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The functional state of the rowing kayaks (boys) athletes in the simulation of training activities

Volodymyr Bogush[1]
Sergiy Getmantsev[2]
Olga Kuvaldina[1],
Oleksandr Kosenchuk[1]
Yevgen Yatsunskiy[1]

[1]*Admiral Makarov National University of Shipbuilding, Mykolayiv, Ukraine*
[2]*V. Sukhomlynskiy Nikolaev National University, Mykolayiv, Ukraine*

Purpose: *to conduct a comprehensive study of the functional status of athletes (boys) of various age groups specializing in rowing, for the possible subsequent determination of prospects in this sport.*

Material & Methods: *athletes of various age groups (11–12 years old, 13–14 years old, 15–16 years old, 17–18 years old) and sports qualifications were surveyed, in total 95 people, according to our method of measuring the effect of a training action, and also visual-motor hearing and motor reactions, the level of musculo-articular sensitivity and coordination of movements, the power of forced inhalation and exhalation.*

Results: *studies have allowed us to study the functional state of athletes. The optimal structure of sports activities contributes to the improvement of all its components, which in the early stages and due to the age characteristics of athletes, as well as the patterns of development of motor skills do not significantly affect the level of results, but have a great impact on the appearance of the corresponding functional basis, especially in the early age periods realization of individual capabilities. Features of the reaction of the body of athletes are a manifestation of effective individual adaptation to intense and complex stimuli of training and competitive activity. The functional state of athletes is determined by the level of development of various physical qualities, coordination abilities, properties of the nervous system, the optimal combination of which is characteristic of each particular sport and allows you to specifically choose sports specialization.*

Conclusion: *the proposed tests for measuring the effect of the training action, electromyoreflexometry, pneumotachometry and reverse dynamometry are sufficiently informative in sports practice and allow us to determine and evaluate the individual prerequisites for sporting achievements. The obtained parameters of the functional state allow you to identify the individual characteristics of the athlete's body, the possibility of their correction and management of the training process. Conducted comprehensive examinations of the psycho-physiological and functional characteristics of the body of athletes rowers allow you to create methods for assessing the prospects of athletes in their chosen sport.*

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

Introduction

The functional state of a person is defined as the degree of adaptation of an organism to environmental conditions, its physical, mental and social influences, which is especially important for athletes who are constantly exposed to extreme physical, psychological and other stress [1; 2]. Increasing the volume and intensity of training loads, used to train qualified athletes and maximize the overall and special performance, are necessary to assess the functional state of the athlete's body at each moment of the training process [3; 4].

The growth of achievements in sports is mainly due to the improvement of the training process, the alignment of the biological laws of the flow of adaptation processes with the main parameters of training and competitive loads, the correct management of physical condition of athletes. The organization and conduct of the training process can lead to a positive result only if there is an objective assessment of the athlete's functional state [4].

The most important factor in training and competitive activity are functional diagnostics, including testing of physical performance, functional readiness, adaptation reserves and other characteristics of the functional state of athletes [5]. Dynamic monitoring of the functional state of an athlete allows to ensure high physical performance, improve the efficiency of the training process, which contributes to the achievement of high sports results [6].

Violation of the body's ability to adapt to environmental conditions is due to a decrease in its functional capabilities, since adaptation to new conditions occurs due to mobilization of functional reserves and causes a certain tension of regulatory systems [7].

The capacities of functional systems of athletes characterize their professional viability and the possibility of achieving high athletic performance, since the role of body reserves increases with changing environmental conditions in sub-extreme and extreme situations of life, especially during intense training and competitive activities. The effectiveness of the dynamics of adaptation to improve performance, prevent physical overvoltage depends on an objective assessment of the functional state of the body of an athlete [8; 9].

Functional condition of an athlete is a system of stable functioning integrative physiological mechanisms that ensure the constancy of various physiological parameters and adapting all systems of the body to intense physical and psycho-emotional specific effects which constantly changes under the influence of internal and external factors, including the intensive physical and psycho-emotional stresses [10; 11].

To determine the functional state of the body, the capabilities of its main systems are evaluated: cardiorespiratory, nervous and motor [12]. The effectiveness of the process of training and competitive activity improves with the intensification of the use of functional reserves of the body and stimulation of adaptation processes. Improved performance contributes to a balanced system of physical activity, rest, nutrition, rehabilitation facilities; accounting of competitions in different climatic zones, time zones, oxygen level tension (plain, middle mountains); improvement of motor skills based on the use of various instruments and methods [13].

Purpose of the study: to conduct a comprehensive study of the functional status of athletes (boys) of various age groups specializing in rowing, for the possible subsequent determination of prospects in this sport.

Material and Methods of the research

Pupils of sports schools in the city of Mykolaiv and the higher school of physical education, young men specializing in rowing were surveyed. Individual indicators were determined in various age groups: 11–12 years old – 26 people, 13–14 years old – 23 people, 15–16 years old – 25 people, 17–18 years old – 21 people, in total – 95 athletes.

The study of the functional state included a test measuring the effect of a training action (META), created on the basis of a tapping test, which allows determining the complex of kinematic characteristics of movements in an autonomous mode. This technique allows you to study the pace of movements and their accuracy in the sum of points gained, as well as the accuracy of a single movement. The study of movements performed with maximum speed and accuracy was carried out in different conditions, successively in three time periods: for 15 s, 60 s and 15 s. This formulation of the problem provided an objective assessment of the pace and accuracy of movements in various conditions: with an optimal functional state in the first period of time, in the process of long work in the second and after a long and maximum pace of movement of work in the third period.

The change in the number of movements during the first period of time indicates a high mobility of the nervous processes, the second indicates balance, the third indicates strength and, in total, the state of the nervous system as a whole. This physiological justification allows the coach to objectively evaluate the processes occurring in the body, and purposefully conduct the management of training and competitive activities. A detailed methodology for studying the effect of the coaching action was published in the *"Slobozans`kij naukovo-sportivnij visnik"* (2015), No. 4 (48), pp. 19-25 [14].

The latent periods of visual-motor and auditory-motor reactions were determined using an electromyoreflexometer (EMR) using the standard method. These reactions are an indicator of complex psychophysiological processes, reflecting the characteristics of receptor perception, the nervous and muscular systems, which characterizes the mobility of nervous processes, that is, one of the most important indicators of higher nervous activity.

The level of muscular-articular sensitivity and coordination of movements, as well as the diagnostic capabilities of the principle of repeated reproduction of a given load were studied by the method of reverse dynamometry (DM_{rev}), which was modified and adapted for the purposes of our study. The possibility of developing a skill to reproduce a given load without visual correction of each of the ten attempts was determined.

Measurement of the power of forced inspiration and expiration was carried out using a pneumotachometer (PT). Estimated air velocity in $l \cdot s^{-1}$ with the maximum fixed inspiration and expiration. 10 attempts were used with an interval of at least 20 s. Determining the maximum air flow during inhalation and exhalation allows you to indirectly judge the ability of the respiratory muscles to work intensively. With regular sports activities, the power of forced inhalation and exhalation can increase significantly.

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

Results of the research

Results of the study of the functional state of boys 11–12 years old, trains in rowing, are presented in Table 1.

In the first period of the test of measuring the effect of the training action, the average rate of movement was 28,5±0,933 strokes, the total accuracy of movement for the sum of points scored was 216,3±7,94, and the accuracy of one movement was 7,59±0,384 points (hereinafter the text indicates the amount of points and accuracy, respectively); maximum: pace – 31 blows, total points – 243, accuracy – 7,89 points; minimum: tempo – 23 beats , total points – 179, accuracy – 7,78 points.

In the second period of the test averages were as follows: the pace – 4,5±4,093 beats, score – 244,5±7,593, accuracy – 7,10±0,459 points, the maximum and minimum, respectively: the rate – 38 strokes and 27 strokes, the amount points – 331 and 213, accuracy – 8,71 points and 7,88 points.

In the third period, the average values were: tempo – 34±1,359 beats, total points – 238,6±13,02, accuracy – 7,02±0,435 points, maximum and minimum, respectively: tempo – 39 beats and 28 shots, total points – 306 and 162, accuracy – 7,85 points and 5,79 points.

The total figure for the three test periods averaged: the pace – 33,42±3,017 shots, the sum of points – 232,65±7,191, the accuracy – 7,16±0,435 points; maximum results: rate – 37 beats , total points – 312, accuracy – 8,43 points; minimum results: tempo – 26,5 beats, total points – 198, accuracy – 7,47 points.

In the second period, compared to the first, the rate increased by 6 beats (21,05%), the amount – by 28,65 points (13,25%), the accuracy on average decreased by 0,49 points (6,91%), the best and worst results were higher, respectively, by 0,82 points (10,39%) and by 0,1 points (1,29%).

Table 1

Survey results (rowing, boys 11–12 years old)

		Indicators	M±m	M_{max}	M_{min}	σ	A
Effect of a training action	First period	Pace (number of beats)	28,5±0,993	31	23	2,81	9,86
		Total points	216,3±7,94	243	179	22,46	10,44
		Accuracy (points)	7,59±0,384	7,89	7,78	1,088	14,33
	Second period	Pace (number of beats)	28,5±0,993	31	23	2,81	9,86
		Total points	216,3±7,94	243	179	22,46	10,44
		Accuracy (points)	7,59±0,384	7,89	7,78	1,088	14,33
	Third period	Pace (number of beats)	138±16,37 (34,5±4,093)	152 (38)	108 (27)	46,32	33,56
		Total points	941±30,37 (244,95±7,593)	1324 (331)	851 (213)	85,96	9,13
		Accuracy (points)	7,10±0,459	8,71	7,88	1,298	18,29
	Total	Pace (number of beats)	34±1,359	39	28	3,86	11,35
		Total points	238,6±13,02	306	162	36,84	15,81
		Accuracy (points)	7,02±0,435	7,85	5,79	1,23	17,49
Tests	EMR (s)	Sound	0,207±0,063	0,236	0,185	0,01789	8,64
		Light	0,232±0,011	0,272	0,189	0,02912	12,55
	PT ($l \cdot s^{-1}$)	Inhale	5,3±0,579	7,67	3,0	1,639	30,91
		Exhale	5,16±0,268	6,16	4,0	0,758	14,69
	DM_{rev} (kg)		1,5±0,248	2,3	0,3	0,702	46,78

Remark. *The data in brackets are given to a single time indicator of 15 s, in particular 138±16,37 (34,5±4,093).*

In the third period, as compared with the first, the pace increased by 5,5 beats (19,29%), the amount of points increased by 22,3 (10,31%), the accuracy decreased by an average of 0,57 points (8,12%), by the maximum indicator – by 0,04 points (0,51%) and by the minimum – by 1,99 points (34,37%); compared to the second period, the pace decreased by an average of 0,5 beats (0,15%), the sum of points by 6,35 (2,66%), the accuracy by 0.08 points (1,14%), that is The indicators studied remained virtually unchanged.

The results of the studies for the three test periods were as follows: the maximum indicators were more than the average values for the pace by 3,58 beats (10,71%), the sum of points was 79,35 (34,11%), the accuracy was 1,27 points (17,74%); the minimum – less than the average in pace by 6,92 beats (26,11%), the total points – by 34,65 (17,50%), but the accuracy was higher than the average by 0,31 points (4,33%).

It should be noted that in the first test period, the accuracy of movements in the maximum indicator was better than the average value by 0,3 points (3,95%) and in the minimum – by 0,19 points (2,50%); in the second period, the maximum value exceeds the average by 1,61 points (22,68%), the minimum – by 0,78 points (10,99%); in the third period, the accuracy of movements in the best indicator was higher than the average by 0,83 points (11,82%), in the minimum – less than the average value by 1,23 points (21,24%).

Sensomotor reactions to a sound stimulus were determined, on average, 0,207±0,063 s; the best result – 0,185 s, less than the average values by 0,022 s (11,89%), the worst – 0,236 s, more than the average by 0,029 s (14,01%); light stimuli were on average 0,232±0,011 s; the best result – 0,189 s, which is less than the average by 0,043 s (22,75%), the worst – 0,272 s, more than the average by 0,04 s (17,24%).

Indicators of pneumotachometry were observed on average during inhalation 5,3±0,579 $l \cdot s^{-1}$, maximum – 7,67 $l \cdot s^{-1}$, which is 2,37 $l \cdot s^{-1}$more than the average value (44.72%), minimum – 3,0 $l \cdot s^{-1}$, less than the average by 2,3 $l \cdot s^{-1}$ (76,67%); on expiration, on average – 5,16±0,268 $l \cdot s^{-1}$, maximum – 6,16 $l \cdot s^{-1}$, which is 1,0 $l \cdot s^{-1}$ more than the average value (19,38%), minimum – 4,0 $l \cdot s^{-1}$, less than the average 1,16 $l \cdot s^{-1}$ (29,00%).

In the test of reverse dynamometry, the task was set: to produce muscular effort of 15 kg on a dynamometer with a leading hand without vision control, an error in performing the task was determined. The error of the exercise performance was on average 1,5±0,248 kg (10,00%), maximum – 2,3 kg (11,5%), minimum – 0,3 kg (1,5%).

The results of a survey of 13–14-year-old boys trains in rowing are presented in Table 2.

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

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

In the third period, the average indicators: pace – 34±1,53 beats, total points – 258±10,39, accuracy – 7,59±0,163 points; maximum indicators: tempo – 41 beats, total points – 310, accuracy – 7,56 points, minimum: tempo – 25 beats, total points – 201, accuracy – 8,04 points.

The total values for the three periods of the test of measuring the effect of the training action were as follows: averages – a pace of 33±0,428 beats, the accuracy of all movements or the

Table 2

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

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

Remark. *The data in brackets are given to a single time indicator of 15 s, in particular, 133±5,33 (33,25±1,382).*

sum of points – 254±8,513, the accuracy of one movement – 7,69±0,14 points; maximum: pace – 38,8 beats, total points – 294,6, accuracy – 7,58 points; minimum: pace – 24,3 points, total points – 191, accuracy – 7,84 points.

Athletes maintained a high rate of movement, which in the second period was more than the first by 2,25 beats (7,26%), the amount of points increased by 2,75 (1,09%), the accuracy decreased by 0,46 points (6,03%). In the third period, as compared with the first, the rate increased by 3 beats (9,68%), the accuracy of all movements increased by 7 points (2,79%), the accuracy of one strike decreased by 0,5 points (6,59%); compared to the second increased: the pace – by 0,75 beats (2,26%), the amount of points – by 4,25 (1,67%), the accuracy was almost unchanged, decreased by 0,04 points (0,53%).

The accuracy of movements in the first period in the maximum and minimum values was less than the average, respectively, by 0,37 points (4,79%) and 0,48 points (6,31%); in the second period, with the maximum rates and the sum of points, the accuracy was less than the average by 0.07 points (0,93%), that is, it did not change, with the minimum – the accuracy was noted more than the average values by 0,22 points (2,88%); in the third period, according to the maximum results, the accuracy of one strike was virtually the same with the average value, the difference was 0,03 points (0,39%), and the minimum - more than the average by 0,45 points (5,93%).

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

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

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

The results of pneumotachometry were noted on average on the inhale 5,66±0,199 $l \cdot s^{-1}$, the maximum – 6,5 $l \cdot s^{-1}$, more than the average by 0,84 $l \cdot s^{-1}$ (14,84%), the minimum – 4,4 $l \cdot s^{-1}$, less than the average by 1.26 $l \cdot s^{-1}$ (28.64%); on expiration – 5,26±0,15 $l \cdot s^{-1}$, maximum – 6,1 $l \cdot s^{-1}$, 0.84 $l \cdot s^{-1}$ more than the average (15.97%), minimum – 4,5 $l \cdot s^{-1}$, less than average at 0,76 $l \cdot s^{-1}$ (16,89%).

The indicator of reversible dynamometry noted an error in the execution of a given muscular effort of 15 kg, which was on average 1,03±0,162 kg, maximum – 2 kg (10%), minimum – 0,3 kg (1,5%).

Athletes aged 15–16 years were examined according to the method of measuring the effect of the training action (Table 3).

In the first period of the test, the average indicators were observed as follows: pace – 32±2,05 beats, total points – 245±14,69, accuracy – 7,65±0,44 points; maximum: pace – 39 beats, the number of points for all movements – 280, accuracy – 7,18 points; minimum: tempo – 23 beats, total points – 162, accuracy – 7,04 points.

The maximum indicator was more than the average rate of 7 hits (21,88%), the sum of points – by 35 (14,29%), the accuracy decreased by 0.5 points (6,55%); minimal: less than the average pace by 9 beats (39,13%), total points – by 83 (51,23%), accuracy – by 0,61 points (8,66%).

Table 3

Survey results (rowing, boys 15–16 years old)

		Indicators	M±m	M_{max}	M_{min}	σ	A
Effect of a training action	First period	Pace (number of beats)	32±2,05	39	23	6,49	20,29
		Total points	245±14,69	280	162	46,43	18,95
		Accuracy (points)	7,65±0,44	7,18	7,04	1,40	18,01
	Second period	Pace (number of beats)	142±6,22 (35,5±1,555)	164 (41)	105 (26,25)	30,84	21,72
		Total points	1050±52,50 (262,5±13,125)	1182 (295,5)	824 (206)	165,91	15,80
		Accuracy (points)	7,39±0,32	7,21	7,84	1,01	13,43
	Third period	Pace (number of beats)	37±3,08	42	27	9,74	26,33
		Total points	262±6,16	314	212	19,48	7,44
		Accuracy (points)	7,30±0,39	7,48	5,35	1,23	16,86
	Total	Pace (number of beats)	211±13,25 (35,17±2,208)	245 (40,83)	156 (25,83)	41,88	19,85
		Total points	1556±54,35 (259,5±9,058)	1776 (296)	1199 (199,67)	266,56	17,13
		Accuracy (points)	7,42±0,34	7,25	7,69	1,09	14,48
Tests	EMR (s)	Sound	0,170±0,01	0,250	0,150	0,032	19,10
		Light	0,194±0,006	0,225	0,170	0,019	0,595
	PT ($l \cdot s^{-1}$)	Inhale	6,4±0,266	7,6	5,0	0,84	13,19
		Exhale	5,9±0,29	7,3	4,5	0,91	15,41
	DM_{rev} (kg)		1,77±0,560	2,0	0,5	1,29	73,4

Remark. *The data in brackets are given to a single time indicator of 15 s, in particular, 142±6,22 (35,5±1,555).*

In the second test period, the average values: tempo – 35,5±1,555 beats, total points – 262,5±13,125, accuracy – 7,39±0,32 points; maximum: pace – 41 beats, the sum of points – 295,5, which is more than the average, by 5,5 beats (15,49%) and 33 points (12,57%), the accuracy is less than the average by 0,18 points (2,49%); minimum: the pace is 26,25 beats, the sum of points is 206, which is less than the average, respectively, by 9,25 beats (35,24%) and 56,5 points (27,43%), the accuracy is higher than the average by 0,45 points (6,09%).

In the third test period on average: the pace – 37±3,08 beats, the sum of points – 262±6,16, the accuracy – 7,30±0,39 points; maximum: pace – 42 beats, total points – 314, accuracy – 7,48 points; minimum: pace – 27 hits, total points – 212, accuracy – 5,35 points. The best result was observed more than the average pace by 5 hits (13,51%), the sum of points – by 52 (19,85%), accuracy – by 0,18 points (2,47%), the worst – less than the average pace by 10 beats (37,04%), total points – by 50 (23,58%), accuracy – by 1,95 points (36,45%).

The sum of the three periods was observed on average: the pace – 35,17±2,208 hits, the sum of points – 259,5±9,068, the accuracy – 7,42±0,34 points; maximum: pace – 40,83 beats, total points – 296, accuracy – 7,25 points; minimum: tempo – 25,83 beats, total points – 199,67, accuracy – 7,69 points. The best indicator was more than the average pace by 5,66 beats (16,09%), the sum of points – by 36,5 (14,07%) and less in accuracy of movements by 0,17 points (2,34%), the worst – less than average in pace by 9,34 points (36,16%), total points – by 59,83 (29,94%) and more in accuracy of movements by 0,27 points (3,64%).

In the first period of the test, a rather high level was noted, when compared with our other observations, the pace of movements, the number of points scored for all motor actions, the accuracy of one movement.

In the second period of the test of measuring the effect of the training action, compared with the first period, the average pace increased by 3,5 beats (10,94%), the amount – by 17,5 points (7,14%), the accuracy decreased by 0,25 points (3,52%); at the maximum – the pace increased by 2 beats (5,13%), the amount – by 15,5 points (5,54%), accuracy – by 0,03 points (0,42%); at the minimum – the pace increased by 3,25 beats (14,13%), the amount – by 44 points (27,16%), accuracy – by 0,8 points (11,36%).

In the third period of the test, compared with the first and second periods, respectively, increased the mean value – pace of 5 beats (15,63%) and 1,5 beats (4,23%), the amount – at 17 points (6,94%) and did not change, the accuracy decreased by 0,35 points (4,79%) and 0,09 points (1,23%); maximum – the pace increased by 3 beats (7,69%) and 1 beats (2,44%), the amount – by 34 points (12,14%) and by 18,5 points (6,96%), accuracy – by 0,3 points (4,18%) and 0,27 points (3,74%); minimum – the pace decreased by 4 beats (17,39%) and 0,75 beats (2,86%), the amount – by 50 points (30,86%) and 6 points (2,91%).

Athletes aged 15–16 years old who are practicing rowing, on average, maintained a good level of pace during testing, which gradually increased by more than 15%, the total points gained increased by 7%, but the accuracy decreased by 5%; according to the best indicators, the pace increased slightly less – 8%, the amount of points – by 12%, accuracy – by 4%; at worst – the pace increased by 17%, the amount of points – by 30%, accuracy – by 3%.

Sensomotor reactions to the sound signal ranged from 0,170±0,01 s with a minimum time of 0,150 s, a difference of 0,020 s (13,33%), a maximum of 0,250 s, a difference of 0,080 s (47,06%); the light signal is 0,194±0,006 s with a minimum time of 0,170 s, the difference is 0,024 s (14,12%), the maximum is 0,225 s, the difference is 0,031 s (15,98%).

The result of pneumatic tachometer inhalation was on average 6,4±0,266 l·s^{-1}, maximum – 7,6 l·s^{-1} , which is 1,2 l·s^{-1} (18,75%), minimum – 5,0 l·s^{-1} , less by 1.4 l·s $^{-1}$ (28.00%); on expiration, the average result is 5,9±0,29 l·s^{-1}, maximum – 7,3 l·s^{-1} , more by 1,4 l·s^{-1} (23,73%), minimum 4,5 l·s^{-1}, less by 1,4 l·s^{-1} (31,11%).

The reverse dynamometry test showed an average error when performing an exercise of 1,77±0,560 kg (8,85%), the maximum error was 1,0 kg (5%), the minimum error was 0,5 kg (2,5%).

The results of a survey trains in rowing young men aged 17–18 years, are presented in table 4.

In the first period of the test of measuring the effect of the training action, the average pace was 31,7±0,68 beats, the number of points scored for all movements at a certain time was 247±5,42 points, and the accuracy was 7,79±0,18 points. The maximum result: the pace – 40 beats, the sum – 285 points, the accuracy – 7,12 points, which is more than the average – by the pace of 8,3 beats (26,18%) and the sum – by 38 points (15,38%) , and the accuracy of motor actions is less by 0,67 points (9,41%); minimum: pace – 22 beats, total – 175 points, accuracy – 7,95 points, which is less than the average – in terms of 9,7 beats (44,09%), total – by 72 points (41,14%), and accuracy is above average value by 0,16 points (2,05%).

In the second period, the average indicators were: pace – 34±1,448 beats, total – 250,25±7,055 points, accuracy – 7,36±0,29 points; the maximum indicator is 8,5 times more than the average pace (25,00%), the sum is 54 points (21,58%), the accuracy is less than 0,2 points (2,79%); the minimum is less than the average pace by 11 beats (47,83%), the amount is 68.75 points (1,38%), the accuracy is 0,53 points higher (7,21%).

In the third period, the average values: pace – 36,5±1,34 beats, the sum – 253±10,99 points, accuracy – 6,93±0,44 points; maximum: pace – 44 beats, the sum – 308 points, accuracy – 7,01 points, which is more than the average – by the rate of 7,5 points (20,55%), the amount – by 55 points (21,74%) of accuracy – 0,08 point (1,15%); minimum: pace – 26 beats, sum – 160 points, accuracy – 6,15 points, which is less than the average – by pace by 10,5 beats (40,38%), sum – by 93 points (58,31%), accuracy – 0,78 point (12,68%).

Over the three periods, the total average results: pace – 34,03±1,288 beats, total – 251,8±5,183 points, accuracy – 7,36±0,33 points; maximum result: the pace is 42,33 beats and the sum is 301 points, which is 8,3 hits (24,39%) and more than the average, and 49,2 points (19,54%), however, the accuracy is less than 0,25 points (3,52%); the minimum result: the pace – 23,33 beats and the amount – 176,8 points, which is less than the average, respectively, by 10,7 beats (45,86%) and 75 points (42,42%), and the accuracy – 7,58 points higher than average by 0,22 points (2,99%).

The level of functional preparedness in athletes of this age group, sports specialization and qualification is characterized by indicators of pace, total points, accuracy of motor actions, as well as dynamic changes during all testing periods according to the method of measuring the effect of a training action. In the second period compared to the first in average, the pace increased by 2,3 beats (7,26%), the amount – by 3,25 points (1,32%), the accuracy decreased by 0,43 points (5,84%); at the maximum – the rate increased by 2,5 beats (6,25%), the amount – by 19,25 points (6,75%), the accuracy – by 0,04 points (0,56%); at the minimum – the pace increased by 1 hit (4,55%), the amount – by 6,5 points (3,71%), and the accuracy decreased by 0,06 points (0,76%); in the third period, compared with the first and second, respectively, average values – the pace increased by 4.8 beats (15,14%) and 2,5 beats (7,35%), the amount – by 6 points (2,43%) and 2,75 points

Table 4

Survey results (rowing, boys 17–18 years old)

		Indicators	M±m	M_{max}	M_{min}	σ	A
Effect of a training action	First period	Pace (number of beats)	31,7±0,68	40	22	2,31	7,27
		Total points	247±5,42	285	175	21,03	8,52
		Accuracy (points)	7,79±0,18	7,12	7,95	0,71	8,93
	Second period	Pace (number of beats)	136±5,79 (34±1,448)	170 (42,5)	92 (23)	22,48	16,52
		Total points	1001±28,22 (250,25±7,055)	1217 (304,25)	726 (181,5)	109,50	10,94
		Accuracy (points)	7,36±0,29	7,16	7,89	1,14	15,12
	Third period	Pace (number of beats)	36,50±1,34	44	26	5,19	14,21
		Total points	253±10,99	308	160	42,65	16,85
		Accuracy (points)	6,93±0,44	7,01	6,15	1,71	23,53
	Total	Pace (number of beats)	204,2±7,73 (34,03±1,288)	254 (42,33)	140 (23,33)	30,00	14,69
		Total points	1511±31,10 (251,8±5,183)	1810 (301)	1061 (176,8)	120,70	7,99
		Accuracy (points)	7,36±0,33	7,11	7,58	1,27	16,80
Tests	EMR (s)	Sound	0,166±0,009	0,211	0,132	0,028	16,69
		Light	0,201±0,006	0,241	0,178	0,020	10,18
	PT (l·s^{-1})	Inhale	6,17±0,257	7,10	4,60	0,81	13,15
		Exhale	5,73±0,363	7,00	5,46	1,15	20,05
	DM_{rev} (kg)		1,59±0,20	2,16	0,66	0,73	46,11

Remark. *The data in brackets are given to a single time indicator of 15 s, in particular, 136±5,79 (34±1,448).*

(1,09%), however, the accuracy decreased by 0,86 points (12,41%) and 0,43 points (6,21%); maximum – the pace increased by 4 beats (10,00%) and by 1,5 beats (3,53%), the amount – by 23 points (8,07%) and by 3,75 points (1,23%), accuracy decreased by 0,11 point (1,57%) and 0,15 point (2,14%); the minimum ones – the pace increased by 4 beats (18,8%) and 3 beats (13,04%), the amount decreased by 15 points (9,38%) and 21,5 points (13,44%), as well as accuracy by 1,8 points (29,27%) and 1,74 points (28,29%).

Athletes of 17–18 years old, specializing in rowing, in the test of measuring the effect of a training action showed, by average values, a gradual increase in the rate of movement from the first to the third period by 15%, the total points by 3%, but a decrease in accuracy to 10–12 was observed %; at maximum – an increase in pace by 10%, the sum of points – by 8%, accuracy – by 2%; at minimum – an increase in pace by 18%, a decrease in the amount of points by 13% and accuracy – up to 29%.

Sensomotor reactions were noted at the level: on average, a sound stimulus – 0,166±0,009 s, the best indicator – 0,132 s, less than the average by 0,034 s (25,76%), the worst – 0,211 s, more than the average by 0,045 s (27,11%); on average, the light stimulus is 001±0,006 s, the best result is 0,178 s, less than the average by 0.023 s (12,92%), the worst – 0,241 s, more than the average by 0.04 s (19,90%).

Indicators of pneumotachometry on inspiration were observed within 6,17±0,257 $l \cdot s^{-1}$, maximum – 7,10 $l \cdot s^{-1}$, which is more than the average by 0,93 $l \cdot s^{-1}$ (15,07%), minimum – 4,60 $l \cdot s^{-1}$, less than the average by 1.57 $l \cdot s^{-1}$ (34,13%); on the exhale – 5,73±0,363 $l \cdot s^{-1}$, maximum – 7,00 $l \cdot s^{-1}$, 1,27 $l \cdot s^{-1}$ more than the average (22,16%), minimum – 5,46 $l \cdot s^{-1}$, less than average at 0,27 $l \cdot s^{-1}$ (4,95%).

In the reverse dynamometry test, the average reproduction error of a given force of 20 kg was 1,59±0,20 kg (7,95%), the maximum – 2,16 kg (10,80%), the minimum – 0,66 kg (3,30%).

When comparing the results of the survey of young men specializing in rowing, the following results were obtained in the test of measuring the effect of the training action.

In the first period of the test, which reflects the body's ability to quickly start work, from the youngest to the older group, the average rate increased by 12,28%, the sum of points – by 16,04%, the accuracy – by 6,59%; at the maximum value they increased: the rate – by 29.03%, the sum of points – by 17,28%, the accuracy – by 10,81%; on the minimum value increased: the pace – by 4,55%, the amount of points – by 10,49%, the accuracy – by 12,93%.

In the second period of the test, which determines the functional state of the body if possible to perform long-term work, the pace increased by 6,77%, the amount of points increased by 7,16%, and the accuracy increased by 7,46%; at the maximum value, the rate increased by 11.84%, but the sum of points decreased by 12,21% and the accuracy by 20,81%; at the minimum – the rate decreased by 17,39%, the amount of points – by 17,36%, the accuracy practically did not change, the difference was 0,51%.

In the third test period, which characterizes the body's ability to continue working after prolonged physical exertion, the pace increased by an average of 8,82%, the sum of points increased by 9,81%, the accuracy rose by 9,52%, and the maximum value increased by 12,82%, the sum of points practically did not change, the difference was 2,61%, the accuracy of movements from the younger to the older group decreased by 11,98%; at the minimum – to the older group, the rate decreased by 12,00%, the amount of points increased by 25,62%, the accuracy changed from 8,22% to 38,86%.

In terms of the total test score, which characterizes athletic ability, on average, the highest values of the pace of movement were observed in 15–16-year-old athletes (third group), the lowest – among 13–14-year-old athletes (second group), the difference was 6,58%; 11–12-year-old athletes had the lowest score (the first group), a little more – by 8,23% among the fourth group of athletes (17–18 years old), even more – by 9,18% among the rowers in the second group and the big one – among the athletes of the third group, the difference was 26,85 points (11,54%); the accuracy of movements is the smallest – in athletes of the first group, in the second – the biggest, the difference is 7,41%, slightly less accurate in the third group – 3,63% and even less in the fourth group – 2,79%. In terms of maximum values, the lowest rate among the first group of rowers is gradually increasing and the biggest among the fourth group athletes, the difference is 14,41%, the sum of points is the highest in the first group, the others are smaller, the difference is 5,91%, the accuracy of movements is the same trend, the difference was 18,57%; on the minimum – low rate in the fourth group and high in the first, the difference was 13,59%, the sum of the points was the smallest in the fourth group, in the others about the same level, the difference was 12,94 (4,95%).

When analyzing sensorimotor reactions, there was a clear tendency for a decrease in average response time to a sound stimulus from the younger group to the elder one, the second to the first – 13,74%, the third to the second – 7,06%, the fourth to the third – 2,41%, the total the difference is 24,69%; according to the best results, the difference was 19,62%, for the worst – 18,48%. The same directionality of the reaction to the light stimulus – the average reaction time gradually decreases, the difference was 19,59%, at the best fluctuations – 19,62%, at the worst – 20,89%.

The index of pneumotachometer on inspiration gradually increased from the second group to the first by 6,79%, from the third to the second – by 13,07% and slightly decreased from the fourth to the third by 3,73%; on the exhale, the air flow rate also increases, respectively, by 1,94%, 12,17% and decreases slightly by 2,97%. The difference in all age groups for maximum and minimum values does not have a clear focus and is not reliable.

The average error of muscular effort in the test of reverse dynamometry was the lowest among athletes of the second group, less than the first – by 0,47 kg (2,34%), the third – 0,74 kg (3,70%), and the fourth – 0,56 kg (2,80%), by the minimal error the best result in the first and in the second groups, slightly worse in the third – by 0,2 kg (1,00%) and the fourth – 0,36 kg (2,80%), the maximum error was actually the same in all groups – 2–2,3 kg (10–11,5%).
Features of the reaction of the body of athletes are a manifestation of effective individual adaptation to intense and complex stimuli of training and competitive activity.

In determining the functional state of athletes, a comprehensive analysis of the level of development of various physical qualities, coordination abilities, properties of the nervous system is necessary, which allow you to specifically choose sports specialization, since for each particular sport is characterized by the optimal combination of the above factors. Insufficient development of some of these may be offset by other factors, but the fundamental importance are some indicators that determine suitability for employment by the sport that cannot be compensated at all.

Conclusions / Discussion

The results of our research on the method of measuring the effect of the training action developed by us and the proposed parameters for determining the reaction rate to sound and light stimuli, measuring the air flow rate during inhalation and exhalation, accuracy of muscular effort in terms of various levels – average, maximum, minimum – made it possible to study the functional state athletes to determine the prospects of training in their favorite sport.

The optimal structure of sports activities contributes to the improvement of all its components, which in the early stages and due to the age characteristics of athletes, as well as the patterns of development of motor skills do not significantly affect the level of results, however, have a great impact on the appearance of the corresponding functional basis, especially in the early age periods maximize the realization of individual capabilities.

The proposed tests for measuring the effect of the training action, electromyoreflexometry, pneumotachometry and reverse dynamometry are sufficiently informative in sports practice and allow us to determine and evaluate the individual prerequisites for sporting achievements.

The obtained parameters of the functional state allow you to identify the individual characteristics of the athlete's body, the possibility of their correction and management of the training process.

Conducted comprehensive surveys of the psycho-physiological and functional characteristics of the body of athletes rowers allow you to create methods for assessing the prospects of athletes in their chosen sport.

Prospects for further research. On the basis of new information about the developmental characteristics of the ontogenesis of the corresponding psycho-physiological and motor mechanisms, develop a methodology for their improvement with the help of special training loads

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References

1. Platonov, V.N. (2005), *Sistema podgotovki sportsmenov v olimpiyskom sporte* [System Preparation athletes in the Olympic dispute], Sovetskiy sport, Moscow. (in Russ.)
2. Anohin, P.K. (1975), *Ocherki fiziologii funkcional'nyh sistem* [Essays on the physiology of functional systems], Medicina, Moscow. (in Russ.)
3. Gunina, L., & Cherednychenko, O. (2012), "Assessment of the combined effect of nontraining facilities on the indicators of special working capacity and homeostasis parameters of qualified rowers", Teoriia i metodyka fizychnoho vykhovannia i sportu, No. 2, pp. 103-107. (in Ukr.)
4. Rovnyi, A.S. (2015), "Features of the functional activity of kinesthetic and visual sensory systems in athletes of various specializations", *Slobozans`kij naukovo-sportivnij visnik*, No. 1 (45), pp. 104-108, doi: 10.15391/snsv.2015-1.020.
5. Platonov, V.N., & Bulatova, M.M. (2005), *Fizychna pidgotovka sportsmena* [Physical training of an athlete System], Olimpiiska literatura, Kiev (in Ukr.)
6. Druz, V.A., Omelchenko, M.V., & Omelchenko, D.A. (2015), "Basics of sprint running technique", *Slobozans`kij naukovo-sportivnij visnik*, No. 3 (47), pp. 41-46, doi: 10.15391/snsv.2015-3.007. (in Russ.)
7. Vinohradov, V. (2006), "Effectiveness of extra-curricular means, aimed at increasing the implementation of anaerobic potential in a series of unidirectional training sessions of qualified rowers", *Teoriia i metodyka fizychnoho vykhovannia i sportu*, No. 4, pp. 57-62. (in Ukr)
8. Dal-Monte, A. (1995), "Special requirements for assessing the functionality of athletes", *Nauka v olimpiyskom sporte*, No. 1, pp. 30-38. (in Russ.)
9. Turevskiy, I.M. (2009), "Extreme conditions as a factor of adaptation of young athletes to the motor", *Materials of the First International Scientific and Practical Conference: Gifted in Sporting and Extreme Activities*, Moscow. (in Russ.)
10. Rovnyi, A.S., & Rovnyi, V.A. (2012), "Psychosensory correlates as a mechanism for controlling precise human movements", *Symposium "Features of formation and formation of psychophysiological functions of a person in ontogenesis"*, pp. 73-74. (in Ukr.)
11. Kamaiev, O.I. (2017), "Structural features and characteristics of the process of training an athlete as a system object", *Slobozans`kij naukovo-sportivnij visnik*, No. 1 (57), pp. 41-48, doi: 10.15391/snsv.2017-1.007. (in Russ.)
12. Malikov, M.V., Bohdanovska, N.V, & Svatiev, A.V. (2006), *Funktsionalna diahnostyka v fizychnomu vykhovanni ta sporti* [Functional diagnostics in physical education and sports], Zaporizhzhia. (in Ukr.)
13. Laputyn, A.M. Hamalii, V.V., & Arkhypov, O.A. (2005), *Biomekhanika sportu* [Biomechanics of sport], Olimpiiska literatura, Kiev. (in Ukr.)
14. Bogush, V.L., Getmantsev, S.V., Sokol, O.V., Reznichenko, O.I., Kuvaldina, O.V. & Yatsunskiy Ye.A. (2015), "Rowing sportswomen motor actions formation", *Slobozans`kij naukovo-sportivnij visnik*, No. 4(48), pp. 19-25, doi: 10.15391/snsv.2015-4.003 (in Russ.)

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Information about the Authors

Volodymyr Bogush: *PhD (Medicine), Associate Professor; Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*
ORCID.ORG/0000-0002-7178-6165
E-mail: toops@ukr.net

Sergiy Getmantsev: *PhD (Biology), Associate Professor; V. Sukhomlynskiy Nikolaev National University: Nikolskaya str. 24, Mykolayiv, 54030, Ukraine.*
ORCID.ORG/0000-0003-1829-9832
E-mail: s.v.getmantsev@rambler.ru

Olga Kuvaldina: *PhD (Physical Education and Sport), Associate Professor; Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*
ORCID.ORG/0000-0002-3402-2369
E-mail: olga.kuvaldina@nuos.edu.ua

Oleksandr Kosenchuk: *Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*
ORCID.ORG/0000-0001-9235-3409
E-mail: kosenchuk_1980@ukr.net

Yevgen Yatsunskiy: *Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*
ORCID.ORG/0000-0001-7450-252X
E-mail: lily0210837@gmail.com