke.

Prospects for further research are to find ways to apply the basics of biomechanics in this direction, using the methodological recommendations and determining the preparedness of rock'n'roll athletes at the stage of preliminary basic training.

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Forms of physical culture and sports activities of general education schools pupils at the age of 15–17 years in their spare time

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Purpose: *to determine the forms of physical culture and sports activities in the general structure of spare time for pupils of general education schools aged 15–17 years.*

Material & Methods: *analysis and generalization of scientific literature; methods of theoretical level of research (analysis and synthesis) sociological survey. The study was attended by students of 10–11 grades of general education schools. Lviv, Ternopil, Ivano-Frankivsk and the city of Khmelnitsky. The total number of interviewed students was 907 people.*

Results: *most common types of activities are identified, to which students of general education schools aged 15–17 are involved in their spare time. Factors that determine the choice of activity by students in their spare time are established.*

Conclusion: *most popular types of physical culture and sports activities in their spare time among students aged 15–17 years is active rest and physical training and sports. The main factors influencing the choice of activities in their spare time among students aged 15–17 years, have their own tastes and preferences, a healthy lifestyle and school.*

Keywords: *physical culture, motor activity, spare time, leisure, students.*

Introduction

The period of study in grades 10–11 is characterized by an increased level of academic load, which, as a rule, is not limited to compulsory school lessons. Preparation for final exams and external independent evaluation reduces the amount of free time that students can spend on other activities, including motor activity [7].

Intensification of the teaching load leads to school hypokinesia, negatively affecting the health status of modern schoolchildren [5]. In addition, a significant part of the student population prefers passive forms of rest in their spare time, which further reduces the necessary volume of daily motor activity [2; 4]. As a result, the number of school leavers who are practically healthy is between 5 and 25%, and by the end of schooling, every second student [10].

An effective way to prevent hypokinesia is to attract students of all ages to physical culture and sports activities in their spare time. Leisure is one of the unique and most effective sociocultural spheres, according to many scientists and practitioners affects the development of the personality of adolescents and young people [12].

Rational use of sports and fitness forms contributes to the proper organization of leisure, positively influences the formation of a culture of free time and promotes the observance of a healthy lifestyle [2]. The study of content filling leisure offers significant opportunities for updating, enriching and actualizing recreational activities in accordance with the real needs of different socio-demographic groups [1].

The formation and organization of the rational activity of students in their spare time is in the list of priority problems requiring urgent solutions in various fields of science [12]. The forms of activity of students in their spare time are often analyzed in scientific works on sociology and pedagogy. Today there are also separate studies of this subject in the field of physical education.

The structure of leisure of schoolchildren was investigated by S. V. Gudim and M. P. Gudym who established ways of spending free time among students [5].

Studying the structure of the motor leisure of adolescents, T. S. Bondar singled out two components of the forms of organization of motor leisure, namely leisure activities in the educational system and recreation recreational activities [4].

The place of motor activity in the leisure of modern schoolchildren was studied by Ivanna Bodnar and Anna Kindzer [3].

In a study aimed at studying the socio-pedagogical prerequisites for the formation of a culture of motor activity among students in general educational institutions, A. Kh. Deineko found that the forms of motor activity that are carried out at leisure are less popular among pupils of grades 4–11 than forms of motor activity in mode of school day [6].

The widespread scientific works, the object of study of which is extracurricular, as well as independent forms of physical education, many of which are realized in their spare time. In this context, we recall the research of Natalia Kovalyova, who, studying the factors of negative influence on the organization of extracurricular activities in physical education, among others singled out the factor of the lack of consideration of the factors influencing the volume and structure of the free time of schoolchildren [9]. The peculiarities of the method of forming the readiness of high school students for independent physical exercises were studied by Vladimir Zachychy [8].

Group of authors – M. Nosko, S. Garkusha and A. Arkhipov, studying the possibilities of improving the health of the out-of-school and out-of-school work on physical education, came to the conclusion that such work can be effective only if spe-

cially developed methodological and methodological provisions are observed [11].

Approaches to the realization of various forms of motor activity in their free time are studied by foreign authors. In particular, a group of scientists from the University of Leuven (Belgium), found that a powerful factor in influencing the systematic involvement of students in motor activity in their spare time is the inner need or inner conviction of the child. The authors proposed their own method of step-by-step impact on the psycho-emotional sphere of students in order to form a stable need for physical training and sports [16].

Motor activity in the period of leisure among different age and social groups of Estonia was investigated by Peter Lusmagi, Mart Einasto and Eve-Liz Rossman. The authors established the dependence of the level of involvement in motor activity in their free time from age, social and economic factors [15].

Scientists at the Texas Technical University, Mark Lochbaum and Javan Jin-Noel, in their study of the connection between physical education and leisure time of students, note that the level of involvement of high school students in motor activity of at least 60 minutes per day in developed countries is critically low [14].

A group of authors from the University of Western Australia and the University of Kartin explored the influence of school physical education and the structure of leisure time for schoolchildren on the level of motor activity [13].

At the same time, the problems of the place of various sports and sports form in the general structure of free time for schoolchildren of different ages.

Relationship of research with scientific programs, plans, themes. The research was carried out in accordance with the research topic of the Department of Theory and Methods of Physical Culture of Lviv State University of Physical Culture for 2017–2020. "Theoretical and methodical aspects of the optimization of the motor activity of various population groups" (Minutes No. 4 of 17.11.2016).

Purpose of the study: to determine the forms of physical culture and sports activities in the general structure of free time for pupils of general education schools aged 15–17.

Objectives of the study:

1. Identify the most popular types of physical culture and sports activities, carried out in their spare time by students aged 15–17 years.

2. Determine the factors that affect the choice of activities in their spare time.

Material and Methods of the research

Research methods: analysis and generalization of scientific literature; methods of the theoretical level of research (analysis and synthesis), a sociological survey.

In the course of the survey, students of secondary schools aged 15–17 years in the cities of Lviv, Ternopil, Ivano-Frankivsk and Khmelnytsky were interviewed. The survey was conducted on the basis of such educational institutions: No. 1, No. 2, No. 9, No. 34, No. 54, No. 87, No. 89 (Lviv, 988 people) No. 9, No. 16, No. 20 (Ternopil , 322 people) No. 5, No. 7, No. 17, No. 24 (in Ivano-Frankivsk, 325 people); No. 3, No. 19 (Khmelnytsky metro station, 314 people).

The total number of students surveyed was 907, which is 4% of the total population. The number of interviewed children was 451 people, the number of interviewed girls – 456 people. The error in the study was ±3%.

Results of the research and their discussion

At the initial stage of the study, we found out the opinion of students aged 15–17 on the degree of satisfaction with their own free time. The students were asked to answer the question: "Are you satisfied with the amount of your own free time?".

The obtained results showed that 31.5% of the students surveyed in grades 10–11, as a rule, are satisfied with the amount of their own free time. Among young men, this figure was 32,4%, among girls 30.9% (Figure 1).

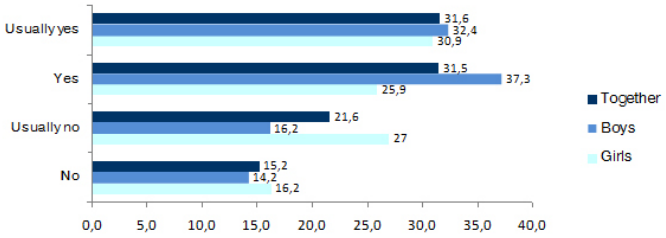

Figure 1. Satisfaction with the amount of your own spare time by students of general education schools aged 15–17 (%, n=907)

The generalization of the results of groups of students, positively or in part, positively assesses the amount of their own free time has shown that on the whole 63,1% of pupils of the senior school age to some extent positively estimate the amount of their own free time. Among young men this indicator reached the level of 69,7%, while among the girls it was lower, making up 56,8%.

Total number of pupils of the senior school age, who on the whole negatively estimate the amount of free time available to them, was 36,8%. The indicator of boys in this group of students was 30.4%, the indicator of girls – 43,2%.

The study of the role of various forms of motor activity in leisure activities of pupils is impossible without determining the structure of free time. That is why the next stage of our survey was the identification of the most common types of activities that students of senior school age in their leisure time do. For convenience analysis, adjacent activities were grouped into groups that indicated the general orientation of a particular activity carried out by students in their free time. In response to a question of open-mindedness, pupils of senior school age could choose the appropriate thematic group of activities, or give their own answer.

Results of the research showed that the most common among students in grades 10–11 is a type of activity at leisure is the use of the worldwide Internet. This was indicated by a total of 71,7% of the students surveyed. The indicator of involvement in the use of the Internet at leisure was found to be equally

high among both boys and girls, accounting for 70,7% and 72,6% respectively (Figure 2).

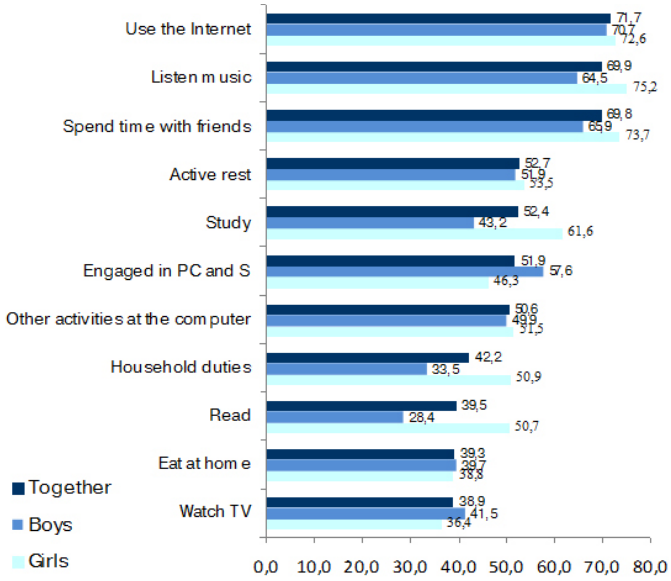

Figure 2. Most popular activities that are carried out by students of secondary schools aged 15–17 years in their spare time (%, n=907)

In the top three most popular activities, pupils of the senior school age also attributed music listening (69,9%) and pastime with friends (69,8%). Differences in results, taking into account the gender factor, accounted for 10,7% of listening to music and 7,8% for pastime with friends. In both cases, high rates were recorded among girls. The corresponding absolute figures for girls were 75,2% and 73,7%. Among the young men, these figures were 64,5% and 65,9%.

The next most popular type of activity among students of high school age was an active vacation. The total number of students who chose this option was 52,7%. Among young men, this indicator was 51,9%, among girls – 53,5%. It should be noted that activities such as activities requiring the active work of skeletal muscles (cycling, swimming in water bodies, skateboard, rollers, etc.) were included into the category of "active rest".

In general, 51,9% of schoolchildren attending physical education and sports in their free time. Among young men, the rate of such children was higher and amounted to 57,6%, while among girls it was 46,3%. In the category of "physical education and sports" classes were included classes in sports sections or self-employment with certain types of sports.

Important in the context of our study is this type of activity in their spare time, like "attending sports events". It is about attracting students of the senior school age to various events of the sporting direction as spectators. To this activity in their free time, 22,9% of pupils of grades 10–11 participate in the whole. Among young men, this figure was 30,2%, almost double the rate among girls on 15,8%.

The next stage of the study was to study the factors that determine the structure of leisure time for pupils of senior school age. The choice of these or other activities in their spare time is due to certain factors that form a stereotype of students' behavior, influencing the formation of a certain regime of the day.

The study found that the main factor that influences the choice of activity of students of senior school age in their spare time is their own tastes and preferences of students. In general, 65,9% of respondents indicated this. Among the girls, this indicator was significantly higher than the rate of children, making up 77%. The figure among young men was 60.8% (Figure 3).

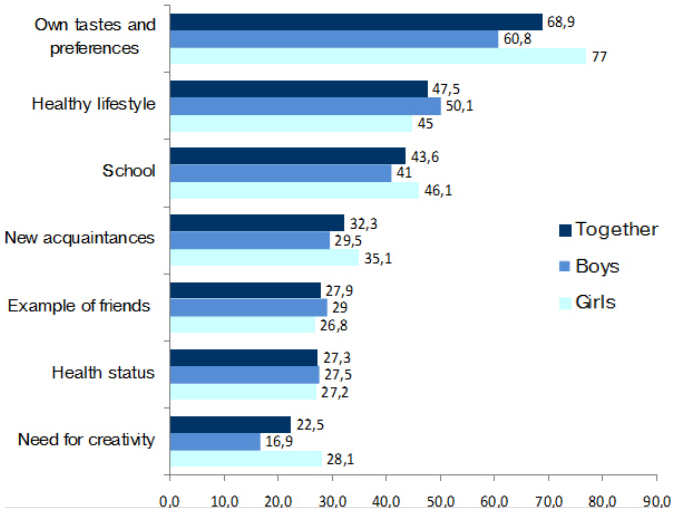

Figure 3. Factors affecting the choice of activities in their spare time students of senior school age (%, n=907)

A healthy lifestyle determines the choice of activity at leisure 47,5% of pupils of senior school age. Among young men, this figure was 50,1%, among girls, 45%.

In the three most important factors, the school also caused 43,6% of students aged 15–17 years to work in their spare time.

For 27,3% the choice of activity in free time is determined by the state of health. The rates of girls and boys in this group of students were almost the same, amounting to 27,2% and 27.5%, respectively.

One of the important indicators of the quality of the content of activities carried out in their spare time is the personal satisfaction or dissatisfaction of students with their own leisure. That is why, having received an approximate structure of free time for students of senior school age, we inquired about the opinion of this contingent of students on satisfaction with the content of their own leisure. The results obtained showed that the majority of high school students are more or less satisfied with the content of their own free time. In general, 48,1% of students in grades 10–11 indicated that they were unambiguously positive about the content of their leisure time and were satisfied. Among young men, this indicator was higher, amounting to 57,4%, while among girls it was 38,8% (Table 1).

Usually, 42,8% of pupils of the senior school age are satisfied with the content of their own free time. The children's figures were 34,1% and 51,3%, respectively.

Usually, dissatisfied with the content of their own time, 6.8% of students aged 15–17 years. Among girls, the rate of such children was 7,5%, among men – 6,2%.

Table 1
Satisfaction of pupils of secondary schools aged 15-17 with their own free time (%, n=907)

Possible answer	Boys	Girls	Together
Yes	57,4	38,8	48,1
Usually yes	34,1	51,3	42,8
No	6,2	7,5	6,8
Usually no	2,2	2,4	2,3

Generally dissatisfied with the content of their own leisure 2.3% of students of senior school age. The figure among young men was 2,2%, among girls – 2,4%.

Conclusions

Among students aged 15–17 years, the most popular activities in their spare time are the use of the Internet (71,7%), listening to music (69,9%) and spending time with friends (69,8%).

At the senior school age, the total rate of students who are attracted to various forms of active leisure in their spare time 52,7%.

The total number of students in general education schools aged 15–17, who are attracted to various forms of physical culture and sports in their free time, is 51,9%. Among young men, the figure of pupils involved in this activity is 57,6%, among girls – 46,3%.

The main factors influencing the choice of activities in their free time among students in general education schools aged 15–17 years are their tastes and preferences of students (68.9% overall), a healthy way of life (47,5%) and school (43,6%)

Prospects for further research are the details of the time parameters that are spent on certain activities in their spare time, as well as in setting the desired activities that the students would like to do during leisure.

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Use of mobile and educational games in the sports training of young football players

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Purpose: *determine the content and sequence of the use of mobile and educational games in the process of sports training for young football players.*

Material & Methods: *analysis, synthesis and generalization of scientific information on the problem of research, educational and methodological literature and Internet sources, pedagogical observations.*

Results: *it is established that the effectiveness of the use of mobile and educational games should be ensured not only through their appropriate selection in accordance with the pedagogical conditions and due organizational and methodical decision, but also by determining the optimal sequence of their implementation in the training process, adapting their content and structure to the contingent students and a specific pedagogical situation. The generalized sequence of application of these games in the process of sports training of young football players is considered, on a specific example their approximate content is revealed.*

Conclusion: *the content and sequence of the use of mobile and educational games are determined by methodological provisions that provide for the primary solution of the tasks of the individual side of the training of young football players with the subsequent resolution of interrelations in its limits. After that, those tasks of a certain side of sports training that can be solved by means of another are realized. In the future, the relationship and integration of two or more parties of long-term training is carried out in control games and official competitions.*

Keywords: *mobile and educational games, sports training, young football players, use.*

Introduction

Constant growth in the level of football requires a steady improvement in the sports training of young players, the modernization of the selection and forecasting system, improving the management of the training process, improving the quality of training of qualified personnel.

In the conditions of reorientation to the new conceptual provisions in the system of reserve preparation in sport, a number of topical issues have been singled out, on which the solution of the problem of the formation of the sporting skills of young football players depends. Analysis of scientific and educational literature allows us to state that: fundamental research, which is characterized by a comprehensive approach, a wide age range, aimed at deepening and expanding the theoretical and methodological foundations of children's and youth football is not enough [2]; in children's and youth football there are still unsolved a number of issues related to the construction and content of the training process at the stages of initial, preliminary basic and specialized basic training [5]; contradictions remain between training and competitive activities in the system of long-term preparation of the football reserve [7]; as a result of organizational and methodological miscalculations in the preparation of young football players, premature exhaustion of the reserve capabilities of their organism occurs [11].

Improvement of sports training should be carried out on theoretical and methodological bases, reflecting the current trends in the development of football, the main of which V. Shamardin determines the increase in the number of power combat and speed of the game, improving the interaction of players in the changing of their functional duties, further improving collective action and strengthening them role in the attack and defense, increasing the reliability of the implementation of technical and tactical actions and gaming tasks, involvement in playing episodes of numerous groups of football players [12].

A necessary factor for the successful solution of the tasks of sports training for young football players is the provision of mutual communication and assistance of all parties to this long-term process – theoretical, technical, tactical, physical, psychological and integrative (game), as well as training and competitive activities. At the same time, the formation of links between the components of training with the aim of uniting them into a single integrated competition activity requires a continuous, purposeful impact.

An important indicator of achieving the planned results in the training process is the ability of each student to effectively apply gaming techniques in difficult game and competition conditions. Young athletes should learn how to implement the entire amount of program material in gaming and successfully adapt to the specifics of football competitions. Integral components of this pedagogical process are mobile and educational games. Their use allows qualitatively solve various cognitive-developing, educational, control and evaluation, recreational and recreational tasks, facilitates the transformation of differentiated educational and training effects in the effectiveness of gaming and competitive activities.

The effectiveness of competitive activities in football is ensured by the appropriate level of all aspects of the sports preparedness of each player and the team as a whole. In this case, the best way to prepare for the game is herself. However, as V. Nikolaenko points out, today the model of the training

and exercise is not a game, but an exercise that significantly hinders the growth of the sports skills of young football players [7]. After all, it is utopia to teach to play with only one exercise. Exercise is a kind of football theory, and the game is a practice. And no matter how much the pupil does not exercise with the ball, it does not guarantee that he will learn how to play [10]. The need for systematic work on what a young football player will deal with on the field during the competition determines the need for optimal use of the potential of the game in its various forms in the training process.

Purpose of the study: to determine the content and sequence of the use of mobile and educational games in the process of sports training for young football players

Material and Methods of the research

To achieve this purpose, a set of interrelated methods was used, namely: analysis, synthesis and generalization of scientific information on research, educational and methodological literature and Internet sources, pedagogical observations.

Results of the research and their discussion

A purposeful process of training young players is based on the laws of the formation of sportsmanship. According to V. Platonov, these regularities are stipulated by the factors determining the effectiveness of the competitive activity and the optimal structure of preparedness, the peculiarities of adaptation to socially characteristic means and methods of influence, the individual characteristics of children, the timing of the main competitions and their correspondence, optimal for achieving high results of the athlete's age, long-term sports development [9].

Objectively existing patterns of medical-biological, psychological-pedagogical, social, sporting character are realized and unfolded in didactic (scientific, conscious and active, systematic, consistent and successive, accessible and individualized, strength and progress, the connection between theory and practice) and specific principles of sports preparation (focus on the maximum possible achievements, in-depth specialization and individualization, continuity of training on the process, the unity of the earth and the special preparation, the cyclicity of the preparation process, the unity of the gradual increase in loads and their tendency to the maximum possible values, the waviness and variability of the dynamics of the loads, the unity and interrelationship of the structure of the athlete's competitive activity and structure, the age-related compliance of long-term sports activity) which determine the requirements for the structure, content, nature of this activity and act as its regulators. All these principles are implemented in close relationship, providing a correct understanding of the process of sports training, as a consistent achievement of the highest possible level of preparedness by the individual, largely determines the results of her participation in competitions.

Didactic and specific principles of sports training serve as guidelines for determining the content and sequence of using mobile and educational games in the training of young athletes. The essence of these games is a meaningful activity aimed at achieving specific motor tasks in a rapidly changing environment. Their characteristic feature is the gaming techniques – active creative motor actions aimed at achieving the goal of a game and are motivated by its common design. Motor actions are determined by certain rules, which determine the manifestation by children of the corresponding initiative behavior. On the way to victory, the purposeful nature of the behavior requires an analysis of the situation, constantly changing, predicting it and effectively responding with the use of a large volume of motor actions in various combinations and variations, manifesting the necessary qualities, abilities, and Fig. Independence and relative freedom of action in combination with the fulfillment of the established conventions accepted by players under the subordination of personal interests are realized in conditions of emotional saturation and entertainment.

The game as a manifestation of one of the main types of human activity can be viewed from different perspectives: pedagogical as a means and method of influencing the individual, psychological as a means of mental development, a way of mastering social relations and collective forms of activity, according to sociological ones, as a condition the emergence and development of communication, the relationship of people, etc., in contrast to games in general, in mobile and educational games used in the pedagogical process, a clearly stated goal and in accordance with its expected result, which can be and justified, determined by the necessary components of this process and characterized by training and developmental focus.

Modeling any game situation or episode, mobile and educational games require from each student a complex manifestation of psychomotor abilities and intelligence. At the same time, participation in the game encourages an active and proactive position, largely determines the success on the way to achieve the planned sports results. After all, the activity of a young football player is one of the psychological and pedagogical mechanisms of mental, social, moral, physical, emotional growth of personality, its entry into the culture of sports. It is accompanied by an interest, a sense of pleasure and pleasure and is based on them. As emphasized by P. Lesgaft, functional pleasure is the most essential feature of the game [4], which essentially distinguishes it from physical exercise. The confirmation of this is the fact that in any other kind of activity a person does not seek to show his capabilities to the point of view, revealing the available psycho-physical and intellectual resources, as in the game.

Content of the training process is determined by the content of the competition activity, competitive game actions and the conditions for their effective implementation. The interrelation of training and competitive activity is provided primarily through integrative training, an important component of which are mobile and educational games. Their use makes it possible, on the one hand, to significantly improve the technical and tactical actions and functional capabilities of young players, and on the other hand, they successfully solve the problems of direct preparation for competitions. Moving and learning games make not only the integrated and integrative achievements of the goals of various aspects of sports training, but also the maximum realization of their training effects in integral competitive activity. Thus, according to V. Kostyukevich, integrative training "seems to be a synthesis of past training work and a forecast of future competitive activityi" [3, p. 253].

Any aspect of sports training is not an isolated process, be-

cause, for example, the technical aspect of solving game problems is always interconnected with the intellectual, tactical, physical, psychological capabilities of the athlete. This relationship is due to the complex nature of gaming activities and the integrity of motor activities in football. Each action of the player arises as a result of the system of knowledge, the manifestation of physical and psychological qualities, motor experience and is realized as a holistic effect, as an integrative formation. The absence of at least one component or insufficient level of mastery of it inevitably leads to a decrease in the effectiveness of the game action, and in the end makes it impossible to achieve high sports results [6]. At the same time, comprehensive sports training provides for optimal compliance of all its parties with full consideration for the capabilities of the athlete. According to the theory of functional systems developed by P. Anokhin, harmony is achieved not only on the basis of communication and interaction, but also is based on mutual assistance [1]. Accordingly, each side of the sports training of a young football player must be formed and developed in such a combination with others, in which their mutual assistance will be carried out, thereby increasing the level of technical preparedness in this case has a positive effect on others. And, conversely, by developing the intellectual, psychological, physical and tactical abilities of a young athlete to improve his technical skills.

A long-term study of football should be carried out on the basis of methodological provisions that provide for the priority solution of the specific tasks of the individual party to the preparation, and then resolve issues of interconnection within it. So, teaching the technique of the game provides for the consistent education of the necessary physical qualities. Further, those tasks of a certain side of preparation are realized, which can be solved by means of another [8]. In particular, the solution of tasks in football tactics is impossible without the use of technical methods, since any tactical action requires a combination of elements of technology, and the development of special physical qualities involves the use of gaming techniques. In the future, the relationship of two or more parties to training, their integration is carried out in control and official competitions.

Accordingly, the generalized sequence of the use of mobile and educational games in the process of sports training of young players can be this:

I. Preparatory games for soccer, the content of which reveals his specificity: "Shooting footballer", "The ball kicked out of the circle", "Do not miss the ball", "1000", "Start for the ball", "M ball in the goal with a spot" and etc.

II. Moving games on the technique of football: "Jugglers", "Square", "Ball through the net", "Ball Contents", "Circular Ball", "Break the Wall", relay races with elements of technology,

III. Educational double-sided games with tasks in technology: sequential inclusion in the system of tasks of program material for the corresponding year of study with the aim of fixing technical elements in game conditions.

IV. Educational two-sided games with tactical tasks: draws standard positions, using individual, team, team tactical actions in attack and defense on the basis of program material for the relevant year of training.
V. Teaching games with tasks aimed at the implementation of gaming techniques in competitive conditions, mini-football; games using specific ways of performing gaming techniques or distributing the football field to "zones" in which only certain technical elements, tactical actions are used or some of them are banned; games with the definition of the direction of the gear (for example, only forward) and the flight path of the ball; games using non-standard equipment or equipment, etc.

VI. Educational games with tasks-installations aimed at improving gaming techniques and their integration in competitive conditions: playing in unequal or incomplete multiple warehouses, for a time, with a limit in the count, several balls, three, four or more gates, with the definition of the number of touches ball, the addressee of the broadcasts (for example, the ban on returning the ball to the partner from whom the player received it), etc.

VII. Control games with a familiar and unfamiliar rival.

VIII. Official matches meetings.

IX. Conducting the analysis of games.

On the basis of these methodological provisions, a set of mobile and educational games is developed for the corresponding cycle of training and a specific training session. In this context, the content and sequence of games is determined, first of all, by the tasks of training, taking into account the existing organizational and pedagogical conditions. For example, to improve the conduct of the ball - a game reception that directly constitutes the technical training of young players, such an indicative set of mobile and training games can be used:

I. 1.1. Arbitrary ball handling with minimal visual control on a limited area of the football field. A ball for each student.

1.2. The same in pairs. Players, holding a partner by the hand, simultaneously conduct the ball away from him by the foot.

Criteria for determining the winners: the quality of ball control, the absence of collisions with other players, the number of ball losses, interaction with the partner.

II. 2.1. Kicking the ball in the restricted area of the football field. The ball is for every player. According to a certain visual or combined signal from the teacher (raised hand, certain color of the flag, etc.). Students change the initial reference to the specified one: the right/left foot, in a certain way, speed, in the direction indicated, etc.

2.2. The same, but one of the pupils after the announcement of his name, number, etc., sets the reference point for reference.

Criteria for determining the winners: the speed of response to a signal, the quality of ball control, the absence of collisions with other players in the game, the number of ball losses, the degree of attention distribution.

III. 3.1. "Kwach with the ball." The ball is for every player. "Kvach", carrying out the conduct, seeks to catch up with one of the players and touch him. The task of the other participants is to avoid this by controlling their ball. The player to whom touched the "spot", takes over his role.

3.2. "Save the ball". Each of the players seeks to knock the ball out of the playing area of any of the participants of the game, keeping under their control.

Criteria for determining the winner: the number of knocked out balls from rivals, touches of "spots", the loss of their ball.

IV. 4.1. Keeping the ball in pairs, threes, fours on a certain section of the football field. The location of the students in the groups is one column at a time, the distance is 1,5–2 meters. The lead player in the group sets the direction, speed, way of doing or performs additional motor actions with the ball. Famous players – reproduce certain partner motor actions, observing the initial distance. Lead in the pair change the pointer.

4.2. The same in the form of a relay race, in which different tasks for running the ball correspond to certain segments of the distance. Change of the player in the head of the column occurs after the completion of a specific task.

Criteria for determining the winner: observance of the initial distance in the group, the quality of the reproduction of motor actions, the number of losses of the ball, the speed of the tasks.

V. Circular relay race. The initial arrangement of participants is in the form of a geometric figure (square, rectangle, triangle), on the corners of which teams are built. Each side of the figure corresponds to a specific way of running the ball or an additional task. The first numbers of the teams start simultaneously. They consistently overcome all distances, performing certain motor actions and returning to their team, where they pass the ball to the next player.

Criteria for determining the winners: the speed of tasks, the quality of ball control.

VI. Holding the ball with two or three teams. At a certain section of the football field, the team that owns the ball, aspires to keep it as long as possible, using certain methods of conducting and other methods of play. The task of the opponents is to select the ball. The team whose player made a mistake is immediately included in the selection of the ball.

6.2. The same, but using 2–4 sections of the field, located at a distance of 10–30 m from each other. During the game on one of the parcels, according to a conditional signal, players must run to the corresponding other site and continue holding the ball. Selection of the ball begins the team, the player who ran last.

Criteria for determining the winner: the duration of possession of the ball, the quality of control of the ball, the number of losses.

VII. 7.1. Mini football.

7.2. Two-sided training game with the obligatory condition of performing the ball before the final blow to the goal.

7.3. The same, but in unequal or incomplete multiple warehouses.

7.4. The same, but several balls or three or more gates.

7.5. Two-way training game with the distribution of the football field to the "zones", in one of which it is allowed to use only the ball.

7.6. The same with the use of several balls.

7.7. A two-way training game with the obligatory performance of tactical actions, the content of which is the conduct of the ball: crossing, running, etc.

VIII. Control games.

The presented set of games aimed at solving the tasks of the stage of fixing and improving the conduct of the ball – one of the main techniques in the game of football. It should be supplemented and corrected in accordance with the requirements of the curriculum, the period of sports training, the level of preparation and the individual capabilities of students. In addition, the efficiency of the use of mobile and educational games should be ensured not only through their expedient selection in accordance with the pedagogical conditions and due organizational and methodical decision, but also through the definition of the optimal sequence of their implementation in the training process, adaptation of their content and structure to the contingent of students and a specific pedagogical situation.

Thus, the importance of mobile and educational games in the process of sports training is conditioned by the content and nature of football. After all, the purposeful preparation of a young athlete for gaming activities, determines the specifics of football, a priori impossible without the use of various games. The system of training aids can be improved, including through the optimal combination of physical exercises with mobile and educational games and gaming tasks. It should be aimed at the successful achievement of the goals of a certain stage of this multi-year process and is organized in accordance with its organizational and pedagogical conditions, namely the goals and tasks of each of the parties to sports training for a certain period, the state of preparedness of students, their sex, age, individual opportunities and game role, scientific, educational and methodical and material support, forms of employment, etc.

Conclusions

Moving and learning games is an important and integral factor in improving the sports training of young players. Proper use of them allows, on the one hand, to purposefully influence each of the parties of this multi-year process and on the basis of their mutual connection, assistance and integration to improve the playing and competitive potential of young athletes, and on the other, contributes to the solution of the contradiction between the training and competitive activities of students in system of their sports training.

The content and sequence of the use of games is conditioned by didactic and specific principles of sports training, as well as the available organizational and pedagogical conditions. They are directly determined by the methodological provisions that provide for the priority solution of the tasks of the individual side of the training of young football players with the subsequent resolution of issues of interconnection within it. After that, those tasks of a certain side of sports training that can be solved by means of another are realized. In the

future, the relationship and integration of two or more parties of long-term training is carried out in control games and official competitions.

Prospects for further research are related to the study of the features of the use of mobile and educational games in different periods of the annual cycle of sports training for young football players.

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Revelance of standardizing the process of conducting military (research) tests of exercises for physical training

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Purpose: *to substantiate the relevance of standardization of the process of conducting military (research) tests, to determine the quantitative characteristics of criteria for assessing the quality of standards for physical training of servicemen of the Armed Forces of Ukraine.*

Material & Methods: *analysis of the relevance of the issues of standardization of the process of developing, organizing and conducting military (research) tests, determining the quantitative characteristics of the criteria for assessing the quality standards for the physical training of military personnel used in developed countries and in Ukraine.*

Results: *discusses the importance of standardization of documents on the management and organization of physical training in the Armed Forces of Ukraine, reaching eligibility standards PP armed forces – NATO members. Suggested content standard.*

Conclusion: *urgency of creating a standard in conducting military tests of physical training exercises for servicemen and units of the Armed Forces of Ukraine has proved the need to achieve criteria for compliance with the standards PP of the armed forces – NATO members countries. The lack of a regulatory framework makes it difficult to organize and carry out research and development work, operational tasks to develop new standards of physical training for the Armed Forces of Ukraine.*

Keywords: *military standard, physical training, tests, military.*

Introduction

In the conditions of conducting a hybrid war in the east of the country, the problem of developing effective mechanisms for implementing combat experience in the training of specialists through the introduction of changes into practically all combat training programs, both individual and collective, from the initial course of the young soldier (sailor) and the Course of firing to the introduction of new standards in the training of military units and consideration of new forms and methods of using troops [1].

One of the integral mechanisms of state influence on the quality of the process of special physical training is the standardization of the order of checking the level of physical readiness of servicemen aimed at achieving the optimal degree of ordering in the physical training system of the Armed Forces of Ukraine by developing and establishing requirements, norms, rules, technologies, services used in the PP [2].

The urgency of the study is strengthened by the need to comply with the requirements of the Law of Ukraine of 5 June 2014 No. 1315-VII "On Standardization" and the provisions of the Presidential Decree of September 24, 2015. No. 555/2015 "On the new version of the Military Doctrine of Ukraine" [1; 16; 17].

Relationship of research with scientific programs, plans, themes. The research was carried out in accordance with the plan of scientific and scientific and technical activities of the Department of Physical Training of the Central Department of Training and Daily Activity of the Armed Forces of Ukraine for 2011–2015. On the topic of research "Justification of the expedient ways of introducing the Combat Army System into the physical training system of the Air Force of the Armed Forces of Ukraine" (code "Bars-AF") (state registration number 0101U001568).

Purpose of the study: substantiation of the urgency of standardization of the process of development, organization and conduct of military (research) tests, determination of quantitative characteristics of criteria for assessing the quality of standards for physical training of servicemen of the Armed Forces of Ukraine.

Material and Methods of the research

The analysis of the relevance of the issues of standardization of the process of development, organization and conduct of military (research) tests, determination of the quantitative characteristics of criteria for assessing the quality of standards for the physical training of military personnel used in developed countries and in Ukraine.

Results of the research and their discussion

The standardization of documents on the management and organization of physical training (PT) in the Armed Forces of Ukraine is of primary importance for public quality management. Standardization is an activity that consists in establishing provisions for general and repeated use with respect to existing or potential tasks and is aimed at achieving an optimal degree of orderliness in a particular field [3]. The purpose of PT standardization is to ensure that the objects of standardization meet their purpose; diversity management, applicability, compatibility, interchangeability of standardiza-

tion objects; ensuring rational production through the application of recognized rules, regulations and procedures; protection of life and health; ensuring the rights and interests of consumers; ensuring labor safety; preservation of the natural environment and saving of all types of resources; elimination of technical barriers to trade and preventing their occurrence, supporting the development and international competitiveness of products [4].

The first attempts to organize a system of standardization in the field of physical training in the Armed Forces of the Soviet Union, and in the next Ukraine, began in the late 30's – early 40's. And they were conditioned by the introduction of combat experience in civil and other local wars [18–27]. At the present time, a fairly large number of installations that have been put in place to ensure the physical readiness of personnel for the successful performance of combat missions and actions [3].

With a view to reforming the training in the university, in recent years, certain steps have been taken to regulate the individual components of the combat training system, in particular, the orders of the Minister of Defense of Ukraine "On the Adoption of the Interim Instruction on Combat Training in the Armed Forces of Ukraine" [6], the order of the NSAH – "On the approval of the Provisional Instruction for the training of officers, sergeants (foremen) of tactical management, institutions, organizations of the Armed Forces of Ukraine" [5], "The concept of development of physical and training of the Armed Forces of Ukraine for the period up to 2020".

In the field of special physical training, the project "Catalog of standards for physical training for servicemen and units of species, arms and military specialties of the Armed Forces of Ukraine VKT 03.035.001-2016 (01)", the project "Manual on physical training", commissioned research work Commander of the Air Force of the Armed Forces of Ukraine "Justification of expedient ways of introduction of the Combat Army System into the Physical Training System of the Air Force of the Armed Forces of Ukraine" (code "Bars-AF") (number of the state registration 0101U001568), the commissioner of the Air Force of the Armed Forces of Ukraine received a separate instruction from the commander of the Air Force of the Armed Forces of Ukraine to study the impact of the implementation of the standards for the physical training of the Air Force of the Armed Forces of Ukraine on the level of their special physical readiness to operate in difficult conditions of modern combat operations, the power of attorney for the fulfillment of the operational task to substantiate the criteria (normative indicators) and conditions for the implementation of promising military-applied and special physical exercises for servicemen of the Air Force Arms of Ukraine.

The experience of these tasks demonstrates the immediate need to develop standardization of the process of developing, organizing and conducting military (research) tests, determining the quantitative characteristics of criteria for assessing the quality of standards for physical training of servicemen of the Armed Forces of Ukraine.

At the same time, the catalyst for the standardization of physical training is also the need for the Center to achieve operational standards and methods for training the Armed Forces of Ukraine (a group of standards for physical training) for criteria of compliance with the standards of the Armed Forces of the Armed Forces of NATO member countries [7]. The lack of a regulatory framework concerning the requirements for the development of standards for physical training makes it difficult to organize and perform research on the development of new standards for physical training for the Armed Forces of Ukraine and may lead to a discrepancy between the quantitative characteristics of the criteria for assessing the quality of standards developed for the physical readiness requirements of servicemen.

In the Armed Forces of the NATO member states the standardization of the organization of physical training is set out in the field charters and programs [8].

In the understanding of NATO states, standardization is the process of developing concepts, doctrines, procedures aimed at achieving and maintaining the most effective levels of compatibility, interoperability, interchangeability and unification in the fields of technology, management and logistics [3; 9; 10]. There are 4 levels of standardization, which can be acceptable under different circumstances, namely: compatibility – "my system (or procedure) is not inconsistent with yours"; interoperability – "my system (or procedure) has much in common with yours"; interchangeability – "my equipment can be replaced with yours without further modification"; Uniformity (commonality) – "we use a single doctrine, the same procedures or equipment" [11].

The following principles of standardization are singled out in NATO:

– voluntary participation in the development and application of standards;
– cyclicity, that is, the process of standardization is repeated, provided that the efficiency of technologies or the use of resources is increased;
– importance of some levels of standardization for the implementation of plans;
– others are preferred if they increase the effectiveness of implementing plans or improve resource management;
– interaction is the minimum level of standardization desired;
– uniform terminology, which is the basis of standardization.

Thus, it should be noted that the development of a common methodology for organizing and conducting military trials, determining the quantitative characteristics of the criteria for assessing the quality of physical training standards will help solve the problem of the possibility of using them to determine the criteria for assessing the planned program results of training special physical training for servicemen and subunits of species, arms and military specialties of the Armed Forces of Ukraine. Among the arguments in favor of choosing the research topic is the possibility of improving the normative documents and the practice of physical training on their basis. As a result of the conducted research it is established that to solve the existing problem, a sufficient amount of data has already been accumulated, namely textbooks and manuals [12–15].

The process of developing standards is conceptually fairly simple (Figure 1). This is a cyclical process, having six steps: proposal, verification, development, approval, publication and execution. Head of the Center for Operational Standards

and Methods of Training the Armed Forces of Ukraine, Head of the Department of Physical Culture and Sports of the Ministry of Defense of Ukraine make a proposal for the introduction of a standard or installation. The proposal is checked, and then a working group or group of experts is created. This group is developing a draft document on the procedure for checking physical exercises, which is revised as many times as necessary. The next draft is being considered for inclusion in the Defense Ministry's program on military standardization. If this standard is included in the program of the Ministry of Defense of Ukraine for military standardization, it is planned to submit it for approval to the Office for Standardization of Codification and Cataloging. When the project is accepted, he agrees. When a sufficient number of institutions have agreed the document, it is made public (it comes into force as a military standard). When you need to make changes or additions during use, the cycle is repeated.

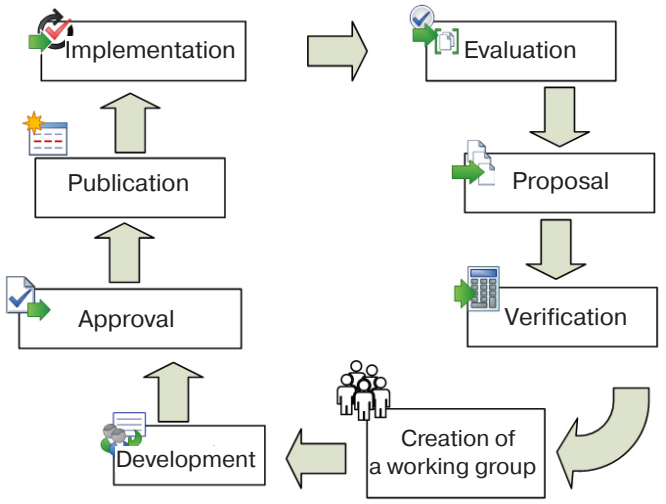

Figure 1. Process of developing a standard for conducting military trials

The structurally military standard (SMS) for the standardization of the development, organization and conduct of military tests is a text document that contains the following sections: the general part and the annexes. The SMS contains a description of the sequential steps aimed at the process of developing, organizing and conducting military trials and algorithms for calculating the quantitative characteristics of the criteria for assessing the quality of physical training standards, taking into account available individual and group means of appointment. The general part contains the following information: the name of the SMS of the Armed Forces of Ukraine; On putting into operation; historical reference; preface (indicated by the institution-developer and the composition of the authors' team, conciliation institutions, the appointment of the SMS, details of the institution where the document was developed); the content of SMS; scope of application; abbreviations and symbols; basic principles of organizing and conducting military trials; algorithm (order) of the standard; material and technical basis for the implementation of the standard; the date of approval of the Ukrainian Defense Ministry. The main part of the SMS of the Armed Forces of Ukraine is an application, is: a way to determine the required sample size; Typical Research Test Plan; order "On approval of the membership of the commission for testing military standards for physical training"; order "On the organization of tests and studies of standards of physical fitness"; form of the final report. An integral part of the SMS is methodical recommendations on the program for determining the quantitative characteristics of the criteria for assessing the quality of the military standard for physical training (Table 1). The program defines the actions, the responsible executor, the executive document. It is indicated that the basis for carrying out the military tests is an order, an order of the relevant head of the structural subdivision of the Ministry of Defense of Ukraine or the General Staff of the Armed Forces of Ukraine, on the basis of which the Plan for carrying out research tests is drawn up, the procedure, terms, place of their holding (military unit) and responsible persons.

For the organization and conduct of tests in a specific military unit, a commission is appointed by the commander of a military unit. The commission includes:

chairman of the commission – commander of the military unit;

Deputy Chairman of the Commission – Head of the Department of Physical Education, Special Physical Training, Head of Physical Training;

members of the commission – the head of the medical service, scientific and pedagogical staff of the Department of Physical Education, special physical training, unit commanders, ICC.

Commission organizes the following major events:

– development of the order of the commander of the military unit (chief) on the organization of tests and studies of standards for assessing special physical training;
– briefing of servicemen involved in testing, about the purpose and procedure for their conduct;
– medical examination of servicemen involved in testing; completion of the preparation schedule for the exercise, the frequency of testing and the study of standards for assessing special physical training with the preparation of the certificate;
– selection and preparation of the necessary educational and material resources;
– reports by the representatives of the Ministry of Defense of Ukraine, the General Staff of the Armed Forces of Ukraine on the establishment of a commission together with the order on the organization of tests, the date of testing and the evaluation standards for the assessment of special physical training.

Study of standards for the assessment of special physical training should be conducted in the real conditions of combat training. Creation of special conditions for servicemen taking part in the tests is prohibited.

Study of evaluation standards for special physical training is usually conducted in comparison with exercises that are used to test the most important aspects of the motor skills of combat training activities of military personnel, professional and special qualities, and are reflected in special tasks of physical training.

When carrying out tests, the following requirements must be observed:

Table 1

Program for determining the quantitative characteristics of criteria for assessing the quality of standards of physical preparedness

Action	Executor					System executive document / data / records
	SU	GS	UC	MU	AU	
Adoption and analysis of the order, the order of the corresponding head of the structural unit of the Ministry of Defense of Ukraine or the General Staff of the Armed Forces of Ukraine, in assessing the quality of the standards of physical training	CAF	CGS				Order, order of the respective head of the structural unit of the Ministry of Defense of Ukraine or the General Staff of the Armed Forces of Ukraine
Development of the Research Test Plan			S			Research Test Plan
Appointment of the membership of the commission			CMU			Order of the commander of the military unit on the approval of the membership of the commission
Report on the establishment of the commission together with the order on the organization of tests in the military unit			DCC			Report of the representatives of the Ministry of Defense of Ukraine, the General Staff of the Armed Forces of Ukraine
Determination of the volume of servicemen is subject to testing			AU			The list of servicemen is subject to testing (Appendix A to Clause 6.1 of the SMS)
Instruction of servicemen involved in testing, about the purpose and procedure for their conduct			AU			Sketch plan. Methodological guide (recommendations) for working out the standard of physical training
Medical examination of servicemen involved in testing				P		Statement of research of standards of an estimation of special physical preparation with a mark of the doctor
Bringing the schedule of preparation for the exercise, the frequency of testing and the study of standards for assessing special physical training with the preparation of an act			AU		C	Schedule of preparation for the exercise, the frequency of testing
Selection and preparation of the necessary educational and material resources				P	C	Schedule of distribution of educational and material resources, statistical analysis package
Control over the accuracy of the organization and testing			DCC			Conclusions on compliance with the requirements for testing in accordance with 6.3.3. TSTA
Assessment of the level of special physical preparedness of servicemen for the exercises of the active NPP			CM	P		Manual on physical training in the Armed Forces of Ukraine (current NPP)
Assessment of the level of implementation of a set of special exercises and actions to determine the level of special physical readiness of servicemen and units			CM			The draft standard of physical preparation СТП 12.035.15.10 (13-17,25-37,39,45) .4.01. Evaluation list for the standard of physical training
Evaluation of test results of new standards			CM			Methodological recommendations for determining the quantitative characteristics of the criteria for assessing the quality of the military standard for physical training
Completion of tests			CMU			Conclusions on the appropriateness of the adoption of research standards or on the directions for their further development. final report

Remark. *CM – commission members; DCC – Deputy Chairman of the Commission; CMU – commander of the military unit; EU – executive unit; S – statement; AU – an auxiliary / supervisory unit; MU – medical unit; P – paramedic; UC – unit commander; GS – General Staff of the Ministry of Defense of Ukraine; SU – structural unit of the Defense Ministry; MU – \military unit; CGS – Chief of the General Staff of the Ministry of Defense of Ukraine; CAF – Command of the Armed Forces of Ukraine; C – coordination.*

– mode of the day before testing should be built according to one scheme. Its excludes medium and heavy loads, but can be held restorative activities. This will ensure the equality of current states of military personnel and the output level before testing will be the same;
– warm-up before testing should be standard (in duration, selection of exercises, sequence of their implementation);
– testing should be carried out whenever possible by the same people who are specially trained;
– test execution scheme does not change and remains constant from testing to testing;
– intervals between repetitions of the same test should eliminate the fatigue that arose after the first attempt (after 2–3 days);
– soldier should strive to show the maximum possible result in the test. Such motivation is real if in the course of testing a competitive atmosphere is created.

Control over the correctness of the organization and conduct of tests is vested in the deputy chairman of the commission.

In the process of testing, quantitative characteristics of criteria for assessing the quality of physical training standards are determined.

The members of the commission participating in the tests assess the test results of the new standards in comparison with the traditional ones for the following indicators:

– quantitative characterization of objectivity is estimated based on the results of the questioning of military personnel who participated in the tests. Questionnaires should include questions on the impact of the assessment (performance result) of the test conditions standard, the complexity of the instruction and the specifics of the implementation of the standard, the stimulating material, the time constraints, the behavior of the diagnosis and the experience of the respondent in testing..
– index of complexity is calculated – I_c test assignments;
– index of differentiating ability is calculated – I_d test assignments;
– average arithmetic mean of the distribution of points is calculated– $\bar{X}$;
– basic statistical parameters of the measure of dispersion of the distribution of test scores – standard deviation – σ;
– quantitative reliability characteristic (correlation coefficient ***R***) is calculated between the test results after the first exam and after its repetition in the same contingent;
– quantitative characteristic of validity (coefficient of validity ***V***) of the standard of physical preparation is calculated.

Order of completion of the tests is.

Test duration of the experimental standards can be from 30 days to a year, and if necessary exceed a year.

In a special period:

– Test period reduced to 15 days;
– in the development of a standard based on the NATO model and approval of the conditions for execution and evaluation procedure, research tests will not be conducted.

Factors that determine the early termination of the study may be:

– a high level of injuries (more than 10% of military personnel who participated in the tests)
– low level of objectivity of physical training standards (more than 81% of experts fully agree on the impact of at least one factor on the result or the process of implementing the standard);
– low level of reliability of physical training standards (correlation coefficient – R<0,6).

When testing the standards proposed to modify existing ones, the validity of the standard should be determined by the criterion, which is chosen as:

– indicators of compliance with the standards of combat training (where they exist) or indicators of the dynamics of indirect performance indicators;
– factor information of tests.

Based on the results of the tests, the commission compiles a report that includes data on all issues related to their organization and conduct, provides conclusions on the appropriateness of adopting research standards to determine the criteria for evaluating the planned program results of training special physical training for servicemen and units of species, arms and military specialties of the Armed Forces of Ukraine or on the directions for their further development.

Final report is sent to the military management body, which organized the trial no later than 10 days after its approval by the chairman of the commission. Copies of the acts are submitted to the structural subdivisions of the Ministry of Defense of Ukraine, the General Staff of the Armed Forces of Ukraine, who took part in the work of the commission.

Conclusions

The urgency of creating a standard in conducting military tests of physical training exercises for servicemen and units of the Armed Forces of Ukraine has proved the need to achieve criteria for compliance with the standards of the armed forces of the armed forces of NATO member countries [7]. The lack of a regulatory framework for the requirements for the development of standards for physical training makes it difficult to organize and perform research and development tasks, to develop new standards of physical training for the Armed Forces of Ukraine and may lead to a discrepancy between the quantitative characteristics of the criteria for assessing the quality of standards developed for the physical readiness of military personnel. Further development of standardization of special physical training on the basis of the general methodology for the development, organization and conduct of military (research) tests, the determination of quantitative characteristics of criteria for assessing the quality of physical training standards will help improve the quality of physical training in the Armed Forces of Ukraine.

Prospects for further research in this area are the development/adaptation of a physical training facility based on the principles and requirements for the development of regulations on combat training.

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Features of technical and tactical actions of the team "Metalist" in the games of the League of Europe

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Purpose: *to analyze the technical and tactical actions (single combats, selection, interceptions) of the "Metalist" in the games of the European League in 2011–2012.*

Material & Methods: *study was carried out using the method of expert assessments. Analyzed 7 games of the League of Europe.*

Results: *average indicators of technical and tactical actions (single combats, selection, interceptions) of the "Metalist" team in the games of the European League in 2011–2012 have been analyzed, the average indicators for the 1st and 2nd half and for the game as a whole have been determined. The rejection coefficient is calculated.*

Conclusion: *quantitative and qualitative indicators of technical and tactical actions (single combat, selection, interception) of the "Metalist" in the games of the European League.*

Keywords: *technical and tactical actions, combat, selections, interceptions, rejection rate, defensive actions.*

Introduction

The structure and criteria of the effectiveness of the competitive activity of football players of different ages, qualifications and playing roles in our time have been studied quite well [1; 5; 10; 11].

The current level of development of football has grown so much that further search for ways to optimize the training process is the most urgent task of modern theory and methods of training football players [9].

The development of modern football is such that further progress will be a breeding ground on the one hand, the growth of differences in the actions of players, on the other – to combine individual and collective actions [7].

One of the key components of technical and tactical actions (TTA) in competitive activities are defensive actions. The main defensive actions include selections, martial arts, interceptions.

On average, for the game in the first half of the XX Championship of Ukraine, the team "Metalist" performed 61 ball selection with a mistake rate of 57,4%, single combat – 31, mistake rate – 35,4%, interceptions – 38, mistake rate – 34,2%. The effectiveness of defensive actions was – 80,9% [8].

In the Championship of Ukraine 2006-2007 the team players in 10 games played 57 selections on average for the game, of which 32 matches were lost to the opponent, the percentage of the mistake was 56,1%. In the structure of the game the selection of the ball was 7,6%. Interceptions of the ball team on average performed for the game 32, of which 4 failed, the percentage of mistake was 10,2%. In the structure of the game, the teams intercepted the ball 5%.

Investigating TTA team "Helios", in the Championship of Ukraine in 2006–2007, an average of 64,5 ball selections was recorded for the game, of which 36 team selections were not executed, the percentage of the mistake was 55,9%. In the structure of the team's game selection was 8,2%.

Interceptions performed on average for the game 38,1, of which 7 was unsuccessful, the percentage of mistake was 18. In the structure of the game, the teams intercepted the ball was 4,8% [4].

According to T. A. Lisenchuk, at one of the world championships the Brazilian team performed combat – 21,7% of the total number of technical and tactical actions. Selection from the leading teams of the world is 18,8–24,1% [6].

Characteristic features of technical skill of the strongest players is the ability to accurately and timely perform any transfer of the ball in the absence of time and space, with high accuracy to perform strikes on the goal, especially attacking, to play with the head, to take the ball any part of the body in difficult situations, at high speed and with mandatory advancement to own a wide arsenal of ways to outline the opponent, be able to effectively play at the interception and in the selection [7].

Control of the game activity of players allows you to get an objective description of TTA in those or other episodes of the match and the game in general, and also provides the opportunity to make adjustments to the training work on an individual basis [3].

When conducting pedagogical observations of the gaming activity of players, it causes some interest in the total number of TTA executed by the players.

So, according to G. S. Zonin, on average, a football player of the highest league performs from 47–116 technical and tactical actions. In the opinion of Yu. M. Arestov and M. A. Godik for successful actions in the game, the defender must perform 130 TTA with an effectiveness factor of at least 85%, a midfielder of 140 TTA, with an effectiveness factor of at least

80%, an forward – 80 TTA, with an effectiveness factor of at least 70% [2].

Relationship of research with scientific programs, plans, themes. The research was carried out in accordance with the Consolidated Plan of research works in the field of physical culture and sports for 2011-2015. MES of Ukraine on topic 2.3 "Scientific and methodological basis for improving the system of training athletes in football, taking into account the characteristics of competitive activity", and also, respectively, with the initiative theme of research of the Department of Football and Hockey of the Kharkov State Academy of Physical Culture for 2016–2021. "Psychosensory regulation of the motor activity of athletes of situational sports".

Purpose of the study: to analyze the technical and tactical actions (single combats, selections, interceptions) of the Metalist team in the European League and determine the quantitative and qualitative indicators.

Material and Methods of the research

The game activity of the Metalist team, which took part in the Europe League competitions, was studied. Registration of individual technical and tactical actions (single combats, selections, interceptions) was carried out using the method of expert assessments. It was registered 7 games, which the team spent on its field in the city of Kharkov.

Team "Metalist" of seven games won 4, lost one game and two games ended in a draw. The ratio of goals scored and conceded goals is 14:6. Digital data are processed by the method of mathematical statistics.

Results of the research and their discussion

Table 1 presents the indicators of the technical and tactical actions of the Metalist team in 7 games of the Europa League.

The indicators of combat for the first and second half, as well as the total number of technical and tactical actions per game, were analyzed separately. On average, the players of the Metalist team performed 21,42±2,81 single combats in the 1st half with a rejection rate of 43,42±3,63, in the second half the team performed an average of 19,85±2,49 with a rejection rate of 48,71±5,57. For the game on average players of the team "Metalist" performed 41,28±4,81 with a rejection rate of 45,85±3,44. If we compare the average quantitative indicators combat for the 1st and 2nd half, they differ slightly.

The best indicator of TTA (single combat) was registered in the first half with the team "Zelburg" Austria – 20/5, the mistake rate was 25%. The worst performance was recorded in the game with the team "Olympiakos" Greece in the second half – 25/20, the mistake rate was 80%.

If you analyze the indicators of TTA (combat) for the game, the best indicators were recorded in the game with the team "Zelburg" Austria 31/10, the marriage rate of 32%, the worst performance in the game "Olympiakos" Greece 49/31, the mistake rate 63%

Table 2 presents the results of the technical and tactical actions (selections) of the Metalist team in the Europa League.

On average, for the game in the 1st half, the team players performed – 28±1,15 selections with a rejection rate of 51,42±2,22. In the second half on average, 29,57±1,75 selections were recorded for the game, the rejection rate was 56,57±4,39. For the game, on average, 56,57±2,86 were recorded, the reject rate was 53,57±2,40.

The quantitative averages for the 1st and 2nd half are practically the same.

Top ranking team "Metallist" were recorded in the second half with "Dinamo" Bucharest team – 33/15 to mistake ratio of 45%, the worst performance in game with "Malmo" Switzerland – 25/19, the mistake rate – 76%.

The best figures for the game account in the game with "Dinamo" Bucharest team – 62/28 to mistake ratio of 45%, the worst performance in "Malmo" game Switzerland – 49/31, the mistake rate – 63%.

Table 3 shows the indicators of technical and tactical actions of interception.

n average, for the game in the 1st half the team "Metalist" performed 20,71±2,59, the mistake rate – 20,42±1,46. In the second half, respectively, 18,57±1,83, the mistake rate – 21,42±4,21. For the game on average, the team players performed 39,28±3,42 interceptions, the mistake rate was 20,57±2,18.

Comparing the quantitative indicators for the 1 and 2 time, we can say that they are slightly different.

The best indicators were interceptions in a game with the team "Dinamo" Bucharest in the 2nd half – 13/1, the mistake

Table 1

Indicators of technical and tactical actions (martial arts) of the team "Metalist" in the European League 2011–2012 (the total number of technical and tactical actions / inaccurate actions)

Team	Score	First time	Mistake, %	Second time	Mistake, %	All	Mistake, %
"Dinamo" Bucharest	2:1	11/5	46	15/7	46	26/12	46
"Zalburg» Austria	4:1	20/5	25	11/5	45	31/10	32
"Olympiacos" Greece	0:1	24/11	46	25/20	80	49/31	63
«Austria» Austria	4:1	17/7	41	22/10	45	39/17	43
"Malmo» Sweden	3:1	24/13	54	15/5	33	39/18	46
"Azalkmaar» Holland	1:1	19/10	52	21/9	42	49/19	47
"FC Sochaux-Montbйliard» France	0:0	35/14	40	30/15	50	65/29	44
$\bar{X}$ ±m		21,42±2,81	43,42±3,63	19,85±2,49	48,71±5,57	41,28±4,81	45,85±3,44

Table 2

Indicators of technical and tactical actions (selection) of the team "Metalist" in the European League 2011–2012 (the total number of technical and tactical actions / inaccurate actions)

Team	Score	First time	Mistake, %	Second time	Mistake, %	All	Mistake, %
"Dinamo" Bucharest	2:1	29/13	49	33/15	45	62/28	45
"Zalburg» Austria	4:1	30/14	46	30/15	50	60/29	48
"Olympiacos" Greece	0:1	27/13	48	26/17	65	53/30	56
«Austria» Austria	4:1	33/17	51	38/24	63	71/41	57
"Malmo» Sweden	3:1	24/12	50	25/19	76	49/31	63
"Azalkmaar» Holland	1:1	25/13	52	26/12	46	51/25	49
"FC Sochaux-Montbйliard» France	0:0	28/18	64	29/15	51	57/33	57
$\bar{X}$ ±m		28±1,15	51,42±2,22	29,57±1,75	56,57±4,39	57,57±2,86	53,57±2,40

Table 3

Indicators of technical and tactical actions (interception) of the team "Metalist" in the European League 2011–2012 (the total number of technical and tactical actions / inaccurate actions)

Team	Score	First time	Mistake, %	Second time	Mistake, %	All	Mistake, %
"Dinamo" Bucharest	2:1	16/3	19	13/1	7	29/4	14
"Zalburg» Austria	4:1	27/7	26	28/8	28	55/15	27
"Olympiacos" Greece	0:1	15/3	20	18/3	16	33/6	18
«Austria» Austria	4:1	20/4	20	19/4	21	39/8	20
"Malmo» Sweden	3:1	13/2	15	19/4	21	32/6	18
"Azalkmaar» Holland	1:1	32/8	25	14/6	42	46/14	30
"FC Sochaux-Montbйliard» France	0:0	22/4	18	19/3	15	41/7	17
$\bar{X}$ ±m		20,71±2,59	20,42±1,46	18,57±1,83	21,42±4,21	39,28±3,42	20,57±2,18

rate – 7%, the worst performance in the 2nd half with the team "Alkmar" Netherlands – 14/6, the mistake rate – 42%.

The best indicators for the game with the team "Dynamo" Bucharest – 29/4, the mistake rate – 14%, the worst with the team "Alkmar" Holland – 46/14, the mistake rate – 30%.

Conclusions

1. Comparing the technical and tactical actions of the Metalist team players in the Europa League with model characteristics, it should be noted that they are much worse, except for interceptions.

2. Quantitative indicators of martial arts, selections, interceptions for the first and second half do not differ significantly.

3. In single combats, and especially in selections, the indicators of technical and tactical actions are significantly low, and accordingly were 45,85%±3,44 and 53,57%±2,40, and the performance of interceptions was at the level of model characteristics – 20,57%±2,18.

4. Despite the low quantitative and qualitative indicators in defensive actions (single combats and selections), the "Metalist" team played in the games of the Europa League in most matches successfully at the expense of effective attacking actions, which indicates a sufficiently good functional preparedness of the team's players.

Prospects for further research. In the future, it is planned to conduct pedagogical observations of the attacking actions of the teams taking part in the competitions of the European League and the Champions League.

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Characteristics of effective shots on goal in the games of the first league team of the championship of Ukraine "Helios" Kharkiv

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Purpose: *to determine the quantitative indicators of effective shots on goal in the games of the team "Helios" Kharkiv.*

Material & Methods: *analysis of scientific and methodological literature, registration of technical and tactical actions, methods of mathematical statistics. The research of the competitive activity of the first league team of the championship of Ukraine "Helios" Kharkiv in the season 2017–2018.*

Results: *in the article the data characterizing the peculiarities of performance of effective shots on goal in the games of the team "Helios" Kharkiv.*

Conclusion: *data of the conducted research testify to the differences in the quantitative indicators of the effective shots on goal made by the players of the teams of the first league of Ukraine in different intervals of playing time, from different zones of the football field.*

Keywords: *shots on goal, standard position, free kick, penalty kick, ball transfer, penalty area, gate area.*

Introduction

Solving the problem of increasing the effectiveness of attacking actions in football involves studying the features of building a game in attack by teams of different levels [2; 4; 5; 8; 9; 10]. Of particular interest are the data that characterize the completion of the final phase of the attacking actions by professional teams that participated in the Premier League competitions of the Ukrainian championship and the first league of the championship of Ukraine.

Analysis of the attacking actions of teams of different qualifications is devoted to the research of many specialists [2; 3; 5; 6; 7; 11].

As noted by S. Golomazova and B. Chirva [1], the probability of a goal is primarily determined by the probability that the ball hits the target. Players can more often or less often deliver the ball to the shock position, better or worse act during the attack – in any case, the outcome of the match depends on the accuracy of the final blows.

So, according to observations in the games of high-class teams of 10 strikes on the average, the average hit is only after 3–4 hits.

If the football players perform attacks on the goal in non-player conditions (on a stationary ball, when there is no opposition to the opponent, and if the speed of the strike is not needed), the probability of the ball hitting the target strictly linearly depends on the distance of the strikes. However, the strictly linear dependence of the probability of the ball falling into the goal range from the strike distance is violated when the shots are carried out in a real game, and the greatest deviations are observed where the conditions for striking the target are the heaviest, namely in the area of the penalty area line.

So, according to S. Golomazov and B. Chirva [1], the percentage of ball hits on the target range can vary depending on the level of preparedness and qualification of the players, but in any case, with the increase in the distance of the blows, the accuracy of falling into the target shots will decrease. Calculations show that as the distance is increased by 1 meter, the probability of falling into the target gate in game conditions is reduced by about 3%.

In high-class teams, in some cases, players strike the goal from 1–2 meters, which means that the absolute accuracy of the ball hit the target of the goal in football, obviously, can be achieved when carrying out shots in a very short distance from the goal line – up to 1 meter.

It is established [1] that the probability of getting the ball into the target shots in the game conditions is reduced by approximately 3% with an increase in the strike distance by 1 meter. Thus, the authors argue that when carrying out strikes from 33-35 meters the probability of hitting the target is not more than 5%.

The probability of a goal is determined not only by the probability of the ball reaching the target but also by the actions of the goalkeeper. Of all attacks on the target, not more than 25 meters from the goal (except for head punches from the goal area and penalty shootout), approximately 30% are parried by the goalkeepers regardless of the distance of the blows.

Relationship of research with scientific programs, plans, themes. This work was carried out according to the topic of research of the departments of football and hockey, sports and mobile games and martial arts of the Kharkov State Academy of Physical Culture for 2016–2020 on the theme "Psycho-sensory regulation of the motor activity of athletes of situational sports".

Purpose of the study: to determine the quantitative indicators of effective strikes in the gates in the games of the team "Helios" Kharkov.

Material and Methods of the research

Methods: analysis of scientific and methodological literature, registration of technical and tactical actions, methods of mathematical statistics. The research of the competitive activity of the team of the first league of the championship of Ukraine "Helios" Kharkiv in the season 2017–2018.

Results of the research and their discussion

Data of the tournament table of the first league of the championship of Ukraine show that the team "Helios" Kharkiv after 22 rounds takes 6th place. In this case, the players of the "Helios" team scored 30 goals (on average for the game 1,4 goals) and conceded 20 goals (on average for the game 0,9 goals).

Table 1 presents the quantitative indicators of goals scored and conceded by the players by the team "Helios" Kharkov in the games of the first league of the championship of Ukraine 2017–2018 in different segments of playing time.

Table 1

Number of goals scored and conceded in different pieces of playing time by the team "Helios" Kharkov in the games of the first league of Ukraine 2017–2018

Time	Goals scored		Goals missed	
	Amount	%	Amount	%
Sum of balls	30	100,0	20	100,0
1-15 minutes	3	10,0	4	20,0
16-30 minutes	9	30,0	2	10,0
31-45 minutes	6	20,0	0	0,0
46-60 minutes	3	10,0	4	20,0
61-75 minutes	4	13,3	6	30,0
76-90 minutes	5	16,7	4	20,0

So, the results of the table show that the players of the "Helios" team scored more goals from 16 to 30 minutes (9 goals), less – from 1 to 15 and from 46 to 60 minutes (3 balls each).

The table shows that the players of the "Helios" team missed more goals in the game segment from 61 to 75 minutes (6 goals), fewer goals – from 31 to 45 (0 goals) and 16 to 30 minutes (2 goals).

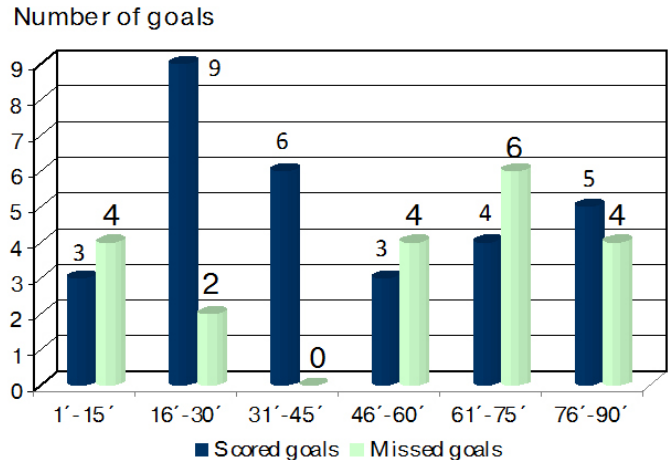

Figure 1. Ratio of goals scored and missed by the team "Helios" Kharkov in different segments of playing time

As a result of the research of the football field areas, from which the effective strikes were made, it was established (Table 2) that 10 players scored from the area of the goal by the players of the Helios team (34,5%).

Table 2

Number of goals scored and conceded by the team "Helios" Kharkov from different zones of the football field in the games of the first league of Ukraine 2017–2018 biennium

Football field area	Goals scored		Goals missed	
	Amount	%	Amount	%
Goalkeeper's area	10	34,5	4	2,1
Between the goal area and the penalty spot	12	41,4	10	52,6
Between the penalty point and the penalty area line	2	6,9	3	15,8
From outside the penalty area	5	17,2	2	10,5
Sum of goals scored	29	100,0	19	100,0

Remark. *Players of the team "Helios" Kharkov scored 29 goals and 1 own goal, conceded 19 goals and 1 own goal.*

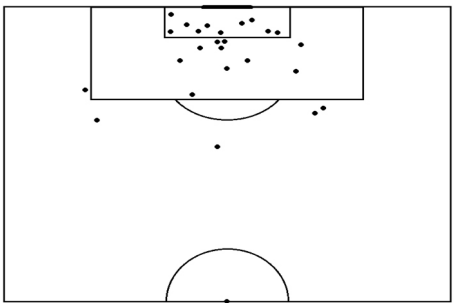

Figure 2. The goals scored by the team "Helios" Kharkov from different zones of the football field
Remark: players of the team "Helios" Kharkiv scored 5 goals from an 11-meter mark

From the area between the goal area and the penalty spot, 12 effective strikes (41,4%) were made. From the area between the penalty spot and the penalty area line, 2 goals were scored (6,9%). Outside the penalty area, the players of the Helios team scored 5 goals (17,2%) (Figure 1).

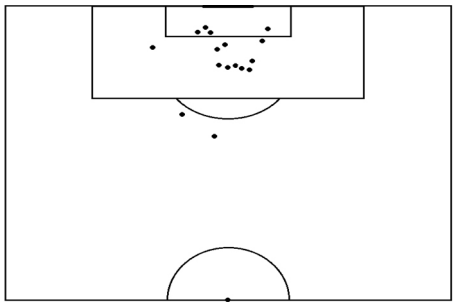

Figure 3. Missed balls by the team "Helios" Kharkov from different zones of the football field
Remark: players of the team "Helios" Kharkov missed 3 goals from the penalty spot

From Figure 2 it can be seen that the "Helios" team missed 4 goals from the goalkeeper's area (2,1%), 10 goals – from the area between the goal area and the penalty spot (52,6%), 3 goals – from the zone between the penalty point and the line penalty area (15,8%), 2 goals – from outside the penalty

area (10,5%).

The results of Table 3 show that the players of the "Helios" Kharkov team from 29 goals of 23 goals (79,3%) scored from the game and 6 goals (20,7%) from standard positions.

Table 3

Number of goals scored and conceded from the game and from standard positions by the players of the "Helios" team of Kharkiv in the games of the first league of Ukraine in 2017–2018

Shots on goal	Goals scored		Goals missed	
	Amount	%	Amount	%
With the game	23	79,3	16	84,2
From standard provisions	6	20,7	3	15,8
Sum of goals scored	29	100,0	19	100,0

Of the 19 conceding goals, 16 goals (84,2%) were omitted from the game and 3 goals (15,8%) from the standard positions by the "Helios" team.

Analysis of the goals scored from the standard positions of the team "Helios" Kharkov testifies (Table 4) that out of 6 goals, 5 goals (83,3%) were scored from 11-meter hits and 1 goal (16,7%) from a free-kick.

Table 4

Number of goals scored and conceded from standard positions by the players of the team "Helios" Kharkov in the games of the first league of Ukraine 2017–2018

Standard Provisions	Goals scored		Goals missed	
	Amount	%	Amount	%
A penalty kick	5	83,3	3	100,0
Free kick	1	16,7	0	0,0
Sum of goals scored	6	100,0	3	100,0

Analysis of the goals scored by the foot and the head with players in the games of the first league teams testifies (Table 5) that 16 goals (55,2%) of the 29 goals of the "Helios" team were scored with the right foot, 6 goals (20,7%) – left foot and 7 goals (24,1%) – head.

Table 5

Number of goals scored and missed by the foot and the head of the team "Helios" Kharkov in the games of the first league of Ukraine 2017–2018

Shots on goal	Goals scored		Goals missed	
	Amount	%	Amount	%
Right foot	16	55,2	9	47,4
Left foot	6	20,7	4	21,1
Head	7	24,1	6	31,6
Sum of goals scored	29	100,0	19	100,0

In turn, the opponents of the "Helios" team of 9 goals scored 9 goals (47,4%) were scored with the right foot, 4 goals (21,1%) – the left foot and 6 goals (31,6%) – head.

Table 6 shows the data of the number of assists in the gates from the game in various game situations. It can be seen from the table that out of 23 effective hits from the game of the players of the "Helios" team, 18 goals (78,3%) were scored after transferring the ball from the partner and 5 goals (21,7%) after the ball rebounded from the goalkeeper, defenders, barbells or crossbeams. In turn, out of 16 goals scored by the opponents of the Helios team, 10 goals (62,5%) were scored after the ball was transferred from the partner and 6 goals (37,5%) after the ball was rebound from the goalkeeper, defenders, bar or crossbar.

Table 6

Situations in which effective strikes were made to the goal (from the game) by the players of the teams of the first league of the championship of Ukraine 2017–2018

Shots on goal	Goals scored		Goals missed	
	Amount	%	Amount	%
After passing the ball from the partner	18	78,3	10	62,5
After bouncing the ball from the goalkeeper, defenders, barbells or crossbar	5	21,7	6	37,5
Total per game	23	100,0	16	100,0

Table 7 shows the quantitative indicators of effective shots in the goal from the game, performed in various ways (first touch, after receiving the ball, after the dribbling).

Table 7

Ways to perform effective strikes against the gate (with the game) by the players of the teams of the first league of the championship of Ukraine 2017–2018

Shots on goal	Goals scored		Goals missed	
	Amount	%	Amount	%
First touch	13	56,5	12	75,0
After receiving the ball	8	34,8	2	12,5
After dribbling	2	8,7	2	12,5
Total per game	23	100,0	16	100,0

It can be seen from the table that most of all the goals of the "Helios" team were scored by Kharkiv with the first touch (56,5%). At the same time after receiving the ball, 34,8% of the goals were scored, and after the dribbling was scored 8,7%.

As a result of the analysis of the conceded goals of the "Helios" team, it was found that Kharkiv was missed most of all goals by the players of the "Helios" team after hitting the goal with the first touch (75,0%). After strikes at the gate with a second touch and after the dribbling was played by the team "Helios" was skipped over 12,5%.

Table 8 shows the indicators of effective shots in the gate, performed in different conditions (kick the ball from the ground and hit the flying ball). Thus, it is established that the players of the "Helios" team of 29 goals of 20 goals (69,0%) were hammered by the ball from the ground and 9 goals (31,0%) by a blow on the flying ball.

From the table it can be seen that the players of the rival teams from 19 goals of 12 goals (63,2%) were scored after hitting the ball from the ground and 9 goals (36,8%) – after a strike on the flying ball.

Table 9 presents the quantitative indicators of effective strikes at the goal, executed by the players of the teams of the first

Table 8

Conditions in which the effective strikes to the goal of the players of teams of the first league of the championship of Ukraine 2017–2018

Shots on goal	Goals scored		Goals missed	
	Amount	%	Amount	%
On the ball from the ground	20	69,0	12	63,2
On a flying ball	9	31,0	7	36,8
Total per game	29	100,0	19	100,0

Table 9

Area of the goal, in which the effective strikes by the players of the team "Helios" Kharkiv in the games of the first league of Ukraine in 2017–2018.

Part of the gate	Amount	%	Amount	%
Upper part of the gate	4	13,8	5	26,3
Middle part of the gate	8	27,6	5	26,3
Lower part of the gate	17	58,6	9	47,4
Total per game	29	100,0	19	100,0

league of the championship of Ukraine in different areas of the gate. It can be seen from the table that the players from the Helios team from 29 goals scored 4 goals (13,8%) were scored in the top of the goal, 8 goals (27,6%) in the middle section of the goal and 17 goals (58,6%) – in the lower part of the gate.

In this case, the players of the "Helios" team of 19 goals conceded 5 goals (26,3%) were passed to the top of the goal, 5 goals (26,3%) – in the middle section of the gate and 9 goals (47,4%) – in lower part of the gate.

Conclusions

1. The results of the research show that the players of the "Helios" team scored 1,4 goals on average per game. More goals were scored from 16 to 30 minutes (30,0% of goals), less – from 1 to 15 and from 46 to 60 minutes (10,0% of goals). Of the gate area, the players of the "Helios" team scored 34,5% of goals. 41,4% of the goals were scored from the area between the goal area and the penalty spot. 6,9% of the goals were scored from the zone between the penalty spot and the penalty area line. Out of the penalty area, the players of the "Helios" team scored 17,2% of the goals. 78,3% of the goals of the players of the "Helios" team were scored after the transfer of the ball from the partner and 21,7% of the goals after bouncing the ball from the goalkeeper, defenders, bar or crossbar. The first touch was scored 56.5% of the heads, after receiving the ball was scored 34,8% of the goals, and after dribbling– 8,7%.

2. It was found that the team "Helios" on average for the game missed 0,9 goals. More goals were missed from 61 to 75 minutes (30,0% of goals), fewer goals – from 31 to 45 (0,0% of goals) and from 16 to 30 minutes (10,0% of goals). From the area of the goal players of the "Helios" team missed 2,1% of the goals. 52,6% of the goals were missed from the area between the goal area and the 11-meter mark. From the zone between the penalty spot and the penalty area line, 15,8% of the goals. Out of the penalty area, the players of the "Helios" team missed 10,5% of the goals. 62,5% of the goals of the players of the "Helios" team were missed after the transfer of the ball from the partner and 37,5% after the ball was rebound from the goalkeeper, defenders, bar or crossbar. After hitting the goal, 75,0% of the goals were missed by the first touch, after striking the goal with a second touch and after the ball was played by the team "Helios" was missed 12,5%.

Prospects for further research. Further studies will be devoted to the study of the peculiarities of the performance of effective strikes against the players in games among the teams of the second league of Ukraine and the Premier League of the Ukrainian Championship.

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Influence of health-normalizing walking regimens on the state of the respiratory system of students with chronic bronchitis

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Purpose: *to determine the influence of the types of walking on the state of the respiratory system of students with chronic bronchitis in the period of convalescence.*

Material & Methods: *73 students were studied at the age of 17–20 years, MG1 (n=25) and MG2 (n=21) were engaged in the developed program, but MG1 students additionally applied the types of walking and running at various health-normalizing regimes, CG (n=27) did not have bronchopulmonary pathology and were engaged in physical culture according to the program of the university. All students underwent spirometric studies, hypoxic tests.*

Results: *at the end of the course of physical rehabilitation of students of MG1, spirometric indicators were statistically significantly improved and reached the level of CG indices. MG2 students observed improvement in all parameters, but they did not receive any statistical significance.*

Conclusion: *it is proved that the inclusion in the program of physical rehabilitation during the convalescence period of varieties of walking and running on various health-normalizing regimes promotes the complete restoration of the lost functions of the respiratory system.*

Keywords: *chronic bronchitis, students, physical rehabilitation, a variety of walking.*

Introduction

Diseases of the respiratory organs remain the most common on all continents among different strata of the population, regardless of sex and age [6; 9]. Most acute diseases of the respiratory tract and lungs are caused by viruses, bacteria, parasitic fungi. Inflammatory processes in the respiratory system can be caused not only by the penetration of pathogens of the infection, but also by the impact on the body of other unfavorable factors: the influence of the environment, the state of other organs and systems [1; 2].

Chronic bronchitis is a disease with a predominant airway damage, which is associated with inflammation or prolonged irritation of the bronchial mucosa by various agents, characterized by a progressive recurrent course [7; 8]. The progressive course of chronic bronchitis leads to pulmonary and cardiac failure, therefore, rational treatment of this disease has an important socio-economic significance. However, in recent years, the number of scientific studies devoted to the rehabilitation of patients with chronic bronchitis, especially young people, has significantly decreased. Substantiated recommendations for physical rehabilitation for patients with chronic bronchitis are almost absent today, and support signs of the formation of restorative medical complexes have not been determined. All of the above identified the relevance of this study and allowed to formulate the purpose and objectives of the work.

Relationship of research with scientific programs, plans, themes. The work was carried out in accordance with the priority thematic area No. 76.35 "Medical and Biological Substantiation for Conducting Recovery Measures and Assigning Physical Rehabilitation to Persons of Different Age of Fitness". Number of state registration – 0116U004081.

Purpose of the study: on the basis of the study of the function of external respiration, to establish the influence of the types of walking on the state of the respiratory system of students with chronic bronchitis in the period of convalescence.

Material and Methods of the research

The examination and physical rehabilitation of students with chronic bronchitis were conducted on the basis of the University Clinic of Kharkov National Medical University. We observed 73 students aged 17–20 years who were divided into three groups. The MG1 included 25 students who subsequently underwent a course of physical rehabilitation according to the developed program with additional application of the types of walking and running at various health-normalizing regimes, in MG2 21 students were assigned, engaged in the developed program of physical rehabilitation, the CG consisted of 27 students who did not have bronchopulmonary pathology and were engaged in physical culture according to the program of the university. The course of treatment was 21 days.

The study protocol included conducting a study of the function of external respiration (FER) on the spirographic complex "Spirokom-Pro", with an assessment of the following parameters: respiratory rate (RR), respiratory volume (RV), minute respiration volume (MRV) , the forced vital capacity of the lungs (FVC), the forced expiratory volume in the first second (FEV1), the peak space velocity (PSV), the maximum space velocity at the time of expiration of 25%, 50%, 75% of the forced vital capacity of the lungs (MSV25, MSV50, MSV75), maximum ventilation of the lungs (MVL). All students were subjected to hypoxic tests of Stange and Genci.

The statistical processing of the received digital data was carried out using a package of data processing programs for general purpose Statistica for Windows version 6,0. To deter-

mine the statistical significance of the differences, Student's t-test was used. For all the analyzes performed, the differences were considered reliable at a significance level of $p<0,05$, where the minimum probability of differences was 95%.

Results of the research and their discussion

According to anthropometric indices, the groups of subjects were homogeneous by sex, age, height-weight (Table 1).

Table 1

Anthropometric indices of students of both groups, patients with chronic bronchitis and students of the control group

No.	Indices	MG1 (n=25) Me±m	MG2 (n=20) Me±m	CG (n=27) Me±m
1.	Height, cm	172,52±3,79	172,46±3,97	173,38±3,46
2.	Weight, kg	71,06±3,52	70,72±3,29	71,38±3,84
3.	BMI, kg cm^{-2}	23,75±0,41	23,85±0,61	23,74±0,41
4.	CE, cm	5,07±0,11	5,08±0,11	5,36±0,14

When examining students of both groups with chronic bronchitis, there were complaints of weakness, increased fatigue, periodic dyspnoea with physical exertion, a cough with transparent sputum.

In primary analysis, the background indicators of the function of external respiration in students MG1 and MG2 statistically significant differed from the indices of the CG students, namely, the RR in the MG1 was 1,26 times and in the MG2 1,14 times higher than in the CG students; The rate in MG1 was 1,33 times and in MG2 was reduced by 1,37 times than for the students of the CG; MVL was also reduced by 1,07 times in groups MG1 and MG2. The students from MG1 and MG1 were 1,12 times less than in the CG students; FVC was also reduced in individuals MG1 and MG2 by 1,12 and 1,13 times, respectively ($p<0,05$).

Analysis was carried out by calculating the actual values and comparing them with the calculated values due to age, sex, height and weight (Table).

Resistance to hypoxia and hypercapnia due to data from the Stange and Genci assays was statistically significant in MG1 and MG2 patients compared to those of the CG students ($p<0,05$).

To restore the functional state of the respiratory system of the examined patient population, we developed a physical rehabilitation program [3], which was made taking into account two stages of the reconvalescence period, clinical and biological recovery, since even after normalization of human health, objective indicators of the function of the respiratory system and other systems the body does not yet reach the values of healthy individuals.

At the first stage, MG1 and MG2 students were prescribed exercise therapy, muscle massage of the trunk, shoulder girdle, upper limbs; physiotherapy: UHF was on duty with salix on the bridge of the nose and chest; internally vitamins B, C, E; Eleutherococcus (to stimulate the resistance of the body). Students of both groups practiced curative gymnastics 3 times a week, performed general strengthening and general development exercises in relation to respiratory exercises 4:1.

MG1 students were additionally used in various types of walking at various health-normalizing regimes with a combination of permutations of hand movements. It is established that muscle contraction during physical work or during physical exercises activates breathing. With muscular work, the nervous mechanisms of breathing regulation provide adequate ventilation and constancy of the CO_2 tension in the arterial blood. When the gymnastic exercises are performed, the movements of the hands, coinciding with the phases of breathing, become a conditioned stimulus of the respiratory system, conducive to the formation of a conditioned reflex of the respiratory system. The cerebral cortex during muscular activity renders not only the starting, but also correcting the action, since it during the whole work provides the appropriate pulmonary ventilation, the rate and rhythm of breathing [4; 5; 10].

At the second stage, MG1 students performed morning hygienic gymnastics in the morning, accelerated walking in the evening for 20 minutes; slow running – 30 minutes; acceler-

Table 2

Indicators of external respiration function in students of different levels of fitness, patients with chronic bronchitis in the period of convalescence

№ i/o	Indicators	MG1 (n=25) Me±m	MG2 (n=20) Me±m	CG2 (n=27) Me±m
1.	RR, for min	16,99±2,22*	15,42±2,38+	13,48±0,49
2.	RV, l	0,70±0,04	0,71±0,04	0,84±0,03
3.	MRV, l	9,99±0,44*	9,70±0,42+	13,33±0,40
4.	FER,л·min^{-1}	110,00±1,85*	109,93±1,75+	118,29±1,31
5.	VC, l	4,69±0,11*	4,69±0,12+	5,26±0,24
6.	FVC, l	4,20±0,09*	4,15±0,09+	4,72±0,14
7.	FEV1, l·s^{-1}	4,06±0,07	4,06±0,06	3,98±0,26
8.	PSV, l·s^{-1}	8,04±0,11	7,90±0,39	8,34±0,08
9.	MSV_{25}, l·s^{-1}	7,35±0,64	7,31±0,13	7,56±0,11
10.	MSV_{50}, l·s^{-1}	4,91±0,11	4,98±0,12	5,08±0,12
11.	MSV_{75}, l·s^{-1}	2,45±0,08	2,39±0,07	2,41±0,05
12.	test of Stange, s	55,00±0,75*	55,51±0,78+	69,97±0,47
13.	test of Genci, s	39,01±0,48*	39,27±0,58+	48,96±0,48

Remark. ** – statistical significance between the groups MG1 and CG is reliable; + – statistical significance between the MG2 and CG groups is significant (p<0,05)*

ated walking – 10 min. MG2 students continued to perform the motor tasks of the first stage, gradually completely replacing them with motor programs, which included special, basic and simulation exercises with increasing load to the level of normal training.

After the application of the comprehensive physical rehabilitation program proposed by us to MG1, the spirometric parameters were statistically significantly improved and reached the level of CG indices. The students of MG2 observed an improvement in all parameters, but they did not receive statistical significance (Figure 1).

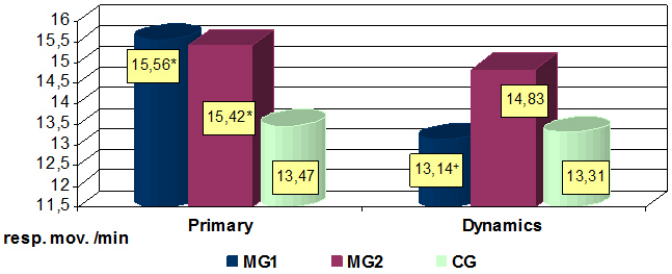

Figure 1. Dynamics of the BH indicator of students of MG1 (n=25), MG2 (n=21) and CG (n=27)
Remark: * Statistical significance of the primary examination is reliable; + Statistical significance of dynamics in the OG1 group is reliable (p<0,05)

Figure 2 shows the dynamics progress of the MRV indicator of student MG1 (n=25), MG2 (n=21) and CG (n=27).

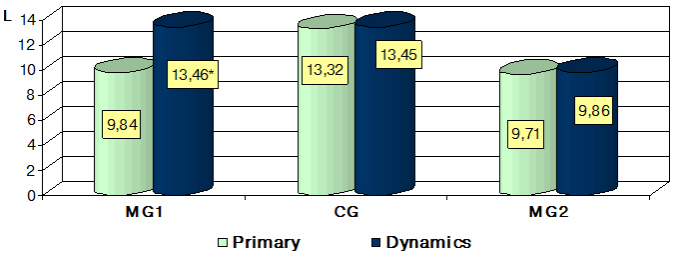

Figure 2. Dynamics of minute respiratory volume in students MG1 (n=25), MG2 (n=21) and CG (n=27)
Remark: statistical significance of the dynamics in the group MG1 (p<0,05)

After the application of the comprehensive physical rehabilitation program for MG1 students, statistically significant increased VC and received the level of the VC indicator among the CG students, MG2 students showed a tendency to increase, but did not receive statistical significance (Figure 3). A similar dynamics was observed with high-speed indicators that reflect the state of obstructive changes: MG1 students statistically significantly increased the FVC (t=5,37; p <0,05), PSV (t=2,43; p <0,05).

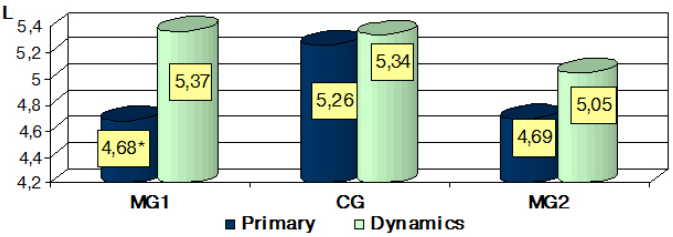

Figure 3. Dynamics of the indicator of the vital capacity of the lungs in students MG1 (n=25), MG2 (n=21) and CG (n=27)
Remark: statistical significance of the dynamics in the group MG1 (p<0,05)

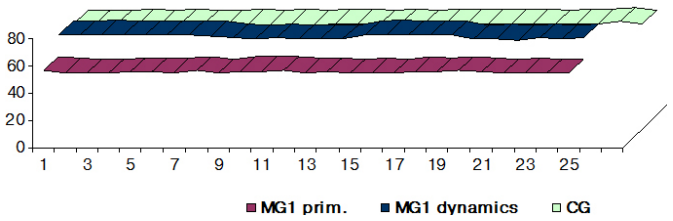

Figure 4. Dynamics of the Stange test score for students MG1 (n=25) and CG (n=27)

Resistance to the phenomena of hypoxia and hypercapnia, according to the Stange and Gench samples, statistically significantly increased in individuals MG1 and MG2 compared with the primary indicators (t=7,12; p<0,05 and t=2,04; p <0,05 in accordance) (Figure 4).

Thus, at the end of the course of physical rehabilitation of students of MG1, the spirometric parameters were statistically significantly improved and reached the level of CG values. MG2 students observed an improvement in all parameters, but they did not receive any statistical significance.

Conclusions

A special feature of the physical rehabilitation of students with chronic bronchitis is not only the early onset, but also the appointment from the first days of the period of convalescence next to medical gymnastics, physiotherapy and massage of the forms of walking and running at various health-normalizing regimes with a combination of permutations of hand movements. After the application of the proposed comprehensive physical rehabilitation program for MG1 students, the impaired functions of the respiratory system reached the level of healthy individuals.

Prospects for further studies are related to the assessment of the dynamics of the adaptive potential in students with chronic bronchitis after the application of a comprehensive program of physical rehabilitation during the reconvalescence period.

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Features of technical and tactical actions of female athletes of various qualifications specializing in complex swimming at a distance of 200 meters

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Purpose: *determine the features of technical and tactical actions of female athletes of various qualifications specializing in complex swimming at a distance of 200 meters.*

Material & Methods: *analysis of literary sources, video shooting, timing, methods of mathematical data processing. The contingent of the surveyed were female athletes who specialized in complex swimming at a distance of 200 meters and had the level of sports qualification of the CMS, I and II adult category.*

Results: *author established that the technical and tactical actions of female athletes of various skills during the crossing of the 200 meters distance by complex swimming have their own peculiarities; the degree of influence of the speed, pace and "step" indicators of the cycle of strokes on the result of the swimming of a distance of 200 meters in female athletes with a qualification level of CMS, I and II adults.*

Conclusion: *determination of the specifics of the technical and tactical actions of female athletes of various qualifications specializing in complex swimming at a distance of 200 meters can serve as a guide for the construction of the training process, which will allow it to be improved in order to achieve high results.*

Keywords: *complex swimming, 200 meters, athletes, skill level, technical and tactical actions, relationship.*

Introduction

The current level of development of swimming dictates the need to search for the most promising ways to improve the training system, which ensure that athletes achieve high results in competitions of the highest rank [1, 6; 9; 12].

Among a wide range of different directions reflecting the concept of training high-class swimmers, an important role is played by the analysis of competitive activities [3; 4; 7; 8; 10].

Despite the fact that a lot of research has been done in this direction, a number of aspects remain fully studied. In particular, in the modern literature there is not enough research related to the analysis of technical and tactical actions of athletes in the process of overcoming them by a distance of 200 meters by complex swimming [2; 5; 11]. While the structure of the competitive activities of those who specialize in this type of program, has a pronounced specificity.

Conducting relevant studies related to the study of the features of the passage of this competitive distance, the determination of the relationship between the indicators of technical and tactical skill and the result of athletes of different ages, gender, and skill level opens new prospects for the growth of achievements in the national complex swimming.

Relationship of research with scientific programs, plans, themes. The research was carried out in accordance with the initiative theme of the Department of Water Sports of KhSAPC "Modeling of competitive activities in modern sports swimming".

Purpose of the study: determine the features of technical and tactical actions of athletes of various qualifications specializing in integrated swimming at a distance of 200 meters.

Objectives of the study:

1. To characterize the dynamics of the speed, pace and "step" of the cycle of strokes in athletes of various skills in the process of overcoming the distance of 200 meters by complex swimming.
2. To determine the degree of interrelation between the indicators of technical and tactical skill and the sporting result at a distance of 200 meters by complex swimming for athletes with the qualification level of the CMS, I and II senior category.
3. Identify areas of the competitive distance, in which the impact of technical and tactical parameters on the result in swimmers of different levels of sportsmanship is significantly different.

Material and Methods of the research

To solve the set tasks, the following methods were used in the work: analysis of literary sources, video shooting, timing, methods of mathematical processing of numerous data.

The collection of experimental data was carried out at the Championships and Ukrainian Swimming Cups during 2015–2017.

The surveyed group consisted of participants in the final swim at a distance of 200 meters in complex swimming. All female athletes had a level of sports qualification of the CMS, I and II senior category.

Results of the research and their discussion

Assessment of technical and tactical actions of female athletes specializing in integrated swimming at a distance of 200

meters was carried out according to the speed, pace and "step" of the cycle of strokes, which were recorded at the starting, finishing, turning segments, and remote swimming areas.

The analysis of the obtained digital material made it possible to determine the features of the technical and tactical actions of swimmers of different qualifications when they overcome a distance of 200 meters (Figures 1–9).

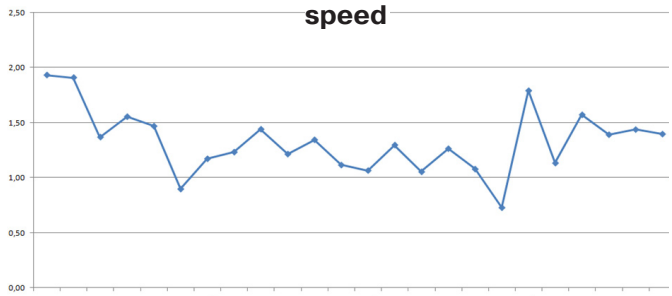

Figure 1. Dynamics of speed indicators for female athletes CMS qualified, in the process of overcoming the 200 meters distance by complex swimming

As can be seen from Figure 1, in athletes qualified to the CMS, when swimming the 200-meter distance, there are significant fluctuations in the speed parameters. They are particularly noticeable at the first and last 50 meters.

The highest speed was recorded on the segment "start-broach" (1,93 m·s^{-1}) and in the "turn-broach" section during the swimming by the breaststroke method to the way the front crawl (1,79 m·s^{-1}).

After a rapid decrease in the speed of advance on the first 50 meters, which occurs before the moment of contact of the turntable, the next two segments (in the way back crawl and breaststroke) pass relatively evenly.

At the final quarter of the distance there is an increase in speed indicators due to the performance of a powerful repulsion from the turntable with subsequent stabilization to the finish mark.

Throughout the competition distance, athletes attempt to maintain relatively stable tempo indicators (Figure 2).

At the same time, the first 50 meters are overcome with a gradual decrease (from 59,8 to 46,0 cycles·min^{-1}).

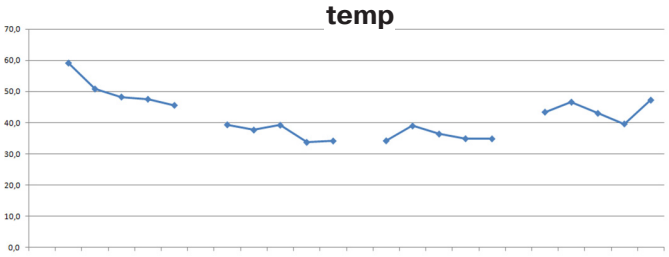

Figure 2. Dynamics of indicators of the tempo of stroke movements for female athletes CMS qualified, in the process of overcoming the 200 meters distance by complex swimming

The most significant slowing of the frequency of movements occurs in the section "85-95 m" when the passage is cut by the way back crawl (from 39,5 to 33,8 cycles·min^{-1}).

When swimming by the breaststroke method after the turn, the tempo indicators increase and reach a value of 39,0 cycles·min^{-1}. In the future, its relative stabilization proceeds.

At the last 50 meters of the distance, the frequency of swimming movements increases significantly, reaching 46,6 and 47,3 cycles·min^{-1}, respectively, on the sections "broach-165 m" and "195-200 m".

Significant fluctuations in the "step" indicators of the cycle of strokes are traced in each 50-meter section of the competitive distance of 200 meters (Figure 3). And in the ways of swimming butterfly and breaststroke, the oscillations of this parameter are generally similar. Just like when swimming in a way the crawl on the chest and back.

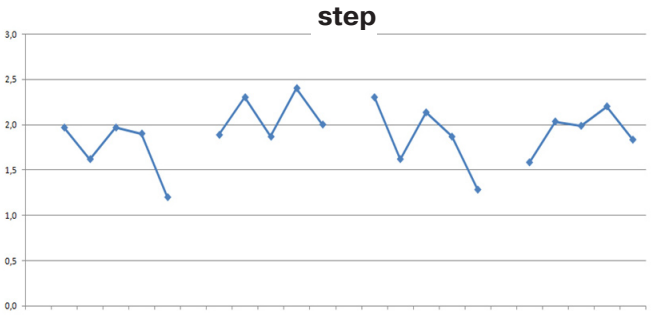

Figure 3. Dynamics of indicators of the "step" of stroke movements for female athletes CMS qualified, in the process of overcoming the 200 meters distance by complex swimming

The smallest values of the "step" of the cycle of strokes are fixed on the section "45-50 m" (1,2 m) and "145-150 m" (1,3 m). The largest values take place on the segments "75-85 m" (2,4 m) and "65-75 m" (2,3 m).

In female athletes of the 1st category, a distance of 200 meters by complex swimming is overcome with significant wave-like velocity variations (Figure 4).

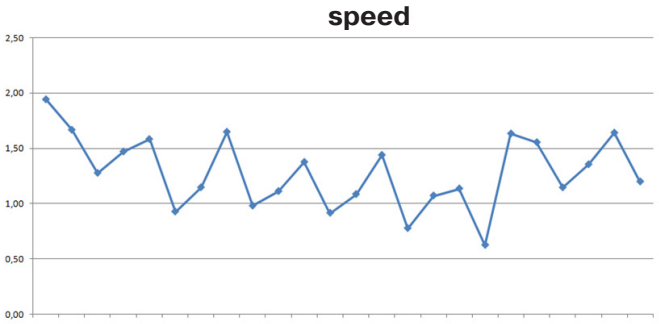

Figure 4. Dynamics of speed indicators for female athletes 1 senor category, in the process of overcoming the 200 meters distance by complex swimming

The most powerful swimmers pass the section "broach-15 m" (1,94 m·s^{-1}), the slowest part is the "145-150 m" section (0,63 m·s^{-1}).

In general, the first 150 meters of the race distance is flush with the general tendency to decrease the speed indicators.

When swimming in the way the crawl on the chest the segments "turn-broach" and "165-195 m" there is a noticeable increase in the speed of advance (up to 1,63 m·s^{-1} and 1,64 m·s^{-1}, respectively). At the finish line, traffic slows to 1,20 m s^{-1}.

The analysis of the tempo values allows us to state that when the distance is traveled by the butterfly method after the frequency of movement decreases at the first 25 meters, the athletes have an increase in the tempo (from 44,5 to 49,2 cycles·min^{-1}) (Figure 5).

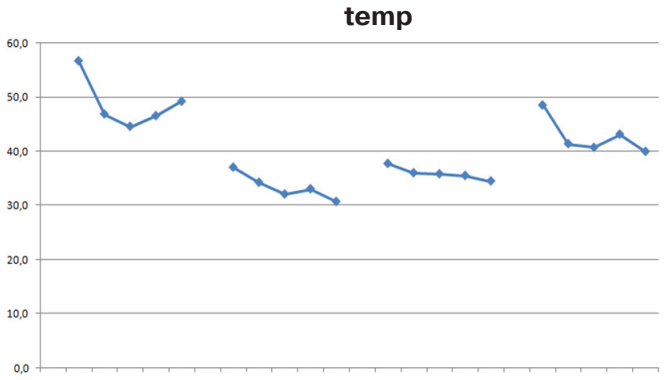

Figure 5. Dynamics of indicators of the tempo of stroke movements for female athletes 1 senior category, in the process of overcoming the 200 meters distance by complex swimming

On the second and third 50 meters, which are overcome by the methods of crawl on the back and breaststroke, there is a moderate decrease in the frequency of movements.

On the last stretch of the distance (when swimming in the way of a crawl on the chest), there is a rapid decrease in the tempo 48,5 to 38,9 cycles·min^{-1}.

Essential fluctuations of the "step" of the cycle of strokes in athletes of the 1 category are traced in each 50-meter section of the race distance (Figure 6).

In general, the dynamics of the "step" values of the cycle of strokes have a wave-like tendency.

The smallest values of the length of the stroke are fixed on the

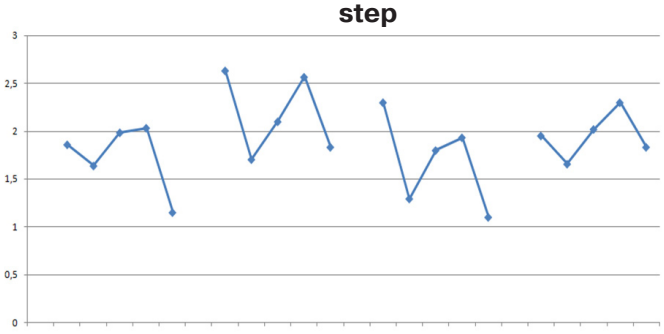

Figure 6. Dynamics of indicators of the "step" of stroke movements for female athletes 1 senior category, in the process of overcoming the 200 meters distance by complex swimming

sections "45-50 meters" and "145-150 meters" (1,2 m and 1,1 m, respectively). The greatest values of the "step" of the athletes are demonstrated in the method of the rabbit on the back (2,6 m).

In the swimmers of the II category, a gradual wave-like decrease in the speed of advance with a noticeable increase in its speed is observed throughout the entire 200-meter distance, when passing from the method of swimming to the breast-way method (from 0,58 to 1,64 m·s^{-1}) (Fig. 7).

When swimming to the turntable, speed indicators in athletes are significantly reduced. Their values on these sections vary from 0,58 to 1,10 m·s^{-1}.

The swimmings of the section of the swimmer's distance pass with significant acceleration due to powerful repulsion from the pool wall.

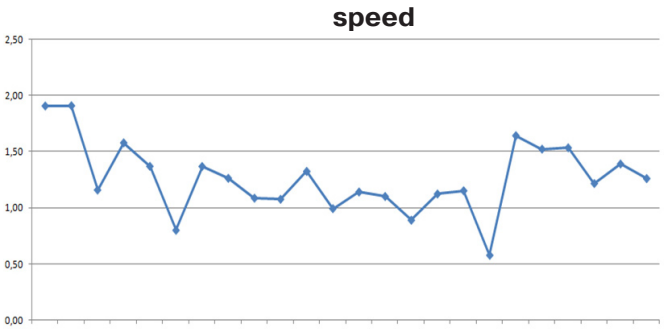

Figure 7. Dynamics of speed indicators for female athletes 2 senor category, in the process of overcoming the 200 meters distance by complex swimming

During the overcoming of the competitive distance, the athletes try to keep the constant tempo of the strokes (Figure 8).

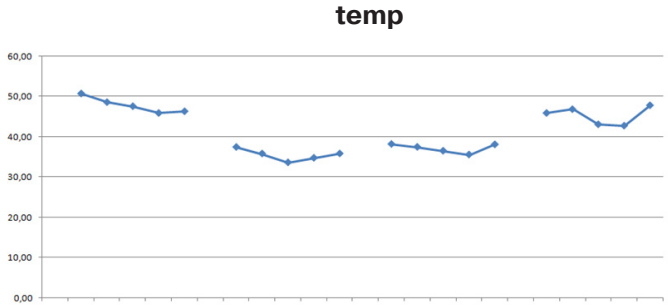

Figure 8. Dynamics of indicators of the tempo of stroke movements for female athletes 2 senior category, in the process of overcoming the 200 meters distance by complex swimming

At the first 50 meters, the average tempo is 47,84 cycles·min^{-1}, in the second 50-meter section the indicator is equal to 35,48 cycles·min^{-1}, the third segment is elongated at an average rate of 37,16 cycles·min^{-1}, at the last 50 meters the frequency of movements increases to the level of 45,29 cycles·min^{-1}.

Changes in the magnitude of the "step" of the cycle of strokes occur wave-like (Figure 9).

When they overcome the distances of the competitive distance by the ways of butterfly and breaststroke, the fluctua-

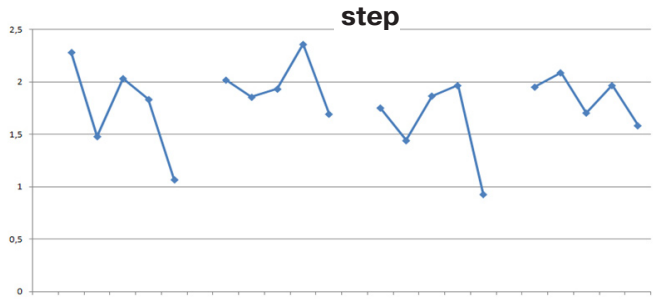

Figure 9. Dynamics of indicators of the "step" of stroke movements for female athletes 2 senior category, in the process of overcoming the 200 meters distance by complex swimming

tions in the indices are similar: after the absolute values decrease at the first 15-25 meters, their growth occurs with a gradual decline at the paddleplant to the turntable.

The greatest value of the length of the stroke in athletes takes place when the segment is overcome by the method of crotch on the back (2,3 m).

Swimming the last 50 meters of the competitive distance is characterized by fluctuations in the values of the "step" of the cycle of strokes with a noticeable decrease in the finish interval (from 2,1 m to 1,6 m).

Thus, the results obtained make it possible to assert that the level of sports qualification leaves an imprint on the features of technical and tactical actions of female athletes in the process of overcoming a competitive distance of 200 meters by complex swimming.

The conducted correlation analysis made it possible to determine the indices of technical and tactical skill, which significantly affect the result of the swimming of a distance of 200 meters for athletes of different skill levels.

So, in swimming – candidates for the master of sports significant for demonstration of high results on a distance of 200 meters are: speed on segments "35-45 m", "broach-65 m", "65-75 m", "115-125 m" , "135-145 m", "175-185 m", the tempo on the section "15-25 m", "step" of the cycle of strokes on the segments "15-25 m", "65-75 m", "165-175 m" (the values of R are in the range of 0,8-0,91).

Among the indicators of technical and tactical skill in girls with a level of sports qualification I category closely correlate with the sports result in the integrated swimming at a distance of 200 meters such parameters as: speed on the sections "15-25 m", "65-75 m" , "115-125 m", "165-175 m", the tempo on the segments "65-75 m", "75-85 m", "185-195 m", "step" of the cycle of strokes on the sections "15- 25 m "," 65-75 m "and" 165-175 m "(the value of R is equated respectively 0,90, 0,91, 0,85, 0,82, 0,91, 0,91, 0,85, 0,90, 0,81, 0,92).

In athletes of the 2 category, the result at a distance of 200 meters is under considerable influence of the speed parameters on the sections "15-25 m", "35-45 m", "145-150 m", "195-200 m", the tempo on the sections "35 -45 m "," 65-75 m "," step "of the cycle of strokes on the segments" 95-100 m "," 145-150 m" and "195-200 m " (the value of R is equated 0,90, 0,91, 0,81, 0,71, 0,60, 0,60, 0,91, 0,71 и 0,92 respectively).

In the course of the comparative analysis it was revealed that the speed index on the section "15-25 m" is significant for both the athletes of the 1st and 2nd category.

Speed on the segments "65-75 m" and "115-125 m" plays a big role in order to achieve a high final result in the female athletes qualifying CMS and I category.

The parameters of the "step" of the cycle of strokes on the sections "15-25 m", "65-75 m" and "165-175 m" are equally important for athletes who have the qualification level of the CMS and the 1 category, and the rate of the warming segment "65-75 m" has a close category of correlation relationship with the athletic result of athletes 1 and 2 category.

Biggest difference in the significance for achieving high results at a distance of 200 meters with complex swimming, depending on the level of sports qualification, is noted in the speed indicators on the sections "broach -65 m", "broach-165 m", the last 50 meters; tempo on the segments "25-35 m", "broach-165 m", "185-195 m"; "Step" of the cycle of strokes on the sections "65-75 m", "115-125 m" and "165-175 m".

The results of the analysis of the technical and tactical actions of athletes of various qualifications specializing in integrated swimming at a distance of 200 meters can be used in the construction of the training process, which will allow it to differentiate with the aim of achieving high results.

Conclusions

1. The level of sports qualification leaves an imprint on the features of technical and tactical actions of female athletes in the process of overcoming the competitive distance of 200 meters by complex swimming.

2. Swimming of the 200-meter distance in the qualification of the athlete is characterized by significant fluctuations in the speed and "step" of the cycle of strokes, the content of stable pace indicators.

3. Athletes qualifying for the I category, overcome the distance of 200 meters by complex swimming with significant changes in the indicators of technical and tactical skill.

4. Peculiarities of swimming 200 meters distance by female athletes of the II category is a gradual decrease in speed, constant tempo, wavy oscillation of the "step" of the cycle of strokes with a noticeable contraction at the finish line.

5. The degree of interconnection between the indicators of technical and tactical skill and the result at a distance of 200 meters with complex swimming depends on the level of qualification of athletes.

6. Parameters of technical and tactical actions, which significantly affect the outcome of swimming the distance of 200 meters with integrated swimming, predominantly coincide with athletes of the level of qualification of the CMS and I-th category.

7. Determination of the features of technical and tactical actions of athletes of various qualifications specializing in inte-

grated swimming at a distance of 200 meters can serve as a reference for the construction of the training process, which will improve it in order to achieve high results.

The prospect of further research is to study the features of technical and tactical actions of athletes of various qualifications specializing in complex swimming at a distance of 400 meters.

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Determination of the level of tactical readiness of qualified runners at 800 m

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Purpose: *determine the change in the level of tactical preparedness and tactics of competitive activity of qualified runners at 800 m.*

Material & Methods: *theoretical analysis and generalization of literary sources; pedagogical observation; analysis of competitive activities; method of expert evaluation; methods of mathematical statistics. To determine the level of tactical preparedness of the runners, 20 experts were involved (10 coaches and 10 highly qualified athletes). The study involved athletes I category and CMS, specializing in running at 800 m aged 17–21 (10 boys and 10 girls).*

Results: *revealed a low level of tactical preparedness of runners at 800 m. Improved tactical readiness indicators, namely the ability to analyze information about their rivals and the ability to use it during competitions, increase the diversity of the arsenal of tactical actions, increase the ability to impose their tactics and ability to quickly respond to the situation, which has changed, and instantly change tactical techniques depending on the opponent's behavior.*

Conclusion: *shows the positive effect of specially designed exercises on the level of tactical preparedness of athletes. The redistribution of efforts of athletes at a distance, an increase in the average competitive speed and sports result.*

Keywords: *endurance, runners, tactical preparedness.*

Introduction

Recently, in athletics, the number of competitions has significantly increased, which is a consequence of the commercialization of sports. A large number of competitions, in turn, leads to the fact that the achievement is not the achievement of a concrete result, but only a victory [3; 8; 9]. The high level of achievements in the race necessitates the constant search for new forms of training. Experts are increasingly asserting their opinion about the impossibility of an infinite increase in loads, and are constantly looking for new ways to improve the training system. One of the directions of such a search is a purposeful improvement of the tactical training of athletes [1]. In this regard, great importance is acquired by the tactical skill of athletes [3; 9; 10].

The goal of tactical training is to teach an athlete to conduct a sports competition in competitions, to correctly assess his capabilities and the capabilities of an opponent, to adapt skillfully to the conditions that were created in the competitions, using them for victory [5; 6]. A very important indicator of the tactical skill of an athlete is the evaluation of the effectiveness of tactical thinking during competitive activity and the degree of effectiveness of using specific tactical actions in the context of an instantaneous change in the situation [11].

At the same time, it should be noted that most of the work is devoted to the training of highly qualified athletes, and little information is available on the study of lower-skilled athletes. In this regard, in our opinion, there is a need to conduct research in this group of athletes, as they are a reserve of the national teams of Ukraine [8].

Relationship of research with scientific programs, plans, themes. The research was carried out according to the thematic plan of the research work of the Kharkov State Academy of Physical Culture for 2016–2018. on the topic 3.1. "Information-synergetic substantiation of the individual norm of human capabilities in physical education and sport".

Purpose of the study: determine the change in the level of tactical preparedness and tactics of competitive activity of qualified runners at 800 m.

Material and Methods of the research

In the course of the research, the following methods were used: theoretical analysis and generalization of literary sources; pedagogical observation; analysis of competitive activities; method of expert evaluation; methods of mathematical statistics. To determine the level of tactical preparedness of the runners, 20 experts were involved (10 coaches and 10 highly qualified athletes). The study involved athletes I category and CMS, specializing in running at 800 m aged 17–21 (10 boys and 10 girls).

Results of the research and their discussion

Special tactical training is provided by solving two interrelated tasks - studying the conditions of the "battlefield" and, on the basis of this, drawing up a plan for wrestling (tactical plan), which should answer the question of how to achieve victory or the best result [2].

In order to determine the level of tactical preparedness of runners, a study was conducted, the results of which are presented in Table 1. The results given in the table indicate a low initial level of tactical preparedness of athletes.

To improve the level of tactical preparedness, athletes performed a set of developed exercises, namely exercises with various tactical tasks: overcoming the distance with a constant and variable speed; overcoming the distance, using the tactics of the leader or finisher; choice of position when run-

Table 1

Indicators of tactical preparedness of runners at the beginning of the study

Indicators of tactical preparedness	Girls (n=15)	Boys (n=15)	Girls (n=15)	Boys (n=15)
	At the beginning of the study		At the end of the study	
Ability to analyze information about their opponents and be able to use it during competitions, score	2	2	4	3
Presence of personal arsenal of tactical actions, score	2	2	4	4
The ability to impose their tactics on a rival, a score	2	2	4	4
Ability to respond quickly to a situation that has changed, and instantly change tactical techniques depending on the opponent's behavior, score	2	3	4	4

ning in a group; independent choice of athletes tactical options for various situations that arise during the race [4; 8].

The results showed an increase in the level of tactical preparedness of athletes. Analysis of the results of the study showed an improvement in the ability to analyze information about their opponents and skills to use it during competitions, increase the diversity of the tactical arsenal, increase the ability to impose their tactics and abilities on the opponent to react quickly to a situation that has changed, and instantly change tactics depending on the behavior rival. According to A. I. Polunin, knowledge of the details of rivals, their strengths and weaknesses is a step to success. Such information will help to develop the right tactics, which will minimize the strengths of the opponent and with the most efficiency, will allow to use its weaknesses in the main competition [6].

On the tactics of competitive activity can be judged by the dynamics of running speed, and more objectively – by the dynamics of the deviation of the actual speed from the average competitive speed, that is, its deviation from the uniform variant of running along the distance [7].

The results indicate that at the beginning of the study, runners at 800 m ran the first half of the distance faster than the second. After using the exercises aimed at improving the special physical and technical-tactical preparedness, a similar situation was observed, but the deviation of the running speed from the mean values was much smaller (Figure 1). Perhaps, this is due to the increase in the level of high-speed preparedness and special endurance of athletes under the action of the proposed set of exercises.

The practical implementation of theoretical running schedules is complicated by the increasing competition in the competitions, and also by the fact that for the victory it is necessary to own the ability to change the running speed, especially at the finish. The need for the distribution of effort at a distance is based on physiological processes, since it takes about 40

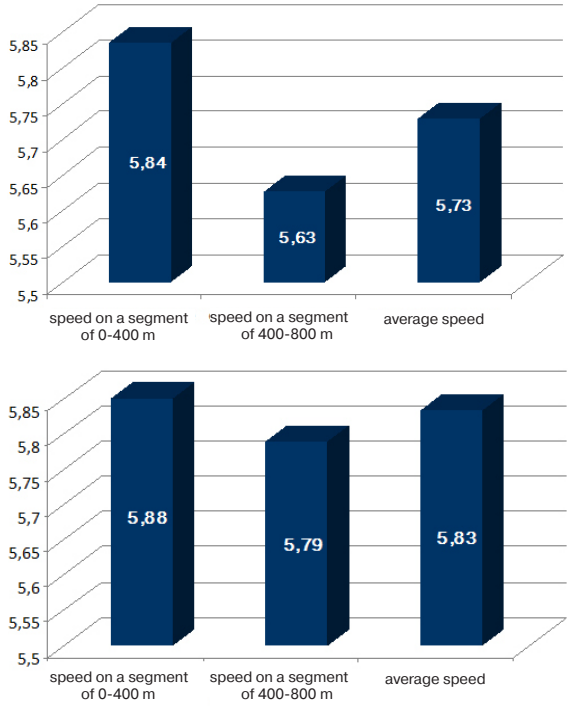

Figure 1. Dynamics of the average competitive speed at a distance of 800 m in girls at the beginning and at the end of the study ($m \cdot s^{-1}$)

seconds for the oxygen received during inspiration to enter the working muscles and begin to participate in oxidative processes. Therefore, it is recommended to run the distance at a speed close to the average, avoiding a sharp drop in it until the end of the race.

The results indicate that at the beginning of the study runners at 800 m ran the first half of the distance faster than the second. At the end of the study, a similar situation was observed, but the deviation of the running speed from the mean values was much smaller (Figure 2). A re-analysis of competitive activity indicates an increase in the average competitive running speed. This, in our opinion, can be explained by an increase in the level of special physical and technical-tactical preparedness of qualified runners at 800 m.

Conclusions

The results obtained during the study showed that the ability to analyze information about their rivals and be able to use it during competitions improved in girls from 2 to 4 points, and in boys from 2 to 3 points. Indicators of the availability of the arsenal of tactical actions and the ability to impose their tactics on girls and boys increased from 2 to 4 points. Ability to respond quickly to a situation that has changed, and instantly change tactical techniques depending on the behavior of an opponent has improved in girls from 2 to 4 points, and for boys from 2 to 3 points.

Use of qualified runners in the training process for 800 m of specially designed exercises helped to redistribute the efforts of the athletes at a distance, which resulted in an increase in the average competitive speed throughout the course of the race and, as a result, in improving the sporting result.

Prospects for further research are to improve the tactical training of runners in the marathon.

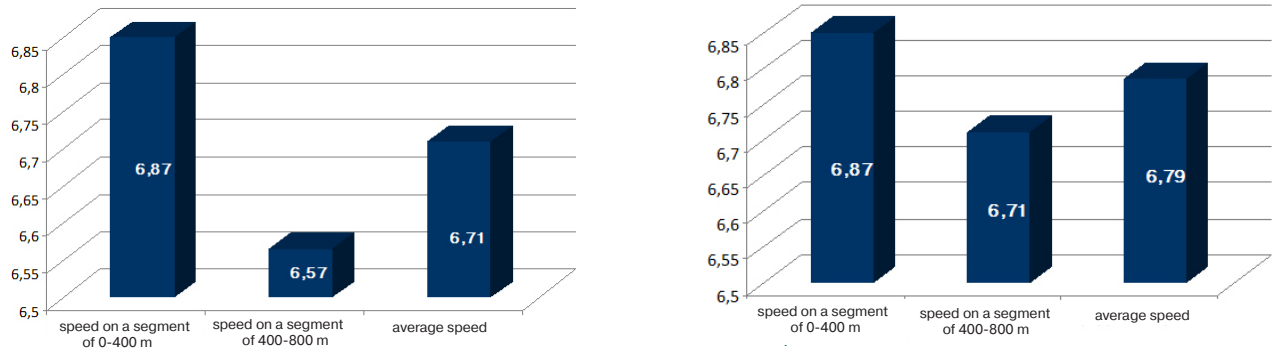

Figure 2. Dynamics of the average competitive speed at a distance of 800 m in boys at the beginning and at the end of the study (m s^{-1})

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Structural rearrangements of the spinal-motor segment with prolonged dynamic loads

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Purpose: *to study structural rearrangements of intervertebral discs and adjacent structures of the spine of rats and the possibility of their preservation under conditions of prolonged dynamic loads in the experiment.*

Material & Methods: *study was performed in an experiment with 90 male rats of the Wistar line, using a training run in a linear treadmill for 20 and 90 days. On the histotopographic sections, after injection into the aortic arch of the animal mascara-gelatin mass, the number of capillary glomeruli in the subchondral parts of the vertebral bodies was counted. Using standard histology methods, structural changes in metaphyseal cartilages, apophyses of vertebral bodies and intervertebral discs of the lumbar spine.*

Result: *The running regimes are defined that cause damage to various structures of the spine and, on the contrary, increase their reliability.*

Conclusion: *it is established that with age the number of blood vessels in the bodies of the vertebrae and capillary glomeruli in their subchondral regions gradually decreases, which is accompanied by a tightening of the intervertebral disk and contiguous structures. Different in intensity and duration of physical activity cause a corresponding change in the number of blood vessels in the vertebrae and, as a consequence, the level of their blood supply.*

Keywords: *running of animals in the treadmill, vertebral-motor segment, intervertebral disc, capillary glomeruli of subchondral parts of vertebral bodies*.

Introduction

The issues of adaptation of biosystems to physical loads are given great attention in physical culture and sports [1; 2; 4]. Physical load is the most important exogenous factor of activation of metabolic processes in the cell and a powerful stimulus of adaptive rearrangements of bone and cartilage [2; 8; 16]. In record sports, training loads of maximum intensity are often used, considering them to be the best way to improve results. Nevertheless, the myth about the benefits of such training is gradually debunked [9; 15]. One of the severe complications of physical overload is dystrophic joint damage [7; 10] and intervertebral (IV) discs [6; 12].

Preservation and improvement of structural reliability of the ventral spine in conditions of dynamic loads is actual for physical culture and sports.

Among the diseases that affect the vertebral-motor segments, degenerative diseases occur much more often than neoplasms, inflammatory diseases and pathologies of development, and therefore degenerative diseases of the spine become of primary clinical importance [3; 5; 18], including in sports [4; 6]. At the same time, it is avascular cartilaginous structures of the spine and braditrophic structures of the intervertebral disc that are especially damaged during physical overloads [13] and especially in young individuals [12; 17]. As for the comparative reaction of IV discs to different modes of dynamic loads, these studies are few [11; 12].

IV disk is the central link of the vertebral-motor segment, the defeat of which triggers the dystrophic processes of contiguous spinal structures and leads to the development of osteochondrosis [3; 10; 19]. Osteochondrosis of the spine is a multifactorial destructive-dystrophic disease, primarily affecting the intervertebral disc, and then other elements of the spine [3; 5; 10]. At the same time, the IV disk is constantly adapted to new types and regimes of motor activity [3; 4]. Practically important is the problem of "fatigue" of fibrous structures and cartilage [7]. With increased loads on the locomotor apparatus, the strength of IV disks, capsules of joints, ligaments and other bradythrophic structures decreases, which causes their dystrophic lesions [6; 10]. Symptoms of overstrain of the structures of the spine are the cause of pain in the back, and in sports – the reason for the decrease in athletic performance [1; 4; 9; 13]. Overloads and, as a result, accelerated aging of joints and IV discs in athletes of a number of sports specializations often cause premature departure from sports [4; 6; 9].

Relationship of research with scientific programs, plans, themes. The research was carried out within the framework of the department theme of the research work "Medico-biological justification for carrying out rehabilitation activities and the appointment of physical rehabilitation to young people of different levels of fitness"

Purpose of the study: to study the structural rearrangements of IV disks and adjacent structures of the spine of rats and the possibility of their conservation under conditions of prolonged dynamic loads in the experiment.

Material and Methods of the research

The study was carried out on 90 white male rats of three age groups: 1, 3 and 12 months. Work with laboratory animals was carried out in accordance with the requirements of the "European Convention for the Protection of Vertebrates, which are

used for experimental and other scientific purposes" [14].

Two groups of rats, three ages, 30 animals in each group participated in the experiment. The control group consisted of 30 animals of the same age. The optimum speed of movement of the treadmill tape (40 m·min^{-1}), which allowed using long running for all age groups in the experiment, was chosen experimentally. The load increased stepwise for 6 minutes of daily running in the first week with a sequential increase of 6 minutes in each following week of training. As a result, rats of the 1st group ran for 10 days 10560 m, and rats of the second group in 90 days – 17280 m.

The material was studied by the methods of macro-microscopy and standard histology with the coloring of preparations by hematoxylin-eosin and picrofuxin according to Van Gieson.

To estimate the condition of the sources of diffusion nutrition of the avascular structures of the spine (IV disks, metaphyseal cartilages, cartilaginous apophyses of the vertebral bodies), the blood supply of the subchondral divisions of vertebral bodies adjacent to the IV has been studied. The method of filling the vessels with a 5% solution of carcass with gelatin was used. The pour was made by a syringe in the arch of the aorta after opening under ether anesthesia of the thorax. Capillary glomeruli were counted on the enlightened sections of the lower lumbar motor segment (in rats this is the L-5-L-6 segment). Number of ink-stained capillary glomeruli was counted in the subchondral parts of the vertebral bodies in the four zones of the subchondral parts of the bodies of adjacent vertebrae:

1 zone – the ventral part of the body of the cranial vertebra;
2 zone – dorsal area of the body of the cranial vertebra
3 zone – the ventral part of the body of the caudal vertebra
4 zone – dorsal area of the body of the caudal vertebra.

The evaluation of statistical differences was determined using the Student's test.

Results of the research and their discussion

Age changes are traced in the lumbar IV discs and adjacent structures of the ventral spine. A specific feature of the rat disc is the preservation of the nucleus pulposus represented by the dorsal chord fragment in all the age groups studied.

In immature 1-month-old rat rats, the disks had a voluminous gelatinous nucleus and a lamellar fibrous ring. The gelatinous nucleus contained clusters of notochordal cells among the copious matrix. In vertebral bodies, a large number of vessels injected with mascara-gelatin mass were detected. At the base of the vertebral bodies, the vessels terminated with terminal microvessels in the form of capillary glomeruli. Neither the gelatinous nucleus nor the fibrous ring of the IV discs of the blood vessels contained. The greatest number of glomeruli was observed in 1-month, the smallest – in 12-month-old animals.

Under the influence of varying physical activity, a change in the number of vessels in the structures of the spine was observed.

After a 20-day run, the animals of the 1st group, in comparison with the control group, determined the increase in the number of capillary glomeruli at the base of the vertebral bodies. The structure of the apophyses of vertebral bodies, growth plates and MP disks remained unchanged. In the paravertebral muscles of the lumbar level, the number of blood vessels that followed the direction of the muscle fibers increased. Vascular injuries not detected.

In 1-month-old animals, the number of capillary glomeruli in the subchondral parts of the vertebral bodies was greatest. At the same time, their higher content was noted in the 1 and 3 zones, which corresponds to the ventral sections of adjacent vertebrae. The number of capillary glomeruli in the 1st zone was more than in the 2nd by 8,07%; and in the third zone is more than in the 4th by 10,41%.

In 3-month-old animals, compared with 1-month-old animals, the number of capillary glomeruli decreased in all zones equally. The difference in the number of glomeruli in the four zones was small. In the 1st zone it is 3.87% more than in the 2nd zone, in the third zone it is 3,32% more than in the 4th zone.

In 12-month-old animals, a decrease in the number of capillary glomeruli was more significant. Compared to 1-month-old animals, the number of glomeruli decreased in the 1st zone in 3-month-old rats by 16.68%, in 12-month rats – by 53,22%.

After a 20-day run, an increase in the number of capillary

Table 1

Changes in the number of capillary glomeruli in the subchondral parts of vertebral bodies in the age aspect under conditions of 20-day hyperkinesia, $\bar{X}\pm m$

Series experiments			1 (n=10) Control	2 (n=10) Experiment	Assessment of statistical significance t	p
1+20	Zones in the bodies of the vertebrae	1	31,0±1,019	35,8±1,13	$t_{1,2}$=4,95	$p_{1,2}$<0,001
		2	28,5±1,056	33,0±1,46	$t_{1,2}$=2,49	$p_{1,2}$<0,05
		3	28,8±1,302	32,5±2,10	$t_{1,2}$=1,48	$p_{1,2}$<0,2
		4	25,8±1,195	28,5±1,58	$t_{1,2}$=1,35	$p_{1,2}$<0,2
3+20		1	25,8±2,309	28,5±1,40	$t_{1,2}$=0,99	$p_{1,2}$>0,05
		2	24,83±0,703	27,7±0,88	$t_{1,2}$=2,52	$p_{1,2}$<0,05
		3	25,0±1,602	30,0±1,46	$t_{1,2}$=2,31	$p_{1,2}$<0,05
		4	24,17±1,602	26,8±1,57	$t_{1,2}$=1,17	$p_{1,2}$>0,05
12+20		1	14,5±2,93	19,0±1,06	$t_{1,2}$=1,44	$p_{1,2}$<0,2
		2	11,06±0,919	18,2±1,22	$t_{1,2}$=4,65	$p_{1,2}$<0,001
		3	13,66±11,116	17,8±3,69	$t_{1,2}$=1,08	$p_{1,2}$>0,05
		4	9,5±0,763	17,5±0,99	$t_{1,2}$=6,40	$p_{1,2}$<0,001

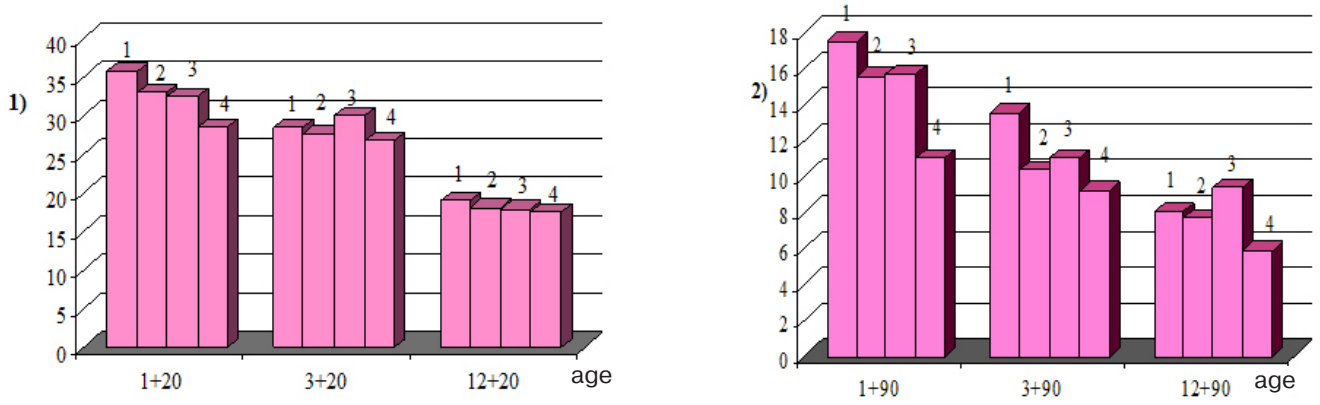

Figure 1. Indicators of the number of capillary loops in the subchondral areas of the vertebral bodies adja--cent to the IV discs, respectively, four zones under running conditions: 1 – after a 20-day run, 2 – after a 90-day run

glomeruli in the 1st zone was observed in rats of the series 1+20 and 3+20 hyperkinesia, and in rats of the 12+20 series in all the investigated zones (Table 1).

After a 90-day run, the number of capillary glomeruli in animals of all age groups, and especially in old animals, on the contrary, decreased. The maximum decrease in the number of glomeruli was noted in the dorsal zones of the vertebral bodies (zones 2 and 4).

In general, compared with the control series, the number of capillary loops in each age group increased after a 20-day run, but decreased after a 90-day run (Figure 1).

Typical was the appearance of newly formed blood vessels in the fibrous ring, especially in the ventral areas of the discs. Here networks of blood vessels were determined, some of which followed between fibrous disc plates.

In accordance with the change in the level of diffusion power, the structure of the disks changed. Dystrophic lesions of the MP tissues were preceded by ingrowth into the avascular IV of the blood vessels, which disrupted the fine structure of the disc and potentiated dystrophic changes in its tissues.

On the inner layer of the fibrous ring, numerous gaps were found, surrounded by acellular regions and damaged by a matrix. At the same time, signs of intradisk dislocation of the gelatinous nucleus, protrusion of the inner sections of the fibrous ring to the surface of the disk, and ruptures of collagen fibers in the ventral regions of the fibrous ring.

These changes in the IV disk were accompanied by rearrangements of adjacent cartilaginous structures of the ventral spine. Metaphyseal cartilage (growth plates) lost the characteristic zonality of the structure, in them the cell-free areas expanded. Apophyses of vertebral bodies underwent deformation and uneven ossification. In the paravertebral muscles of the lumbar level, the natural geometry of the vessels' motion was disturbed, their diameter changed.

Conclusions

Diffusive nutrition of the MP disk comes from the capillary glomeruli of the blood vessels of the vertebral bodies. With age, the number of blood vessels in the bodies of the vertebrae and capillary glomeruli in their subchondral areas gradually decreases, which is accompanied by a tightening of the intervertebral disk and adjacent structures. Different in intensity and duration of physical activity cause a corresponding change in the number of blood vessels in the vertebrae and, as a consequence, the level of their blood supply.

After a 20-day run, the number of capillary glomeruli increased, and most of all in the 1st zone of the vertebral bodies (at the ventral surface), and in the 12+20 hyperkinesia animals, the number of vessels increased in all the investigated zones. Under these conditions, the metaphyseal cartilage retained the zoning of the structure, and the MP disc its structural integrity, without signs of damage.

After a 90-day run, the number of capillary loops compared to the control series decreased in animals of all age groups, and it was uneven in different parts of the base of the vertebral bodies. The most significant decrease was found in the dorsal parts of the bases of vertebral bodies (2 and 4 zones). These changes were combined with the spread of dystrophic processes in the tissues of MP disks and adjacent avascular structures, which indicates a decrease in the level of their diffusive nutrition.

Prospects for further research. The purpose of further research is to find ways of reparative regeneration of the structures of the spinal column.

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Influence of the level of speed-strength preparedness on the agility of volleyball players 12–13 years old

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Purpose: *determine the impact level of indicators of speed-strength preparedness for the agility of young volleyball players 12–13 years.*

Material & Methods: *analysis of scientific and methodological literature, pedagogical testing of speed-strength qualities and agility, pedagogical experiment, methods of mathematical statistics. The study involved 25 volleyball players aged 12–13 years, training in the basic training group of the second year of training of the sports club "Lokomotiv" in Kharkov. Young athletes were divided into an experimental – 13 people and a control –12 volleyball team.*

Results: *after the introduction of the experimental methodology, a link was found between the level of speed-strength abilities and the agility of volleyball players.*

Conclusion: *the positive influence of development of speed-strength qualities on indicators of agility of volleyball players that is necessary for selection of means and methods in training process of young athletes is proved.*

Keywords: *young volleyball players, agility, speed-strength readiness, indicators.*

Introduction

Modern volleyball presents increased requirements for the development of various aspects of fitness of athletes, especially their special physical training. The high development of speed-strength qualities and agility has a positive effect on all types of volleyball training and, first of all, on physical and technical training, which manifests itself in the ability of athletes to coordinate efforts in space and time, the accuracy and efficiency of motor activity, synchronous ownership of the movements of all parts of the body, etc. [1–3; 6].

Volleyball specialists emphasize that the use of the elements of acrobatics in the training process, together with the implementation of technical elements of volleyball, increases the general base of motor abilities of volleyball players, increases the speed-strength training of working muscles and reduces psychological insecurity before conducting the elements, contributing to more effective implementation of the main technical elements of volleyball [4].

The analysis of volleyball research determines the priority value of speed-strength training of young volleyball players in the expansion of the range of game actions, increasing the tension of the game requires the athletes to manifest maximum speed-strength abilities in situations that change rapidly on the volleyball court during the competitive activity [1; 3; 5].

Thus, it can be argued that the development of speed-strength abilities and agility of volleyball players is an urgent task in the long-term preparation of volleyball players.

Relationship of research with scientific programs, plans, themes. The research was carried out in accordance with the theme of the research plan of the Kharkov State Academy of Physical Culture "Psycho-sensory regulation of the motor activity of athletes of situational sports" (2016–2018).

Purpose of the study: determine the influence of the level of speed-strength preparedness on the dexterity of young volleyball players 12–13 years.

Objectives of the study:

1. Analyze the scientific and scientific-methodical literature on the problem posed.

2. Investigate the level of indicators of speed-strength and agility of volleyball players 12–13 years.

3. To develop and experimentally substantiate the methodology for improving the speed-strength preparedness and agility of volleyball players 12–13 years old.

4. Identify the relationship level of speed-strength preparedness and agility of volleyball players 12–13 years old.

Material and Methods of the research

The study involved 25 volleyball players aged 12–13 years, training in the basic training group of the second year of training of the volleyball club "Lokomotiv" in Kharkov. Young athletes were divided into an experimental 13 people and a control group of 12 volleyball players in each.

Research methods: analysis of scientific and methodological literature; pedagogical testing of speed-strength preparedness and dexterity, pedagogical experiment, methods of mathematical statistics. Testing the indicators of speed-strength abilities was carried out by tests: a jump in length from a place with a push of two feet, a jump upwards from the take-off, a throw of a rammed ball (1 kg) in a jump from a place with a two-handed head to a distance through a volleyball net (height 235 cm). The level of dexterity was determined by the methods of A. V. Belyaev and M. V. Savin by tests: running to

agility on the volleyball court and throwing a tennis ball for accuracy in jumping through a rope to a target of 1x1 m [1].

Running for agility was performed on the volleyball court counter-clockwise. Execution: start from zone 1 from the position of the thrust sitting down: roll forward, jerk to the punched ball (1 kg), which lie on the attack line, take the ball and throw with two hands through the net into the attack zone; climb under the banquet (height 50 cm), take the second ball and continue the same actions as at the beginning of the test. After throwing the third ball through the net – drop (roll on the chest – the stomach, hip – back) and finish running backwards along the lateral line to the front.

The throw of the tennis ball into the target was carried out on the volleyball court with 10 throws of the tennis ball on the 1x1 target. The athlete, overcoming the rope above the central line of the volleyball court, at an altitude of 80% of the maximum volleyball jump, with a running jump was carried out by throwing a tennis ball.

In order to check the effect of the level of speed-strength indicators on the dexterity indicators, the level of speed-strength preparedness and dexterity was investigated at the first stage, the experimental training methodology was developed and justified with the purposeful use of dexterity and speed-strength abilities. At the second stage, a comparative pedagogical experiment was conducted. The experiment was conducted from October 2016 to May 2017. The experimental group was engaged in the developed technique, the control group was trained according to the existing method of training in the Youth Sports School. All young volleyball players trained in the group of basic training and had experience of sports for 2–3 years. Training took 12 hours a week.

The pedagogical experiment was based on the application of the principle of advanced training to technical and tactical methods using the means and methods of speed-strength training and development of dexterity in basic training groups of volleyball players.

Selection of special volleyball exercises was aimed both at the simultaneous development of speed-strength qualities and dexterity, and on improving the technical skills of playing volleyball. Exercises for GDP were only 13% of the total training time, and 47% and 40% respectively were allocated to the development of speed-strength qualities, dexterity and technical techniques of volleyball players.

To develop dexterity, new and various motor exercises with novelty elements were used, namely: running at speed in various ways with changing the direction of the somersaults over the shoulder, through the head forwards and backwards and after the overturning of the performance of the reception or transfer of the ball, throw-forward, and reception or transmission ball, jumping through the gym bench with a turn to 90°, 180°, 360° and after the jump reception or transfer of the ball, jump on the block, landing rotation of 180° – receiving the ball with the fall, attacking blows on the suspended ball from the pov oroth jump in the 90°, sports games (volleyball, football) on a reduced site.
The agility exercises were performed in the first half of the workout. The amount of exercises in a single workout was small.

To increase the level of speed-strength qualities in the training sessions, the following exercises were used: jumping from a place, taking a run, taking out a basketball shield, a ring; jumping from deep squats; running jumps with the extraction of metric markings for the best result; jumping with a rope on two legs (variants: from foot to foot, moving forward, on one leg, to sit down, high hips); serial jumps up from the place, from a take-off with the removal of the object; jumping from a running start with a blow on a suspended ball; imitation of attacking strikes in the jump from the spot and after the take-off; Simulate locks in place and after moving; attacking blows through the net after taking off from various gears. Exercises for the development of speed-strength qualities were carried out in the middle and at the end of the main part of the training session of volleyball players.

Results of the research and their discussion

The analysis of the studies shows that a number of specialists were engaged in determining the connections between the strength and maneuverability of athletes [12], others showed a correlation between dexterity and strength of the lower limbs [10], but we were guided by studies in the selection of exercises for testing, where the connections between speed-dexterity [1, 11].

The primary level of speed-strength abilities of volleyball players in the experimental and control groups was determined at the beginning of the pedagogical experiment of pedagogical testing.

As can be seen from the results of the primary testing of the groups under study, the difference in the rates of testing of velocity-strength qualities did not exceed an average of 2,3%, and in some cases, the control group had a slight advantage (Table 1).

The development of speed-strength qualities was carried out with the simultaneous training and improvement of technical techniques of volleyball, which were reflected in the agility indicators of young athletes.

The average dexterity of the experimental and control groups of young volleyball players at the beginning of the pedagogical experiment for the dexterity on the volleyball field had a difference of 4.4%, in the throw of the tennis ball for accuracy in the jump, the average results were the same (Table 2).

The correlation analysis carried out in the experimental group at the beginning of the pedagogical experiment revealed average links between the dexterity and speed-strength indicators r=–0,58, in the control group of the link between the dexterity and speed-strength indicators were r=–0,57. The results of the correlation analysis at the beginning of the pedagogical experiment indicate an approximate uniformity of the experimental and control groups in the parameters of the studied.

In the course of testing, the data obtained from the average indicators of the results of the experimental group give grounds to state that practically all the speed-strength characteristics that are necessary for playing volleyball have been improved during the pedagogical experiment, as evidenced by the studies [1; 3; 7; 8] (Table 1).

The results of the implementation of the pilot program

were most apparent at the end of the macrocycle preparation, in May 2017.

The increase in the results for the entire period of the pedagogical experiment was observed in terms of the experimental group:

– standing long jump – the indicator had an increase in the average result of 32,5 cm or 27% (P<0,05)

– jump up from the take-off – the indicator of the average result improved by 9,8 cm or 8%, but did not have a significant difference (P>0,05)

– throwing a ball of 1 kg in a jump from behind the head – the performance of this test improved the result by 1,62 m, or 13% (P<0,001).

In the control group, the following changes were observed:

– in the standing long jump, the gain was 24,7 cm or 21,6%, but did not have a significant difference (P>0,05) at t=0,88;

– jump up from the take-off – the increase in the average result was 8,4 cm or 6,9%, but did not have a significant difference (P>0,05) for t=1,4.

In the throw of a printed ball 1 kg in a jump from behind the head – the increase in the average result was 0,83 m or 7,4%, but did not have a significant difference (P>0,05) at t=1,6.

The level of development of speed-strength qualities in the control group, trained according to the standard program of the Children's Sports School, was at a lower level compared with the experimental group.

Improvement of the results of speed-strength abilities in the experimental group of volleyball players helped to improve the indicators of agility (Table 2).

For the experimental group in the run of agility on the volleyball court, the average result improved by an average of 19,4 s at t=4,9 or by 14%, and had a significant difference (P<0,001); in the tennis ball's throw on the accuracy of the jump (10 attempts) the result improved on average by 1,95 times at t=2,8 or by 31%, and had a significant difference (P>0,05).

For the control group in the agility on the volleyball court, the result improved on average by 2,3 seconds at t=1,1 or by 6%, and had no significant difference (P>0,05) in the throw of the tennis ball for accuracy in the jump (10 attempts), the result improved by an average of 0,37 times at t=0,99 or 28%, and did not have a significant difference(P>0,05).

After conducting the pedagogical experiment, the correlation ties in the experimental group were strengthened r=–0,64. In the control group, we determine the decrease in the relationship – r=–0,17. The results of the correlation analysis confirm our hypothesis about the relationship between the level of speed-strength preparedness and the dexterity of volleyball players.

The obtained results confirm and supplement the scientific data on the connection of dexterity and the level of speed-strength preparedness of the lower extremities in volleyball women's teams [10]. The use of experimental methodology confirmed the study of volleyball specialists in the role of speed-strength qualities in the training of young volleyball players [3; 7–9].

Conclusions

1. Analysis lyteraturnыh sources showed that the problem of speed-Effect Study of power qualities at lovkost voleybolystov javljaetsja aktualnoy.

2. As a result of pedagogical testing, approximately the same

Table 1

Changes in the rates of speed-strength qualities during the pedagogical experiment (n_1=13, n_2=12)

No. i/o	Test	Units	Groups	At the beginning of experiment $\bar{X}$±m	At the end experiment	t	P
1.	Standing long jump	Cm	EGn_1	173,3±12	205,8±10	2,1	**<0,05**
			CGn_2	174±16	199,3±24	0,88	>0,05
2.	Jump up from the take-off	Cm	EGn_1	36,9±4,40	46,7±3,90	1,7	>0,05
			CGn_2	37,4±5,20	45,8±2,80	1,4	>0,05
3.	Throw a printed ball (1 kg) in a jump from behind the head	m	EGn_1	6,2±0,25	7,82±0,26	4,5	**<0,001**
			CGn_2	6,3±0,32	7,1±0,40	1,6	>0,05

Table 2

Changes in agility during the pedagogical experiment in the experimental and control groups (n_1=13, n_2=12)

Test	Units	At the beginning of experiment $\bar{X}$±m	At the end experiment	P	t
Experimental group					
Running to the dexterity on the volleyball court	(s)	144,2±3,24	124,8±2,21	<0,001	4,9
A throw of a tennis ball on accuracy in a jump	(times)	1,77 ±0,26	2,92±0,33	<0,05	2,8
Control group					
Running to the dexterity on the volleyball court	(s)	148,7±2,10	145±2,46	>0,05	1,1
A throw of a tennis ball on accuracy in a jump	(times)	1,77±0,20	2,08±0,24	>0,05	0,99

indicators of speed-strength training and agility in the experimental and control groups of volleyball players were obtained with a difference in the results of 2,3% and 4,4%, respectively. Correlation analysis has revealed the average connections between the agility and speed-strength readiness in the experimental r=–0,58 and the control r=–0,57 groups.

3. The experimental technique aimed at simultaneous development of speed-strength qualities and dexterity was developed and justified, which was determined in a reliable increase in the indices of volleyball players of the experimental group. Only the results in the jump up from the take-off improved by an average of 6.9%, but did not have a significant difference (P>0,05 at t=1,7).

4. The application of the experimental methodology for the development of speed-strength preparedness and agility contributed to the strengthening of correlation relationships r=–0.64 in the experimental group of volleyball players 12–13 years.

Prospects for further research. Proceeding from the above, further studies are planned to be conducted in the direction of determining the influence of the level of speed-strength preparedness on the effectiveness of the competitive activity of volleyball players of the basic training group.

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Dynamics of other functional state it of cardiovascular and respiratory systems indicators at women under the influence of swimming occupations

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Purpose: *to determine degree of recreational swimming occupations influence on functional state of cardiovascular and respiratory systems of women.*

Materials & Methods**:** *52 women aged 25–45 years have participated in research. Data collection was carried out in recreational groups of Y. Bliznuks author's school of swimming and the "Pioneer" pool. Examinees had identical swimming readiness. Were applied: poll, testing, tool research methods of cardiovascular and respiratory systems. The obtained quantitative data was processed by methods of mathematical statistics.*

Results: *the research demonstrates that occupations in recreational swimming cause positive changes of functional state of cardiovascular and respiratory systems of women aged 25–45 years; considerable improvement of state is cardiovascular and respiratory systems indicators was most shown after 2 years of occupations.*

Conclusions: *it is established that occupations in recreational swimming for 2 years have positively affected state of cardiovascular and respiratory systems of women aged 25–45 years.*

Keywords: *swimming, women, indicators, systems of organism, functional state.*

Introduction

As a result of long observations many researchers have come to conclusion that violations of age character in human body are very similar to violation, being consequence of weak physical activity. The people being inactive have similar changes. "Physical activity of the person – necessary condition of their existence": specifies in his works N. Kardamonov [7]. According to A. Solodkov muscular activity is the main condition of intellectual and working capacity, guarantee of good health and positive emotions [8]. It means that physical activity of the person is determined by social and physiological needs.

Certain "dose" of physical activity is necessary for normal functioning of human body and maintaining health. Dubrovsky specifies that only physical activity, regular physical exercises are capable: to prevent the degenerate changes caused by ageing and hypodynamia; to substantially suspend age changes of various functions of organism and process of aging, to make it less obvious [5].

The improving effect of physical culture occupations is linked first of all with increase in aerobic ability of organism, level of its general endurance and working capacity. The positive effect of occupations is caused by an increase in functionality of cardiovascular system. It consists in development of more efficient cardiovascular activity and lower need of myocardium for oxygen. Besides the expressed increase in reserve of cardiovascular system abilities, the physical culture is also a powerful prophylaxis of cardiovascular diseases [1; 6; 8; 10].

To prevent overall unfitness the most of athletes and ordinary people should train their cardiovascular system. Heart is the only organ which may suffer from exercise stress of an unfit individual. But in too time, heart trains at any kind of an exercise stresses and of course during swimming. Swimming to a large extent, than all other exercises, exerts versatile impact on organism, and, thanks to regular trainings by improving swimming, the big improving effect can be reached. Yu. M. Danko [4] says that improving action of physical exercises in water is shown at any age because swimming is one of the most effective sports in the improving relation, powerful tool of prevention of various diseases. Range of influence of swimming on organism is huge: from the gradual growth of consumption of oxygen and increase in functionality warmly – vascular system before the reaction exceeding the usual level of activity of respiratory organs and blood circulation by 8–10 times [2; 3].

Focusing the attention to a role of swimming as improving factor, most of researchers pay much less attention to studying of dynamics of the changes, occurring under the influence of occupations in recreational swimming, whereas they are one of the main conditions not only of physical, but also of mental health of the person [6; 9–11].

B. Belyayeva considers that long-term practical experience and scientific research of the last years contribute to formation and the further development of modern technique for recreational swimming classes. One of the main tasks of training process in recreational swimming is to obtain objective information on how the exercise stress influences people of different age directly on training occupation and certain time after regular trainings. Insufficiency of data on the positive changes of physical health of trainees under the influence of improving swimming has also induced us to carry out this research. The relevance of the chosen subject is that distribution of such working experience answers practice inquiries, and the offered data will help teachers, instructors, methodologists of physical culture, doctors and also independently engaged to use means of recreational swimming for strengthening of health and increase in physical fitness more effectively [3].

Purpose of the study: to determine extent of recreational

swimming occupations influence on indicators of functional state of cardio-vascular and respiratory systems of women.

Research problems:

1. To analyses literature data about influence of recreational training in swimming on physical development and physical fitness and also the general indicators of women's health.

2. To establish dynamics of functional state indicators of cardio-vascular and respiratory systems of women aged 25–45 engaged in recreational swimming classes.

3. To determine extent of swimming occupations influence on functional state of cardiovascular and respiratory systems indicators of this contingent.

Material and Methods of the research

Data collection was carried out in recreational groups of Y Bliznuk's experimental school of swimming at the "Pioneer" swimming pool. 52 women aged 25–45, who regularly (2–3 times a week) have recreational swimming occupations, participated in our research. Duration of one occupation – 45 minutes. Examinees having identical swimming readiness have been divided into two groups. First group consisted of women aged 25–35 (n=26), second – 36–45 years (n=26).

During the period from October, 2014 to June, 2016 dynamics of cardiovascular and respiratory system functional state indicators of the women engaged in recreational swimming was investigated; also extent of swimming occupations influence on these systems at this contingent has been defined (in October, 2014 – initial metrics were collected; in June, 2015 – indicators after 1 year of recreational occupations were collected; in June, 2016 – after 2 years of occupations).

During data collection the following methods were applied: poll, testing, tool methods of cardio-vascular and respiratory systems research. The obtained quantitative data were processed by methods of mathematical statistics.

Results of the research and their discussion

With age, in cardio-vascular system of the person there are structural and functional changes: the relative hypertrophy of heart increases; its functional abilities decrease; there are short wind, unpleasant feelings in heart, heartbeat; there is atrophy and partial replacement of muscle fibers of heart with connecting tissue that leads to loss of cardiac muscle elastic properties and obstructs blood traffic in coronary vessels; delivery of cardiac muscle decreases; in arteries there is diffusion growth of fibrous ftissue, the aorta and coronal vessels are getting strucked [2; 4–8].

Since heart is the weakest link in the trainees organism, overseeing by its state is especially important since knowledge of hearts reserve opportunities allows to make swimming loadings more safe and efficient and to control the changes happening in cardiovascular system during the course of the occupations.

Were measured in our research two widely used in practice, high-informative and simple indexes – the heart rate and arterial blood pressure as most important indexes of the cardiovascular system functional state (Tab. 1).

Apparently from tab. 1 under the influence of swimming occupations there were reliable changes on all indexes. Among various objects of the recorded indexes, heart rate is extremely important indicator for assessment of the organism functional condition and training efficiency. It is known that increase in fitness is followed by a decrease in heart rate. In our research, as a result of the regular use of the offered swimming programs, after the first year of occupations in group where the age of examinees was 25–35 years, heart rate decreased by 2,5 bpm ($p<0,001$). On the second year of occupations decrease of heart rate continued (by 2,1 bpm) and stabilized on indexes 71,1±0,38 bpm ($p<0,001$).

In a group of women aged 36–45 the similar tendency was observed. Indicators of the heart rate considerably decreased both after the first year of occupations (by 2,2 bpm, $p<0,001$) and after the second (by 2,8 bpm, $p<0,01$). Stabilization happened on indexes 69,9±1,2 bpm ($p<0,01$). Besides, while counting pulse, examinees paid an attention to its rhythm. By estimates of most of women (45 people – 86,5%), as a result of the regular trainings in recreational swimming, ictuses began to follow one by one at regular intervals that also confirms increase in fitness and functionality of cardiovascular system.

Other factor of beneficial influence of swimming on cardiovascular system is a normalization of arterial blood pressure. The reliability of distinctions on an index of systolic arterial blood pressure is revealed in both groups of examinees both after the first year of occupations ($p<0,01$), and after the second ($p<0,01$). During research, indicators of systolic arterial blood pressure in group of women aged 25–35 decreased with 118,1±0,68 to 112,6±0,97 mm Hg., and in group of 36–

Table 1

Dynamics of cardiovascular system indexes at women under the influence of occupations in swimming within 2 years

Indicators	Input data	After 1 year	Reliability level		After 2 years	Reliability level	
			t	p		t	p
Aged 25–35 (n=26)							
Heart rate, bpm	75,7±0,61	73,2±0,45	3,28	<0,001	71,1±0,38	3,57	<0,001
Systolic blood pressure, mm Hg	118,1±0,68	115,4±0,72	2,73	<0,01	112,6±0,97	2,32	<0,01
Dyastolic blood pressure, mm Hg	74,9±0,57	72,4±0,59	3,04	<0,001	70,1±0,38	3,28	<0,001
Aged 36–45 (n=26)							
Heart rate, bpm	74,9±0,58	72,7±0,3	3,37	<0,001	69,9±1,2	2,26	<0,01
Systolic blood pressure, mm Hg	122,1±0,98	119,1±0,73	2,5	<0,01	116,8±0,4	2,77	<0,01
Dyastolic blood pressure, mm Hg	76,6±0,43	74,1±0,67	3,14	<0,001	71,25±0,43	3,58	<0,001

45 years old – with 122,18±0,98 to 116,8±0,4 mm Hg.

At all women taking part in research distinctions of these indexes of diastolic arterial blood pressure are noticeable ($p<0,001$ – after the first year of occupations; and especially noticeable distinctions of these indexes are revealed between initial indexes and indexes of the second year of occupations – $p<0,001$). For 2 years of systematic occupations swimming at young women indicators of diastolic pressure decreased with 74,9±0,57 mm Hg. to 70,1±0,38 mm Hg. and at more mature women – with 76,6±0,43 mm Hg. to 71,25±0,43 mm Hg.

Analyzing results of a arterial blood pressure indexes research, it is possible to note that as a result of occupations in swimming most of examined women managed to reduce amplitude of arterial blood pressure (a difference between the maximal and minimum pressure) and to get indicators of blood pressure closer to those they had in youth.

For healthy people 25 years old and pulse at rest fluctuates within 62–70 bpm for men and 64–72 bpm for women. It's important to note that after two years of occupations in recreational swimming most of the women, who took part in researches, got not only a decrease in indexes of heart rate, but also their normalization (Tab. 2) [6–8].

Table 2 shows that after 1 year of occupations index of heart rate – 72 bpm, was recorded at 12 women (46,1%) aged 25–35 and 9 women (34,6%) aged 36–45 years. After the second year of occupations number of women who normalized their heart rate to 72 was 13 persons (50%) in young people group and 17 persons(65,4%) in group of more mature women.

With age morphological and functional changes in respiratory system are shown in an atrophy of the copular device, weakening of respiratory muscles. A failure of external respiration is shown in a hyperventilation of lungs at rest, in gradual decrease in thorax excursion and vital capacity of lungs (VC). Swimming, like no other sport, develops, strengthens and improves human respiratory system, promotes optimization of oxygen mode of an organism. By means of the functional measurements at women aged 25–40 years, taking parting in a research for 2 years, indexes of the functional condition of respiratory system under the influence of swimming occupations were defined and analyzed (Tab. 3) [2; 4–8].

Chest volume, chest excursion and vital capacity are reflecting the functional condition of respiratory system. Analyzing data from Tab. 3, it is possible to draw a conclusion that under the influence of swimming occupations there were reliable changes of all respiratory system functional condition indexes. Thus, for 2 years of occupations, indexes of chest volume ($p<0,01$ – in group of women aged 25–35; $p<0,001$ – in group of women aged 36–45) and chest excursion ($p<0,01$ and $p<0,001$ accordingly) considerably changed. The reliability of distinctions on these indexes is revealed both after the first year of occupations, and after the second.

One of the major indicators of respiratory system condition, physical fitness, training abilities and common state of health of the person, is vital capacity. It depends both on the lungs measures and on strength of the muscles participating in respiration. Vital capacity increases when the trainings are held correctly. The greater is the vital capacity, the deeper is breath, the greater are volume of pulmonary ventilation volume and

Table 2

Normalization of heart rate at women aged 25–40 under the influence of swimming occupations within 2 years (quantity of cases)

Age	Experience	Quantity of heartbeats per minute								
		108	102	96	90	84	78	72	66	60
25–35	Input data	2	3	1	6	13	–	–	1	–
	After 1 year	–	–	–	3	5	5	12	1	–
	After 2 years	–	–	–	1	3	4	13	4	1
36–45	Input data	1	1	5	7	11	–	1	–	–
	After 1 year	–	–	2	3	3	7	9	1	1
	After 2 years	–	–	–	1	1	5	17	1	1

Table 3

Dynamics of the functional indexes of respiratory system at women under the influence of swimming occupations

Index	Input data	After 1 year	Reliability level		After 2 years	Reliability level	
			t	p		t	p
25–35 (n=26)							
Chest volume, cm	91,7±0,58	89,2±0,36	3,66	<0,001	87,5±0,7	2,16	<0,01
Chest excursion, cm	5,65±0,14	6,71±0,33	2,96	<0,001	7,73±0,12	2,90	<0,001
Vital capacity, ml	3115±25,6	3218±21,7	3,07	<0,001	3325±23,9	3,31	<0,001
Stange's test, sec.	47,19±1,2	57,26±2,6	3,52	<0,001	66,96±2,1	2,9	<0,001
Respiration rate at rest	15,32±0,78	12,24±0,81	2,74	<0,001	10,75±0,85	2,12	<0,001
36–45 (n=26)							
Chest volume, cm	92,6±0,41	90,8±0,57	2,57	<0,01	88,5±0,36	3,41	<0,001
Chest excursion, cm	5,02±0,42	6,48±0,39	2,54	<0,01	7,63±0,38	2,11	<0,01
Vital capacity, ml	3013±25,1	3112±23,2	2,9	<0,001	3176±20,1	2,09	<0,001
Stange's test, sec.	46,61±1,89	54,63±1,64	3,2	<0,001	63,12±1,75	3,54	<0,001
Respiration rate at rest, breaths per minute	15,68±0,95	12,68±0,87	2,36	<0,01	10,82±0,71	2,55	<0,01

respiratory surface. The research revealed that after first year of swimming occupations vital capacity increased (in group aged 25–35 – with 3115±25,6 to 3218±21,7; in group aged 36–45 – with 3013±25,1 to 3112±23,2) and during second year of occupations, or long kept at this level, or continued to increase. Indexes of vital capacity after the second year of occupations in group of women aged 25–35 were 3325±23,9 ($p<0,001$); in group aged 36–45 years – 3176±20,1 ($p<0,001$) [4; 6; 8].

In our research a very simple, but at the same time rather informative functional test of holding breath on inhale (Stange's test). The duration of breath holding indicates condition of all organism, not just respiratory system. Thus, less than in a year of swimming occupations duration of breath holding was about 1 minute (group of women aged 25–35 – 57,26±2,6 s, $p<0,001$; group of women aged 36–45 – 54,63±1,64 s, $p<0,001$), and after the second year examinees aged 25–35 years were able to hold their breath for 66,96±2,1 s ($p<0,001$), and women aged 36–45 years for 63,12±1,75 s ($p<0,001$). Increase of breath-holding duration, although insignificant, demonstrates that occupations improve health of examinees.

The index of respiration rate also changed over time. After the first year of occupations at younger women it decreased with 15,32±0,78 breaths per minute to 12,24±0,81 ($p<0,001$), and at elder women with 15,68±0,95 breaths per minute to 12,68±0,87 ($p<0,01$). During the second year of occupations indexes of respiration rate continued to decrease and made 10,75±0,86 breaths per minute ($p<0,001$) for group of 25–35 years old, and 10,82±0,71 ($p<0,01$) for group of women aged 36–45.

Thus, researches showed that at women of both groups a number functions of respiratory system considerably improved in comparison with input data. The difference swimming was especially noticeable after 2 years of occupations.

Conclusions

After 2-year research it is possible to note that occupations in improving swimming positively affected a state of cardiovascular and respiratory systems of women aged 25–45 years. It is established that there were reliable improvements of cardiovascular ($p<0,01$; $p<0,001$) and respiratory ($p<0,01$; $p<0,001$) systems functional state indexes. It is revealed that indexes of the functional condition of these systems in comparison with input data are reliably high. Improvements were more noticeable after two years of occupations.

Prospects of further researches can be determined by indicators of the dominating condition of women which do swimming, in different phases of a menstrual cycle.

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Comparison of indicators of physical and technical preparedness of basketball players 12th and 13th years old

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Purpose: *the establishment of differences in the physical and technical preparedness of basketball players of 12 and 13 years, taking into account motor asymmetry. The differences in the physical and technical preparedness of basketball players of 12 and 13 years, taking into account the motor asymmetry, are established.*

Material & Methods: *physical preparedness was determined by standard test exercises, and technical preparedness – by test exercises in the transmission, throws and driving with the execution of movements with both hands. The basketball players of the 12th and 13th years of the basketball club "Cherkasy Monkeys".*

Results: *a comparative analysis of physical preparedness indicators has shown a significant advantage of 13-year-old basketball players in the manifestation of speed, explosive strength and speed-strength qualities. A significant difference in the technical preparedness of basketball players of 12 and 13 years is revealed, in particular, the transmissions of dominant and subdominant hands and complex exercises.*

Conclusion: *established a clear lateralization of motor functions of the hands with the prevalence of the accuracy of the movements of the dominant hand of basketball players of 12–13 years, and the motor asymmetry in the course of the ball in 12-year-olds to 13 years acquires the signs of symmetry.*

Keywords: *factors, features, physical readiness, basketball technique, young basketball players, motor asymmetry*.

Introduction

The analysis of the investigated problems in basketball showed that the study of physical qualities in connection with the technique of playing young basketball players is updated from time to time. In accordance with the statements of B. Zavyalova [2], the problem of a differentiated approach to the physical training of young basketball players in the preliminary basic training phase is urgent, when the foundations of technical mastery are laid. Some scientists consider actual the problems of the influence of physical qualities on the technical preparedness of young basketball players. Thus, Yu. A. Kochubey, E. A. Strikalenko, A. G. Shalar [5], N. A. Nesterenko [9] determined speed and speed-strength abilities as factors in the effective solution of technical problems on the site of qualified basketball players. Al Khatib Ahmad [1] noted the importance of high-speed and power components when teaching young basketball players to gears, ball control and throws. In turn, B. G. Manshin [7], A. K. Moiseenko, I. V. Shiryaeva [8] considered the actual problem of the effectiveness of teaching the technique, which, according to their data, depends on the level of development of speed abilities and the accuracy of reproduction of movements in space. Along with this, A. Yu. Chizhov [11] focused attention in scientific searches on the accuracy of the motor part of the technical movement, which will enhance the mastery of technical skills. A number of problems related to the specifics of technical readiness are the works of L. A. Kolesnikova [3], R. V. Kuchina, I. V. Aksarin [6] on the study of the influence of the motor asymmetry of basketball players of 10–12 years on technical preparedness. However, the studies of R. V. Kuchin, I. V. Aksarin [6] were carried out using techniques that are not related to basketball technique, and L. A. Kolesnikov [3] believes that smoothing the motor asymmetry contributes to the increase in technical preparedness. Among a significant number of works, it is not enough to study the specifics and factors of the technical preparedness of basketball players for preliminary basic training taking into account the motor asymmetry.

So, different views on the problem of technical preparedness of young basketball players indicate that it is relevant and insufficiently studied. A certain contradiction has arisen between the need to improve the quality of technical training for young basketball players and the inadequacy of studying it from the specifics in the 12–13 age intervals that contributes to the formation of tactical preparedness of athletes.

Relationship of research with scientific programs, plans, themes. The research was carried out in accordance with the theme of the research work of the Cherkassy National University named after Bogdan Khmelnitsky "Theoretical and methodological bases of mobilization readiness of athletes of different qualifications", state registration number 0116U003858.

Purpose of the study: the establishment of factors and features of technical preparedness of basketball players of 12–13 years taking into account the motor asymmetry.

Objectives of the study:

1. To study the manifestation of physical qualities of basketball players of 12 and 13 years.

2. To investigate the technical preparedness of basketball players of 12 and 13 years taking into account the motor asymmetry.

Material and Methods of the research

The basketball players of the 12th and 13th years of the basketball club "Cherkassky Monkeys" were studied in the number of 35 people. For the study, the following methods were used: analysis of scientific and methodological literature, pedagogical testing of physical fitness (long jumps from the place, flexing and extension of the arms in the lying position, shuttle running 3x10 m, running 30 m) and technical preparedness (transmission in pairs by two grams. "Balls in the number of accurate transfers of right and left hands complex exercise with a stroke of chips and throws on the time of execution and accuracy of hits in the ring with right and left hands, keeping the ball right and left hands at a distance of 15 m turn), methods of mathematical statistics.

Results of the research and their discussion

A significant component of the sports success of basketball players is their physical fitness. From the standpoint of basketball theory, the physical fitness of basketball players has a significant effect on the technical skills of players [10]. This is especially important, as B. Zavyalov [2] points out, at the stage of preliminary basic training of basketball players, that is, at the age of 11–14 years. All physical qualities are important for the training of athletes, but basketball is the most significant for effective action on the site. Yu. A. Kochubei, E. A. Strickalenko, A. G. Shalaru, Al Khatib Ahmad [1], B. G. Manshin [7] consider speed and speed-strength abilities as significant, and A. K. Moiseenko, I. V. Shiryaeva [8] add to them also dexterity. According to the data of V. M. Koryagin [4], at the age of 12, the speed factor is significant, and at the age of 13 it is a speed-force factor of a jumping character. This influenced the choice of test exercises to determine the physical fitness of young basketball players.

Comparison of the indicators of physical fitness of young basketball players of 12 and 13 years showed that a group of senior athletes have a high level of development of speed, speed-strength qualities and explosive strength (Table 1).

Table1

Comparison of physical fitness indicators of young basketball players 12 and 13 years old (M±m)

Test exercises	Young basketball players 12 years old (n=18)	Young basketball players 13 years old (n=17)
Standing long jump (cm)	178,39±3,87	197,65±3,24*
Flexion and extension of the arms in the supine position (times)	37,22±2,58	46,24±1,61*
Shuttle run 3x10 m (s)	7,92±0,12	7,75±0,12
Running 30 m (s)	5,23±0,07	5,00±0,08*

Remark. **p<0,05 – compared with the performance of 12-year-old basketball players.*

The greatest difference in the physical preparedness of the young basketball players studied was recorded in the exercise indices of flexion and extension of the arms in the supine position, where 13-year-olds demonstrated a high level of explosive force manifestation by 24% compared to 12-year-olds (p<0.05). Also, 13-year-old basketball players differed significantly from 12-year-olds in the manifestation of speed-strength qualities (long jump) – by 10% (p<0.05) and speed (30 m) by 4% (p<0.05). At the same time, the level of dexterity development (shuttle run of 3x10 m) of the studied groups of basketball players was almost the same (p>0,05).

Comparison of indicators of technical preparedness of basketball players of 12 and 13 years showed that the results of older athletes in only four of the eight selected exercises significantly prevail in the younger (Table 2).

13-year-old basketball players showed a high level of preparedness in the transfers by dominant and subdominant hands, on average by 24% in each exercise (p<0,05). Also the advantage of older basketball players was also observed when performing a complex exercise by the dominant and subdominant hands over the time of crossing the distance by an average of 6% in each exercise (p<0,05). However, the accuracy of throws in the ring, as well as the speed of the ball, the dominant and subdominant hands in the groups under study did not differ significantly(p>0,05).

Table 2

Comparison of indicators of technical preparedness of young basketball players 12 and 13 years old (M±m)

Test exercises	Young basketball players 12 years old (n=18)	Young basketball players 13 years old (n=17)
Transfers by dominant hand (times)	31,28±1,94•	38,88±1,69*•
Subdominant hand transfers (times)	27,50±1,80	33,82±1,36*
Complex exercise with a dominant hand (s)	26,90±0,52	25,20±0,49*
Getting into the ring by the dominant hand (times)	2,89±0,28•	3,47±0,31•
Comprehensive exercise with a subdominant hand (s)	27,79±0,66	26,04±0,58*
Getting into the ring with a subdominant hand (times)	2,17±0,34	2,59±0,42
Dribble dominant hand (s)	4,18±0,05•	4,17±0,06
Dribble subdominant hand (s)	4,39±0,06	4,29±0,09

Remark. ** – p<0,05 compared with the performance of 12-year-old basketball players; • – p<0,05 by comparison with the performance of the exercise by the subdominant hand.*

The data of M. Koryagin [4] on the factors of physical and technical preparedness indicate that from the age of 13 the technical readiness becomes significant. These data and the significant advantage we have received from 13-year-old basketball players over 12-year-old athletes with the accuracy of transmission and complex exercise suggests that in the age range under study, a qualitative leap in mastering basketball technology is being implemented..

In accordance with the data of R. V. Kuchin, I. V. Aksarin [6], the basic technical base necessary for competitive activity should be formed among basketball players up to 15 years of age. An important role in the formation of preparedness is played by the individual characteristics of athletes, in particular, the profiles of motor asymmetry [6].

Comparison of the performance indicators of the technical readiness exercises for the manifestation of motor asymmetry

showed that young basketball players of both groups perform more accurate transfers and throws with the dominant hand, respectively, on average 13% ($p<0,05$) and 25% ($p<0,05$) (see Table 2). However, when performing the ball-holding exercise with a dominant hand, only 12-year-old basketball players had better scores compared to performing a subdominant hand – on 5% ($p<0,05$). In the group of 13-year-old basketball players, there was no significant difference in the performance dribble the ball with dominant and subdominant hands ($p>0,05$). That is, studies have shown that in the performance of programs and throws in basketball players of both 12 and 13 years there is a lateralization of the motor functions of the hands with the predominance of the accuracy of movements by the dominant hand. At the same time, a comparison of the parameters of the ball control showed a smoothing of the asymmetry from 12 to 13 years. That is, the existing advantage in the performance of the ball by the dominant hand over the subdominant 12-year-old basketball players, at the age of 13 years acquires the signs of symmetry.

Conclusions

A significantly higher level of physical fitness of basketball players was established 13 years compared to 12-year-olds in the manifestation of speed, explosive force and speed-strength abilities. The difference in indices for 12-year-old athletes was in the right run of 30 m – 4% ($p<0,05$), long jump from place – 11% ($p<0,05$), flexion and extension of arms – 24% ($p<0,05$).

Against the backdrop of the substantial advantage of 13-year-old basketball players over 12-year-old physical fitness, there was much better performing skills in the programs and the complex right of dominant and subdominant hands. At the same time, the difference in the indices of basketball players of 12 and 13 years when performing transfers with the dominant hand was 7,6 ($p<0,05$), which is 1.3 transfers greater than the subdominant hand. In the performance of the complex exercise, the advantage of the dominant hand was not traced ($p<0,05$).

It is established that in young basketball players, both 12 and 13 years, the accuracy of the gears and shots is higher when performed by the dominant hand, in comparison with the subdominant, which indicates a clear lateralization of the motor functions of the hands. At the same time, there is a motor asymmetry in the course of running a ball of 12-year-old athletes at age 13 acquires the signs of symmetry.

Prospects for further research. In the future, it is planned to establish interrelationships between physical and technical preparedness taking into account motor asymmetry, as well as differences in the technical preparedness of young basketball players with a different profile of brain asymmetry.

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Relationship between physical development and physical readiness among skilled wrestlers

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Purpose: *to determine the relationship between physical development and physical readiness among qualified wrestlers.*

Material & Methods: *in the study involved thirty qualified wrestlers, aged 19–22 years. For the purpose of analyzing indicators of physical development and physical preparedness, pedagogical testing.*

Results: *the results of the study testify to the homogeneity of the indices of physical development of the athletes under study, the coefficient of variation is in the range from 2,43% to 10,93%. It is revealed that the indices of physical readiness of qualified wrestlers are characterized mainly by small variation in the testing of speed-strength qualities, coordination abilities, general and strength endurance, and average – in the results of special endurance.*

Conclusion: *it is determined that the most informative indicators of physical development are the weight of the wrestler's body, which has a connection with 15 physical preparedness tests, followed by a vital index (12 statistically reliable relationships) and a strength index (11 interrelations).*

Keywords: *qualified wrestlers, correlation, physical development, physical preparedness.*

Introduction

One of the most pressing problems of modern sports science is the search for effective ways to achieve high results provided that athletes develop harmoniously and maintain their health. A successful solution to this problem is significantly hampered by the intense professionalization of sports activities, a notable trend of increasing volumes and intensity of the load [6; 10].

Modern sports of higher achievements make high demands on all sides of the athlete's preparedness, in addition, the main problem of the sport of higher achievements is the impossibility of an infinite increase in training loads, which leads to the need for further searching for new, more effective pedagogical tools and methods in the system of training highly qualified athletes [1; 2; 9; 11].

The main source of information for the preparation of athletes for competitions is the complex control of their condition after the fulfillment of certain loads. The increasing importance of the methodology of comprehensive control of the preparedness of athletes and the management of the training process is due to many reasons that are typical for modern sport, among them: a significant complication of the system of training athletes; lagging the quality of complex control from the requirements for organizing sports training as a controlled process; increase in the number of measured indicators recorded during training and competitions; Increase of requirements to metrological maintenance of gathering and the analysis of the information on readiness of athletes [5; 7].

Relationship of research with scientific programs, plans, themes. The work was carried out according to the plan of research of the Kharkov State Academy of Physical Culture.

Purpose of the study: to determine the relationship between physical development and physical readiness among qualified wrestlers.

Objectives of the study:

– to reveal the level of physical development and physical readiness of qualified wrestlers;

– to establish the degree of correlation between the indicators of physical development and the level of physical preparedness of qualified fighters.

Material and Methods of the research

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

Results of the research and their discussion

Based on the analysis of scientific and methodological information and generalization of best practical experience, it has been established that one of the main tasks of the wrestling training process is the development of physical qualities and the enhancement of the functional capabilities of the athlete's organism at all stages of long-term preparation [12].

Pedagogical testing was carried out for the purpose of analyzing indicators of physical development and physical preparedness.

Table 1 presents the average indicators of the physical development of qualified Greco-Roman wrestlers.

For the homogeneity of sample observations, the coefficient

Table 1

Model indicators of the physical development of qualified Greco-Roman wrestlers (n=30)

№ i/o	Indicators	$\bar{X}$	δ	V, %	m
1.	Age (years)	20,9	1,33	6,36	0,24
2.	Body length (cm)	176,13	4,28	2,43	0,78
3.	Body weight (kg)	73,70	7,55	10,24	1,38
4.	Quetelet index (kg m^{-1})	23,71	1,66	7,00	0,30
5.	Volume of lungs (dm3)	4,30	0,47	10,93	0,10
6.	Life index (ml kg^{-1})	58,54	6,29	10,75	1,15
7.	Dynamometry of the right hand (kG)	46,07	4,60	9,99	0,84
8.	Dynamometry of the left hand (kG)	44,20	4,47	10,11	0,82
9.	Strength index (%)	63,02	5,60	8,89	1,02

of variation was used. It is believed that if the coefficient of variation does not exceed 10%, then the sample can be considered homogeneous [4]. The obtained data testify to the homogeneity of the indices of physical development of the athletes under study, since the coefficient of variation lies in the range from 2,43% to 10,93% (Table 1).

Physical training of wrestlers has its own specific features, which must be taken into account when constructing the training process and load distribution [3; 8]. It is necessary to observe the correspondence between the capabilities of the organism and the requirements presented to it when choosing the means and methods of training, therefore we used various methods of testing the coordination abilities, power endurance, speed-strength qualities, general and special endurance for assessing the physical preparedness of wrestlers. On the basis of these data, the indicators of the physical readiness of the qualified wrestlers of the Greco-Roman style were obtained (Table 2).

The fluctuations of the mean group values of the indices of physical readiness of qualified wrestlers were estimated from the value of the coefficient of variation (V, %). Variability is considered small if the coefficient of variation is in the range from 0% to 10%, medium - from 11% to 20% and high – more 21% [4].

It is revealed that the indices of physical readiness of qualified wrestlers are characterized by predominantly low variability in testing the speed-strength qualities, coordination abilities, general and strength endurance, and the average in the results of special endurance. This gives grounds for the fact that in the training process of qualified wrestlers Greco-Roman style more time was devoted to the development of special endurance.

The informative nature of the relationship between physical development and physical readiness was determined by the method of correlation analysis (Table 3). According to the indicators of the table, the critical value of the sample correlation coefficient for the sample n=30 is equal to r=0,361.

The correlation analysis of the relationship between physical development and physical fitness showed that the age of wrestlers interacts with speed-strength abilities in tests: standing long jump (r=0,41), throwing a ball (3 kg) from behind the head with both hands (r=0,39), pull-ups for 20 s (r=0,40), push-ups for 20 s (r=0,44), lifting the trunk from the supine position on the back for 20 s (r=0,41) and strength endurance in the test, the maximum number of sit-ups with the partner (r=0,36).

Table 2

Model indicators of physical readiness of qualified Greco-Roman wrestlers (n=30)

№ i/o	Indicators	$\bar{X}$	δ	V, %	m
	Speed-strength abilities				
1.	Running on 30 m (s)	4,98	0,31	6,23	0,06
2.	High jump from the spot (cm)	50,97	4,79	9,40	0,87
3.	Standing long jump (cm)	219,20	8,94	4,08	1,63
4.	Hip-roll 10 times (s)	28,13	2,22	7,89	0,40
5.	Suplex 10 times (s)	30,90	2,29	7,41	0,42
6.	Throw the stuffed ball (3 kg) back with both hands (cm)	9,89	0,72	7,28	0,13
7.	Throw a stuffed ball (3 kg) forward from behind the head (cm)	8,89	0,67	7,54	0,12
8.	Climbing a rope without the feet (s)	6,70	0,72	10,75	0,13
9.	Pull-ups for 20 seconds (number of times)	15,57	1,15	7,39	0,21
10.	Push-ups for 20 s (number of times)	30,90	2,33	7,54	0,43
11.	Bending the body lying on the back for 20 seconds (number of times)	18,77	1,33	7,09	0,24
	Strength endurance				
12.	Lifting the legs on the gymnastic wall (number of times)	18,47	1,50	8,12	0,27
13.	Squatting with a partner of equal weight (number of times)	22,23	2,38	10,71	0,43
14.	Pull-ups (number of times)	30,43	4,06	13,34	0,74
15.	Push-ups(number of times)	64,43	4,34	6,74	0,79
16.	Flexion-extension of hands on the uneven bars (number of times)	49,83	4,44	8,91	0,79
17.	Partner's uplift of the trunk from behind (number of times)	15,90	1,35	8,49	0,25
	Coordination abilities				
18.	Running on the "bridge stand" (5 – to the left, 5 – to the right) (s)	15,09	1,35	8,95	0,25
19.	10 somersaults forward (s)	12,15	1,17	9,63	0,21
20.	Turnovers on the "bridge stand" 15 times (s)	34,83	2,06	5,91	0,38
	General endurance				
21.	Running on 800 m (s)	155,83	5,65	3,63	1,03
22.	Running 2x800 m (1 min rest) (s)	320,33	10,27	3,21	1,88
	Special endurance				
23.	1 series 15 hip-roll (s)	32,13	3,34	10,40	0,61
24.	2 series 15 hip-roll (s)	32,83	4,06	12,37	0,74
25.	3 series 15 hip-roll (s)	35,97	5,46	15,18	1,00
26.	Sum of three series of hip-roll (s)	100,93	12,09	11,98	2,21

The length of the athletes' body has interrelationships with the speed-strength abilities in the tests: running at 30 m (r=0,39), jumping from the ground (r=0,37), jogging (r=0,44), climbing on rope 5 m without feet (r=0,45); strength endurance in the test, the maximum number of pull-ups on the crossbar (r=0,51); (r=0.47), 15 running on the "bridge stand" (r=0,51) and special endurance (1 series of 15 hip-roll (r=0,42) and the sum of three series of 15 hip throw (r=0,36)).

Body mass has a relationship with the speed-strength abilities (running at 30 m (r=0,37), joggling (r=0,62), hip-roll (r=0,54), rope climbing 5 m without feet (r=0.45), pull-ups for 20 s (r=0,40), push-ups for 20 s (r=0,44), lifting the trunk from the supine position on the back for 20 s (r=0,38)); (r=0,64), the maximum amount of pull-ups (r=0,49), the maximum number of flexing-extension of the arms in the restraint on the bars (r=0,49)); (r=0,43), 10 somersaults forward (r=0,68), 15 – running on the "bridge stand" (r=0,49), and special endurance (1 series of 15 hip-roll (r=0,41) and the sum of three series of 15 throws across the back (r=0,38)).

The Quetelet index has interrelations with the speed-strength abilities in tests: joggling (r=0,58), suplex (r=0,54), pull-ups for 20 s (r=0,43), push-ups for 20 s (r=0,45); (r=0,57), the maximum amount of push-ups (r=0,48), the maximum number of flexing-extension of the arms on the uneven bars (r=0,47) and coordination abilities in the tests: running the "bridge stand" (r=0,44), 10 somersaults forward (r=0,67).

The results of the study showed that the volume of the lungs has an average statistical relationship with the speed-strength abilities (suplex (r=0,37), climbing on a 5 m rope without the help of the feet (r=0,44), lifting the trunk from the supine position on the back for 20 s (r=0,39)); (endurance of the partner by the capture of the trunk from standing on parallel benches (r=0,44)) and general endurance (run 2x800 m (r=0,39)).

The life index has interrelations with the strength endurance in the tests: lifting the legs to the grip with the hands in the vise on the gymnastic wall (r=0,51), the maximum number of squats with the partner (r=0,40), the maximum amount of pull-ups (r=0, 43), the maximum amount push-ups (r=0,37), the partner's ascents by the trunk grip from behind, standing on the parallel benches (r=0,60); coordination abilities in the tests: running the "bridge stand" (r=0,43), 15 coups on the "bridge stand" (r=0,37); total endurance in the tests: run 800 m (r=0,54) and run 2x800 m (r=0,58) and special endurance (in the second (r=0,45), third series (r=0,57) and

Table 3

Relationship between physical development and physical readiness among qualified Greco-Roman wrestlers(n=30)

Indicators		1	2	3	4	5	6	7	8	9
	10	0,33	**0,39**	**0,37**	0,27	0,19	–0,12	0,08	0,02	–0,33
	11	**–0,41**	**0,37**	0,30	0,18	0,25	0,00	**0,45**	0,30	0,11
	12	–0,28	0,24	0,18	0,10	0,20	0,06	**0,48**	0,32	0,28
	13	0,13	**0,44**	**0,62**	**0,58**	**0,37**	–0,16	0,08	0,18	**–0,59**
	14	0,21	0,36	**0,54**	**0,54**	0,33	–0,15	0,03	0,16	**–0,54**
Speed-strength abilities	15	**–0,39**	–0,26	–0,22	–0,13	0,05	0,28	0,02	–0,01	0,25
	16	–0,28	–0,12	–0,04	0,05	0,10	0,16	0,20	0,11	0,25
	17	0,14	**0,49**	**0,45**	0,30	**0,44**	0,08	0,14	0,28	–0,32
	18	**–0,40**	–0,23	**–0,40**	**–0,43**	–0,25	0,10	0,14	0,06	**0,59**
	19	**–0,44**	–0,27	**–0,44**	**–0,45**	–0,14	0,25	0,06	0,04	**0,55**
	20	**–0,41**	–0,29	**–0,38**	–0,34	**–0,39**	–0,08	0,07	–0,08	**0,46**
	21	0,02	–0,26	–0,26	–0,18	0,20	**0,51**	–0,31	–0,25	–0,02
	22	**–0,36**	–0,04	–0,11	–0,11	0,26	**0,40**	0,11	0,11	0,23
	23	–0,26	**–0,51**	**–0,64**	**–0,57**	–0,17	**0,43**	–0,20	–0,18	**0,51**
Strength endurance	24	0,29	–0,33	**–0,49**	**–0,48**	–0,09	**0,37**	–0,19	–0,11	**0,39**
	25	0,20	–0,33	**–0,49**	**–0,47**	–0,10	0,35	–0,17	–0,06	**0,42**
	26	0,05	–0,13	–0,07	0,01	**0,44**	**0,60**	–0,29	–0,23	–0,23
	27	0,16	0,29	**0,43**	**0,44**	0,00	**–0,43**	–0,11	–0,22	**–0,67**
Coordination abilities	28	0,24	**0,47**	**0,68**	**0,67**	0,32	–0,28	0,00	0,00	**–0,77**
	29	0,15	**0,51**	**0,49**	0,36	0,10	**–0,37**	0,02	–0,04	**–0,58**
General endurance	30	–0,35	0,27	0,18	0,05	–0,31	**–0,54**	0,31	0,23	0,06
	31	–0,15	0,26	0,12	–0,03	**–0,39**	**–0,58**	**0,42**	0,28	0,27
	32	0,13	**0,42**	**0,41**	0,29	0,05	–0,35	**0,41**	**0,36**	–0,01
Special endurance	33	0,13	0,34	0,36	0,28	–0,08	**–0,45**	0,33	0,26	–0,03
	34	–0,01	0,30	0,32	0,26	–0,22	**–0,57**	**0,39**	0,23	0,04
	35	0,07	**0,36**	**0,38**	0,29	–0,11	**–0,51**	**0,40**	0,29	0,01

Remark. 1–9 – indicators of the physical development: *1 – age (years), 2 – body length (cm), 3 – body weight (kg), 4 – Quetelet index (kg m^{-1}), 5 – volume of lungs (dm^3), 6 – life index (ml kg^{-1}), 7 – dynamometry of the right hand (kG), 8 – dynamometry of the left hand (kG); 9 – strength index (%),* ***10–35 – indicators of physical readiness :*** *10 – running on 30 m (s), 11 – high jump from the spot (Abalakov method) (cm), 12 – standing long jump (cm), 13 – hip throw10 times (s), 14 – suplex 10 times (s), 15 – throw the stuffed ball (3 kg) back with both hands (m), 16 – throw a stuffed ball (3 kg) forward from behind the head (m), 17 – climbing a rope 5 m without the feet (s), 18 – pull-ups for 20 seconds (number of times), 19 – push-ups for 20 s (number of times), 20 – bending the body lying on the back for 20 seconds (number of times); 21 – lifting the legs on the gymnastic wall (number of times), 22 – squatting with a partner of equal weight (number of times), 23 – pull-ups (number of times), 24 – push-ups(number of times), 25 – flexion-extension of hands on the uneven bars (number of times), 26 – partner's uplift of the trunk from behind (number of times); 27 – running on the "bridge stand" (5 – to the left, 5 – to the right) (s), 28 – 10 somersaults forward (s), 29 – turnovers on the "bridge stand" 15 times (s); 30 – running on 800 m (s), 31 – running 2x800 m (1 min rest) (s); 32 – 1 series 15 hip-roll (s), 33 – 2 series 15 hip-roll (s), 34 – 3 series 15 hip-roll (s), 35 – sum of three series of hip-roll (s).*

the sum of three series (r=0,51) of hip-roll).

The right-hand dynamometry has interrelationships with speed-strength abilities (standing long jump (r=0,48) and high jumps (r=0,45)); general endurance run 2x800 m (r=0,42) and special endurance (in the first (r=0,41), third series (r=0,39) and the sum of three series of hip-roll (r=0,40)).

The analysis of the left hand dynamometry indices revealed one statistically significant relationship with the first series of throws through the back (r=0,36), which characterizes the special endurance of wrestlers. Probably, qualified wrestlers play a crucial role in competitive actions on the right hand, so wrestlers in training sessions should pay attention to the strength of the left hand.

The power index is influenced by such indicators of physical readiness as speed-strength qualities (suplex (r=0,59), hip-roll (r=0,54), pull-up for 20 seconds (r=0,59), push-ups for 20 s (r=0,55), lifting the trunk from the supine position on the back for 20 s (r=0,46)); (r=0,51), the maximum amount of push-ups (r=0,39), the maximum number of flexing-extension of the arms on the uneven bars (r=0,42)); coordination abilities in the tests: running on the "bridge stand" (r=0,67), 10 somersaults forward (r=0,77), 15 coups on the "bridge stand" (r=0,58).

Conclusions

The results of the study testify to the homogeneity of the indices of physical development of the athletes under study, since the coefficient of variation lies in the range from 2,43% to 10,93%.

It is revealed that the indices of physical readiness of qualified wrestlers are characterized by predominantly low variability in testing the speed-strength qualities, coordination abilities, general and strength endurance, and the average in the results of special endurance. This gives grounds for the fact that in the training process of qualified wrestler's Greco-Roman style more time was devoted to the development of special endurance.

The materials of the research showed that the most informative indicators of physical development are the weight of the wrestlers body, which has connections with 15 tests of physical fitness, followed by a vital index (12 statistically reliable relationships) and a power index (11 interrelations).

Next on the informative indicators are the body length and the Quetelet index, they have 9 reliable correlation links, then follows the age and the right hand dynamometry – 6 statistically reliable interrelations, and the volume of the lungs - 5 reliable correlations.

An analysis of the left hand dynamometry revealed one statistically significant relationship. Probably, qualified wrestlers play a crucial role in competitive actions with their right hands, so fighters in training sessions need to pay more attention to the strength of the left hand.

Further research will be aimed at determining the relationship between psycho-physiological indicators and the special physical preparedness of wrestlers.

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The reliability of the presented results correspond to authors

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