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The research of indicators of speed of movements at girls in rowing

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Purpose: *to investigate indicators of physical quality of speed and components of its elements.*

Material & Methods: *girls of three age groups of different sports qualification, who specialize in rowing, were examined. Rate, time and speed of the single movement, frequency of movements were defined by the developed by us technique of measurement of effect of training action, and also sensomotor reactions to sound and light irritants when modeling conditions of training and competitive activity were investigated.*

Results: *the conducted researches characterize specific psychophysiological features of organism of a sportsman. It is possible to apply the offered technique of the research of effect of training action to the purposeful studying and development of physical quality of speed in the training process. Formation and improvement of motor abilities in the concrete aged ranges is carried out in connection with high rates of development of morphological and functional indicators in the sensitive periods.*

Conclusions: *the age of 13–18 years has the most optimum prerequisites for the improvement of motive qualities and formation of speed of movements. Changes of rate, time, speed, frequency of movements, time of sensomotor reactions to sound and light irritants occur under the influence of training.*

Keywords: *rate, time and speed of movement, frequency of movements, time of sensomotor reactions to sound and light irritants.*

Introduction

The physical quality of speed is complex of functional properties of the person, defining high-speed characteristics of motor actions directly and mainly that promotes opportunity to carry out the movements with certain speed in the interval of time, minimum for these conditions, with necessary frequency and intensity, which depend on animal force and, are characterized by time of the hidden period of motive reaction, speed of the single movement, frequency of movements in unit of time and derivative of these indicators – movement speed in space. The reliable interrelation doesn't always exist between separate manifestations of speed, so high speed of movements can be combined with the slowed-down motive reaction [2; 9; 11].

Indicators of speed of movements and their development are defined by mobility of nervous processes, coordination of muscle work of the central nervous system, features of structure and contractile properties of muscles that is observed in specific forms of high-speed and power qualities, including elasticity of muscles, their ability to relaxation, volume of movements in joints, by the level of proficiency in technique in sports practice [7; 9].

High-speed abilities are the least trained physical quality of the person. It is caused, first of all, by the fact that their physiological basis is the property of the central nervous system which is poorly giving in to the improvement – mobility of nervous processes. Elementary forms of manifestation of speed of movements are rather independent from each other and this property is traced throughout age development of pupils [8; 11].

Speed development as physical quality is caused by the sensitive periods and the concept of primary improvement of these or those parties of physical condition of organism when there is their noticeable natural growth. The younger school age is the major for stimulation of motive preparedness of pupils and first of all such physical qualities as speed and coordination of movements. Purposeful pedagogical influence promotes the development of these qualities at higher level [3; 6].

The age from 7 to 11 years is considered the optimum period for the development of high-speed abilities both at boys, and at girls. The muscular strength and high-speed and power qualities most intensively increase at the initial stages of the pubertal period. The muscular strength of back and legs of girls intensively increases from 9–10 years old. Two periods of strength gain of muscles of legs stand out clearly at boys: from 9 to 11–12 years old and from 14 to 17 years old. The growth of various indicators of speed continues till 14–15 years old to a lesser extent. Stabilization of results in indicators of speed of simple reaction and the maximum frequency of movements occurs to this age actually. However, purposeful influences improve the development of high-speed abilities which can increase by 5–20% and at more advanced age at special training [1; 5].

The development of high-speed abilities takes the important place in physical education of children as many pupils cannot achieve good results in run, jumps, throwing, mainly, in view of underdevelopment of the main motive qualities – force, speed, endurance, dexterity, flexibility. High-speed abilities are necessary in many sports. This quality is closely connected with technique of performance of exercises, muscular strength, flexibility, good coordination of movements. Speed is gathered due to the improvement of these qualities [3; 10; 12].

The purpose of the research

To investigate indicators of physical quality of speed and components of elements – rate, time and speed of the single movement, frequency of motor actions.

Material and Methods of the research

The girls, pupils of Highest school of physical culture and students of HEI, specializing in rowing at the age of 13–14 years (the first group of 27 people, the 2nd sports category), 15–16 years (the second group of 25 people, 2 and 1 sports categories) and 17–18 years (the third group 21 persons, first-grade sportsmen and candidates for the master of sports) were examined. Sensomotor reactions to sound and light irritants were investigated, and also rate, time and speed of one movement, frequency of movements which were studied in three periods of the test were determined by the developed by us technique of measurement of effect of the training action and were registered in the automatic mode. In the first period of the test, lasting 15 s, the task – fast increase in motor actions from scratch to maximum – start push, in the second period, lasting 60 s, – maintenance of optimum speed of movements – remote speed, in the third, during 15 s – finishing acceleration, and also the total indicator on the entire periods of the test characterizing all three types of high-speed work was set. The process of testing models typical conditions of training and competitive activity and estimates performance of task. The technique of the research is published in detail in *Slobozhans'kiy naukovo-sportivniy visnik*, 2015, No. 4(48), pp. 19–25 [4].

Results of the research and their discussion

The following data (tab. 1) were obtained in the investigated group of girls of 13–14 years old, specializing in rowing. Rate of movements was on average 22,3±0,99 at the maximum size of 26 movements and minimum 18 movements, time of one movement was 0,672 s, at the best result – 0,577 s and the worst – 0,833 s; speed of one movement equaled 0,446 $m \cdot s^{-1}$, at the best result – 0,520 $m \cdot s^{-1}$ and the worst – 0,360 $m \cdot s^{-1}$; frequency of movements was noted on average 1,48 Hz, at the best indicator – 1,73 Hz and the worst – 1,20 Hz in the first period of the test of measurement of effect of the training action. The maximum indicators were more average size for 16,46%, and minimum – is 23,95% less.

Rate was defined by the size of 25,2±1,45 movements, at the best result – 33,75 movements and the worst – 22 movements, time of one movement equaled 0,585 s, at the best indicator – 0,445 s and the worst – 0,682 s; speed of one movement was defined by size 0,512 $m \cdot s^{-1}$, at the best result –0,674 $m \cdot s^{-1}$ and the worst – 0,439 $m \cdot s^{-1}$; frequency of movements was on average 1,71 Hz, at the best result – 2,25 Hz and the worst – 1,47 Hz in the second period of the test of the research of effect of the training action. The maximum indicators were more average size for 31,46%, and minimum – is 16,58% less.

Rate was equal 27,4±0,61 movements, at the best result – 35 movements and the worst – 22 movements; time of one

Table 1

Indicators of physical quality of speed (girl of 13–14 years old, rowing)

Indicators			M±m	M_{max}	M_{min}
Effect of the training action	First period	rate (number of movements)	22,3±0,99	26	18
		time of one movement (s)	0,672	0,577	0,833
		speed of one movement ($m \cdot s^{-1}$)	0,446	0,520	0,360
		frequency of movements (Hz)	1,48	1,73	1,20
	Second period	rate (number of movements)	102,5±5,82 (25,5±1,45)	135 (33,75)	88 (22)
		time of one movement (s)	0,585	0,445	0,682
		speed of one movement ($m \cdot s^{-1}$)	0,512	0,674	0,439
		frequency of movements (Hz)	1,71	2,25	1,47
	Third period	rate (number of movements)	27,4±0,61	35	22
		time of one movement (s)	0,547	0,429	0,682
		speed of one movement ($m \cdot s^{-1}$)	0,548	0,699	0,439
		frequency of movements (Hz)	1,82	2,33	1,47
	Total	raet (number of movements)	152,0±3,06 (25,3±1,01)	196 (32,6)	131 (21,8)
		time of one movement (s)	0,592	0,460	0,687
		speed of one movement ($m \cdot s^{-1}$)	0,506	0,652	0,437
		frequency of movements (Hz)	1,69	2,17	1,45
Time of sensomotor reaction					
		Sound (s)	0,210±0,044	0,199	0,222
		Light (s)	0,259±0,017	0,200	0,340

Note. *The data, which were provided to uniform temporary indicator – 15 s, in particular, 102,5:4=25,5 movements are specified in brackets.*

movement – 0,547 s, the best result – 0,429 s, the worst – 0,628 s; speed of one movement – 0,548 m·s^{-1}, the best result – 0,699 m·s^{-1}, the worst – 0,439 m·s^{-1}; frequency of movements – 1,82 Hz, the best result – 2,33 Hz, the worst – 1,47 Hz in the third period of the test of determination of effect of the training action. The maximum indicators were more average size for 27,51%, and minimum – is 24,83% less.

Rate made 25,3±1,01 movements, the best result – 32,6 movements, the worst – 21,8 movements; time of one movement – 0,592 s, the best result – 0,460 s, the worst – 0,687 s; speed of one movement – 0,506 m·s^{-1}, the best result – 0,652 m·s^{-1}, the worst – 0,437 m·s^{-1}; frequency of movements was defined by the size of 1,69 Hz, at the best result – 2,17 Hz and the worst – 1,45 Hz in the total size of the test of the research of effect of the training action of indicators of physical quality of speed at girls of 13–14 years specializing in rowing. The maximum indicators were more average size for 28,41%, and minimum – is 16,55% less.

Time of sensomotor reactions to sound irritant equaled 0,210±0,044 s on average, at the best result – 0,199 s and the worst – 0,222 s; it was defined on light irritant with an average size of 0,259±0,017 s, at the best result – 0,200 s and the worst – 0,340 s.

The analysis of the conducted researches showed that rate of movements, time and speed of one movement, the frequency of movements big differences of the studied indicators were observed at sportswomen 13–14 years at which in the first period of the test between the best and worst indicators rather with average size made 40,48%; in the second period – 48,27%; in the third period – 52,38%; on total indicator – 44,96%; time of sensomotor reactions between the best and worst indicator changed to sound irritant till 11,24%, light – till 60,78%.

Rate of movements increased by 14,35%, time of one movement decreased by 14,87%, speed of one movement increased by 14,81%, the frequency of movements increased for 15,54%; in the third period in comparison with the first and second periods, respectively, rate increased by 22,87% and 7,4%, time of one movement decreased by 22,85% and 6,95%, speed of one movement increased for 22,87% and 7,03%, the frequency of movements increased by 22,97% and 6,43% compared with the first period in the second period. Rate of movements was more, than in the first period for 13,45%, it is less, than in the second and third periods respectively for 0,79% and 8,31%; time of one movement is less, than in the first period for 13,5% it is more, than in the second and third periods respectively for 1,19% and 8,23%, speed of one movement is higher, than in the first period for 13,45% and less, than in the second and third periods for 1,19% and 8,31%, the frequency of movements is more, than in the first period for 14,19% it is less, than in the second and third periods respectively for 1,18% and 7,69% on total indicator.

The following data were obtained in the investigated group of girls of 15–16 years, specializing in rowing (tab. 2). Rate of movements was on average 26,0±1,25 at the maximum size – 37 movements and minimum – 19 movements; time of one movement was 0,576 s, at the best result – 0,405 s and the worst – 0,833 s; speed of one movement equaled 0,520 m·s^{-1}, at the best result – 0,741 m·s^{-1} and the worst – 0,425 m·s^{-1}; frequency of movements was noted on average 1,73 Hz, at the best indicator – 2,47 Hz and the worst – 1,27 Hz in the first period of the test of measurement of effect of the training action. Rate was defined by the size of 29,0±0,55 movements, at the best result – 32 movements and the worst – 23 movements; time of one movement equaled 0,517 s, at the best indicator – 0,469 s and the worst – 0,652 s; speed of one movement was measured of 0,580 m·s^{-1}, at the best result 0,639 m·s^{-1} and the worst – 0,475 m·s^{-1}; frequency of movements was on

Table 2

Indicators of physical quality of speed (girl of 15–16 years old, rowing)

		Indicators	M±m	M_{max}	M_{min}
Effect of the training action	First period	rate (number of movements)	26,0±1,25	37	19
		time of one movement (s)	0,576	0,405	0,705
		speed of one movement (m·s^{-1})	0,520	0,741	0,425
		frequency of movements (Hz)	1,73	2,47	1,27
	Second period	rate (number of movements)	116,0±2,23 (29,0±0,55)	128 (32)	92 (23)
		time of one movement (s)	0,517	0,469	0,652
		speed of one movement (m·s^{-1})	0,580	0,639	0,475
		frequency of movements (Hz)	1,93	2,13	1,53
	Third period	rate (number of movements)	30,5±1,39	44	24
		time of one movement (s)	0,491	0,341	0,625
		speed of one movement (m·s^{-1})	0,610	0,879	0,480
		frequency of movements (Hz)	2,03	2,93	1,6
	Total	raet (number of movements)	172,0±7,52 (28,6±1,25)	244 (40,6)	136 (22,6)
		time of one movement (s)	0,523	0,369	0,662
		speed of one movement (m·s^{-1})	0,573	0,817	0,453
		frequency of movements (Hz)	1,91	2,71	1,51
Time of sensomotor reaction					
		Sound (s)	0,198±0,006	0,152	0,239
		Light (s)	0,217±0,005	0,167	0,247

Note. *The data, which were provided to uniform temporary indicator – 15 from, in particular, 116,0:4=29,0 movements, are specified in brackets.*

average 1,93 Hz, at the best result – 2,13 Hz and the worst – 1,53 Hz in the second period of the test of the research of effect of the training action.

Rate was equal 30,5±1,39 movements, at the best result – 44 movements and the worst – 24 movements; time of one movement – 0,491 s, the best result – 0,341 s, the worst – 0,625 s; speed of one movement – 0,610 $m \cdot s^{-1}$, the best result – 0,879 $m \cdot s^{-1}$, the worst – 0,480 $m \cdot s^{-1}$; frequency of movements – 2,03 Hz, the best result – 2,93 Hz, the worst – 1,60 Hz in the third period of the test of determination of effect of the training action.

Rate made 28,6±1,25 movements, the best result – 40,6 movements, the worst – 22,6 movements; time of one movement – 0,523 s, the best result – 0,369 s, the worst – 0,662 s; speed of one movement has made 0,573 $m \cdot s^{-1}$, the best result – 0,817 $m \cdot s^{-1}$, the worst – 0,453 $m \cdot s^{-1}$; frequency of movements was defined by the size of 1,91 Hz, at the best result – 2,71 Hz and the worst – 1,51 Hz in the total size of the test of the research of effect of the training action of indicators of physical quality of speed at girls of 15–16 years old, specializing in rowing.

Time of sensomotor reactions to sound irritant equaled 0,198±0,006 s on average, at the best result – 0,152 s and the worst – 0,239 s; it was defined on light irritant with an average size of 0,217±0,005 s, at the best result – 0,167 s and the worst – 0,247 s.

The essential distinctions in the studied indicators were noted at sportswomen of 15–16 years old. The deviation between the best and worst indicators made rather with average size in the first period of the test: on rate of movements – 79,15%, time of one movement – 64,61%, speed of one movement – 64,86%, the frequency of movements of 78,99%; in the second period: on rate of movements – 36,43%, time of one movement – 36,34%, speed of one movement – 32,28%, the frequency of movements – 36,50%; in the third period: on rate of movements – 71,34%, time of one movement – 71,28%, speed of one movement – 71,17%, the frequency of movements – 71,21%; on total indicator: on rate of movements – 68,51%, time of one movement – 68,31%, speed of one movement – 69,07%, the frequency of movements – 68,37%; time of sensomotor reactions fluctuated: to sound irritant till 51,47%, light – till 37,76%.

Rate of movements increased by 11,53%, time of one movement decreased by 11,41%, speed of one movement increased by 11,54%, the frequency of movements increased for 11,56%; in the third period in comparison with the first and second periods, respectively, speed increased by 17,30% and 5,17%, time of one movement decreased by 17,31% and 5,29%, speed of one movement increased for 17,30% and 5,17%, the frequency of movements increased by 17,34% and 5,18% compared with the first period in the second period. Rate of movements was more, than in the first period for 10,01%, it is less, than in the second and third periods, respectively, for 1,39% and 6,64%; time of one movement is less, than in the first period for 10,13%, it is more, than in the second and third periods respectively for 1,16% and 6,51%, speed of one movement is higher, than in the first period for 10,19% and less, than in the second and third periods for 1,22% and 6,45%, the frequency of movements is more, than in the first period for 10,41%, it is less, than in the second and third periods respectively for 1,04% and 6,28% on total indicator.

The following data (tab. 3) were obtained in the investigated group of girls of 17–18 years old, specializing in rowing. Rate of movements was on average 27,0±1,26 at the maximum size – 31 movements and minimum – 22 movements; time of one movement was 0,555 s, at the best result – 0,483 s and the worst – 0,681 s; speed of one movement equaled

Table 3

Indicators of physical quality of speed (girl of 17–18 years old, rowing)

		Indicators	M±m	M_{max}	M_{min}
Effect of the training action	First period	rate (number of movements)	27,0±1,26	31	22
		time of one movement (s)	0,555	0,483	0,681
		speed of one movement ($m \cdot s^{-1}$)	0,540	0,621	0,441
		frequency of movements (Hz)	1,80	2,07	1,47
	Second period	rate (number of movements)	120,0±6,73 (30±1,68)	148 (37)	100 (25)
		time of one movement (s)	0,500	0,405	0,600
		speed of one movement ($m \cdot s^{-1}$)	0,600	0,741	0,500
		frequency of movements (Hz)	2,0	2,47	1,67
	Third period	rate (number of movements)	31,8±1,26	36	27
		time of one movement (s)	0,471	0,417	0,556
		speed of one movement ($m \cdot s^{-1}$)	0,636	0,719	0,559
		frequency of movements (Hz)	2,12	2,4	1,80
	Total	raet (number of movements)	178,0±6,17 (29,6±1,02)	217 (36,2)	173 (28,2)
		time of one movement (s)	0,505	0,415	0,520
		speed of one movement ($m \cdot s^{-1}$)	0,594	0,723	0,577
		frequency of movements (Hz)	1,97	2,41	1,92
		Time of sensomotor reaction			
		Sound (s)	0,186±0,005	0,159	0,198
		Light (s)	0,203±0,011	0,165	0,248

Note. *The data, which are brought to uniform temporary indicator 15 s, in particular 120,5:4=30 movements, are specified in brackets.*

0,540 m·s^{-1}, at the best result – 0,621 m·s^{-1}and the worst – 0,441 m·s^{-1}; frequency of movements was noted on average 1,80 Hz, at the best indicator – 2,07 Hz and the worst – 1,47 Hz in the first period of the test of measurement of effect of the training action.

Rate was defined by the size of 30±1,68 movements, at the best result – 37 movements and the worst – 25 movements; time of one movement equaled 0,500 s, at the best indicator – 0,405 s and the worst – 0,600 s; speed of one movement was measured of 0,600 m·s^{-1}, at the best result – 0,741 m·s^{-1}and the worst – 0,500 m·s^{-1}; frequency of movements was on average 2,0 Hz, at the best result – 2,47 Hz and the worst – 1,67 Hz in the second period of the test of the research of effect of the training action.

Rate was equal 31,8±1,26 movements, at the best result – 36 movements and the worst – 27 movements; time of one movement – 0,471 s, the best result – 0,417 s, the worst – 0,556 s; speed of one movement – 0,636 m·s^{-1}, the best result – 0,719 m·s^{-1}, the worst – 0,559 m·s^{-1}; frequency of movements – 2,12 Hz, the best result – 2,40 Hz, the worst – 1,80 Hz in the third period of the test of determination of effect of the training action.

Rate made 29,6±1,02 movements, the best result – 36,2 movements, the worst – 28,2 movements; time of one movement – 0,505 s, the best result – 0,415 s, the worst – 0,520 s; speed of one movement made 0,594 m·s^{-1}, the best result – 0,723 m·s^{-1}, the worst – 0,577 m·s^{-1}; frequency of movements was defined by the size of 1,97 Hz, at the best result – 2,41 Hz and the worst – 1,92 Hz in the total size of the test of the research of effect of the training action of indicators of physical quality of speed at girls of 17–18 years, specializing in rowing.

Time of sensomotor reactions to sound irritant equaled 0,186±0,005 s on average, at the best result – 0,159 s and the worst – 0,198 s; it was defined to light irritant with an average size of 0,203±0,011 s, at the best result – 0,165 s and the worst – 0,248 s.

The following distinctions in the studied indicators were observed at sportswomen of 17–18 years. The difference between the best and worst indicators rather with average size made in the first period of the test: on rate of movements – 37,53%, on time of one movement – 37,61%, on speed of one movement – 37,46%, the frequency of movements of 37,46%; in the second period: on rate of movements – 43,33%, time of one movement – 43,46%, speeds of one movement – 43,51%, the frequency of movements – 43,26%; in the third period: on rate of movements – 30,99%, time of one movement – 31,19%, speeds of one movement – 26,82%, the frequency of movements – 30,99%; on total indicator: on rate of movements – 27,25%, time of one movement – 24,66%, speed of one movement – 24,67%, the frequency of movements – 24,95%; time of sensomotor reactions fluctuated: to sound irritant till 23,43%, light – till 45,20%.

Rate of movements increased by 11,11%, time of one movement decreased by 11,0%, the speed of one movement increased by 11,11%, the frequency of movements increased for 11,11%; in the third period in comparison with the first and second periods, respectively, speed increased by 17,78% and 6,0%, time of one movement decreased by 17,83% and 6,1%, speed of one movement increased for 17,78% and 6,0%, the frequency of movements increased by 17,78% and 6,0% compared with the first period in the second period. Rate of movements was more, than in the first period for 9,63% it is less, than in the second and third periods respectively for 1,36% and 7,34%; time of one movement is less, than in the first period for 9,9% it is more, than in the second and third periods respectively for 1,0% and 7,22%, the speed of one movement is higher, than in the first period for 10,0% and less, than in the second and third periods for 1,01% and 7,07%, the frequency of movements is more, than in the first period for 9,44% it is less, than in the second and third periods, respectively, for 1,52% and 7,61% on total indicator.

It is necessary to pay attention to versatile development and improvement of high-speed abilities (speed of reaction, frequency of movements, speed of the single movement, speed of complete actions) in combination with acquisition of motive skills, especially during the sensitive periods, at specialization of children, boys and girls in sports where speed of reaction or speed of action play the essential role in the training process.

The list of the examined sportsmen in each group is non-uniform on functional and psychophysiological state, sports qualification.

It is possible to apply the developed by us technique of the research of effect of the training action, at the same time the methods, consisting in the fastest repeated performance of the trained movements on signal, are most effective, analytical training in the facilitated conditions, speed of reaction and speed of the subsequent movements, definition of communication between speed of reaction and ability to differentiation of microintervals of time for the purposeful studying and development of speed of simple motive reaction.

Therefore, sportsmen perform the motive task with the maximum or various, in advance determined speed, estimate speed of its realization on the feelings and compare to real time of performance of exercise that improves the accuracy of performance of task and perception of time. The result is controlled and compared. Training in free management of speed of reaction happens at the same time.

Conclusions

At the development of physical quality of speed application of physical exercises of versatile orientation, especially those which develop the motor abilities, having high rates of natural increase in concrete age ranges of ontogenesis, is expedient. At the same time use of opportunities of the sensitive periods in physical education is carried out in connection with high rates of development of morphological and functional indicators.

Compliance of short-term high-speed loadings to functionality of teenagers is caused by high excitability of the innervation mechanisms, regulating activity of the motive apparatus, big mobility of the main nervous processes and high intensity of exchange.
High-speed abilities are one of the most important physical qualities, at the same time the teenage age has favorable prerequisites for formation of speed of movements, improvement of motive qualities. There are changes of rate, time, speed, frequency of movements, time of sensomotor reactions to sound and light irritants under the influence of training.

Prospects of further researches. It is supposed to reveal other functional and psychophysiological indicators which can significantly change under the influence of training along with studying of traditional signs when forecasting sports abilities.

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