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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

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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).*

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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).*

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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).*

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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 $m \cdot s^{-1}$, the maximum is 0,779 $m \cdot s^{-1}$, the average is 0,07 $m \cdot s^{-1}$ (9,87%), the minimum is 0,525 $m \cdot s^{-1}$, by 0,184 $m \cdot s^{-1}$ (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 $m \cdot s^{-1}$, a maximum of 0,819 $m \cdot s^{-1}$, more than the average value of 0,078 $m \cdot s^{-1}$ (10,53%) and a minimum of 0,539 $m \cdot s^{-1}$, by 0,202 $m \cdot s^{-1}$ (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 $m \cdot s^{-1}$, maximum – 0,779 $m \cdot s^{-1}$, more than the average value of 0,076 $m \cdot s^{-1}$ (10.81%) and minimum – 0,516 $m \cdot s^{-1}$, – by 0,187 $m \cdot s^{-1}$ (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 $m \cdot s^{-1}$, a maximum of 0,779 $m \cdot s^{-1}$, more than the average value of 0,145 $m \cdot s^{-1}$ (22,87%); minimum – 0,480 $m \cdot s^{-1}$, less than the average – by 0,154 $m \cdot s^{-1}$ (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 ($m \cdot s^{-1}$)	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 ($m \cdot s^{-1}$)	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 ($m \cdot s^{-1}$)	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 ($m \cdot s^{-1}$)	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).*

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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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