

Programming modes of training sessions of qualified Kayakers who specialize in the distance of 1000 m

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Abstract:

A basic mesocycle program was developed for athletes specializing in the distance of 1000 m in kayaking, the program included structural, target, content and criterion-evaluation blocks. The basis of the program was the use of 14 models of training sessions, developed taking into account the features and characteristics of overcoming the competitive distance of 1000 m by qualified athletes in kayaking and canoeing. **The aim of the study.** Development and research of the effectiveness of the application of training programs for kayaking based on the modeling of load modes, taking into account the features and characteristics of overcoming the competitive distance of 1000 m by qualified athletes. **Material and methods:** 16 athletes (19-23 years) in canoeing from Shandong and Jiangxi provinces. **Results.** Conducted studies on the effectiveness of the developed program confirm data on its reliable advantage, compared to a traditional training program. After completing the program, statistically significant differences ($p < 0.05$) were recorded in the athletes of the BGK compared to the athletes of the CGK, according to the ergometric performance indicators in the 90-second test, they were 260.25 ± 13.59 W ($\bar{x} \pm S$), and 213.0 ± 15.9 W ($\bar{x} \pm S$) respectively. Statistically significant differences ($p < 0.05$) in indicators of ergometric work power, at which the level of maximum oxygen consumption reached when performing the step test, were recorded: BGK 221.87 ± 16.89 W ($\bar{x} \pm S$), and CGK 188.5 ± 17.51 W ($\bar{x} \pm S$) respectively. Thus, the application of the developed program made it possible to increase the effectiveness of the training process of athletes who specialize in the distance of 1000 m in kayaking. **Conclusion.** The application of the developed program made it possible to increase the effectiveness of the training process of athletes who specialize in the distance of 1000 m in kayaking.

Keywords. Kayaking, the distance of 1000 m, the training program, special performance.

Introduction.

The typical individual performance times for men and women have been approximately 210 s for the 1000-m, respectively. Canoeing and Kayaking are classified as event requiring mixed anaerobic lactic energy production, as well as great aerobic capacity and endurance; such reactions of energy production prevail in 1000 m event, during races, energy is supplied via the anaerobic and aerobic pathways, with aerobic metabolism contributing - $82 \pm 5.0\%$ for the 1000-m event (Alacid F. et al. (2004), Bishop D. et al. (2002), García-Pallarés J. et al. (2010), Gomes B. B. et al. (2012), Nekrišius R. et al. (2018), Dyachenko A. et al., (2020-2022)).

At the current stage, new approaches to the formation of programming have been created based on the use of system knowledge about modeling the distance of 1000 meters in kayaking. Significant changes are due to the results of a number of studies, in which, in particular:

- it has been proven that the programming of the training of kayakers is a complex technological process, which is based on the interrelationship and accounting of the structural components of training and competition management, where modeling plays a key role (Kong X. et al., (2018-2021)).
- the possibility of the interaction of functional mechanisms that ensure the maintenance of a high level of special working capacity of kayaking athletes during the start segment, the middle and the second half of the competitive distance in the conditions of hidden (compensated) fatigue, during the performance of the final acceleration, which gave an impetus to the improvement of test load protocols is substantiated, which model the structure of various competitive distances in rowing, including the 1000 m distance in kayaking and canoeing (Dyachenko A.Yu., (2004); Tesch P.A., (1983); Fry R.W. et al., (1991); Bishop D., (2004); Bishop D. et al., (2015); Zamparo P. et al., (1999); Someren K.A. et al., (2008)).
- approaches have been developed to control and evaluate the effectiveness of the functional support of the special working capacity of rowers, based on the modeling of the characteristics of the power and capacity of aerobic and anaerobic energy supply, the reactions of the athlete's thoracic spine to the load, and indicators of

ergometric work capacity taking into account the chosen specialization at a distance of 1000 meters (Dyachenko A. et al., (2020-2022); Nekriošius R. et al., (2018); Garcia-Pallares J. et al., (2010)).

In connection with the need to take into account a large number of factors to increase the effectiveness of the functional support of the special working capacity of athletes in accordance with the structure of the competitive activity of 1000 m in kayaking; the scientific and methodological approaches to programming the training process have changed (Moroz, E.A. et al., (2016); López-Plaza D. et al., (2017-2018)).

The implementation of this approach is particularly relevant in kayaking, which differs significantly from the normative requirements for the functional preparedness of paddlers preparing for the main competitions and qualified kayakers specializing in distances of 1000 m (Pralay Majumdar. et al., (2017), Kozina Z. et al., (2019), Dyachenko A. et al., (2020-2022)).

The purpose of the study – Development and research of the effectiveness of the application of training programs for kayaking based on the modeling of load modes, taking into account the features and characteristics of overcoming the competitive distance of 1000 m by qualified athletes.

Methods:

- analysis and generalization of data from scientific and methodological literature sources and the Internet.

- pedagogical observations.

- instrumental research methods using ergometry, gas analysis, pulsometry, biochemical research methods. Modern means of registration of reaction of cardiorespiratory system and energy supply are applied: gas analyzer “Oxycon mobile” (Jaeger), sports tester “Polar”, laboratory complex for determination of blood lactate “Biosen S. line lab+”, ergometer “Dansprint”;

- methods of mathematical statistics. Methods for calculating the arithmetic mean were used – $\bar{M}$, Standard Deviation – SD, as well as indicators of individual differences – coefficient of Variation V. Determination of model parameters of indicators of reaction of cardiorespiratory system, energy supply and special working capacity is based on a statistical method – rules of three sigma. Processing of experimental material was carried out using integrated statistical and graphical packages MS Excel–7, Statistica–10.

The research involved 16 athletes (19-23 years) in kayaking from Shandong and Jiangxi provinces (PRC).

The composition of test tasks included the formed conditions of realization of structure of energy supply of kayakers according to structure of special working capacity of kayakers on competitive distance of 1000 m:

- “test 10 s” – the load forms the conditions for the realization of the start, taking into account the mobilization of power and capacity of anaerobic lactate energy supply;

- “test 30 s” – the load forms the conditions for the realization of the capacity and capacity of anaerobic lactate and lactate (glycolytic) energy supply in accordance with the initial part of the competitive distance of 1000 m;

- step-increasing load (step test): the first step is the ergometric power of work in accordance with the coefficient determined for men - kayakers, at the level of 1.6 (coefficient * body weight). The increase in ergometric power on each step of work is 20 W, the duration of work on the step is 2 minutes. The work is performed to failure (inability to maintain ergometric power of work on the step). Features of functional training of qualified and especially highly qualified rowers for the kinetics of the cardiorespiratory system and aerobic energy supply. The load forms the conditions for the realization of body functions in terms of modeling the intensity of competitive activity. The period of reaching a steady state (Plateau) of consumption of O_2 , HR, V_E/CO_2 is analyzed;

- Critical power operation: acceleration for 90 s – “test 90 s”. It is used to model the conditions of realization of power and capacity of anaerobic energy supply according to the second half of the distance of 1000 m against the background of increasing fatigue (performed one minute after performing the step-increasing test performed according to the VO_2 max registration protocol).

Used the following research equipment:

1. To record the indicators of special performance and functionality of athletes, was used gas analyzer Oxycon mobile (Jaeger).

2. Sports tester "Polar" with the function of telemetric registration of HR during loading and the HR-analyzer for computer data processing.

3. Laboratory complex for determination of blood lactate Biosen S. line lab+. Blood sampling was carried out by specialists of the Institute of Research in Sports province Shandong, Jinan city. The obtained data were used and analyzed in accordance with the objectives of this work.

4. To standardize the measurements of special performance, was used rowing ergometer “Dansprint”. Current and average indicators of ergometric power of work, calculated indicators of time of overcoming of segments of distance were registered. “Drag factor” (the coefficient of resistance of the ergometer during rowing movements) was selected according to the weight parameters and individual style of rowing of the athlete.

Results.

Based on the modelings of the modes of training work in the process of overcoming the competitive distance of 1000 m by qualified athletes, a basic mesocycle program was developed for athletes who specialize in the distance of 1000 m in kayaking, the program included structural, target, content and criterion-evaluation blocks.

Table 1 presents the program of the basic mesocycle (duration of 30 days), formed taking into account the specialized orientation, for athletes of different typological groups in kayaking using the developed MTS (Mode of Training Sessions).

Table 1

The program of the basic mesocycle using the developed MTS for athletes of different typological groups in kayaking

Basic mesocycle program					
Structural block	Retractable microcycle *	Impact microcycle **	Impact microcycle ***	Restorative microcycle (3 days)	Control-preparatory microcycle (6 days)
Target block (main tasks)	Improvement of rowing technique; development of aerobic energy supply capacity; development of special forces; modeling of remote work in segments lasting up to 30 seconds in auxiliary training sessions to aerobic sessions.	Improving the technique of rowing in remote mode; increasing the efficiency of the start; development of special forces; modeling of the passage of starting acceleration and the average-stationary segment of the distance, the transition from starting work to remote speed (in transient energy supply modes)	Improvement of rowing technique in conditions of increasing fatigue; modeling of passing the second half of the competition distance and final acceleration (in transient energy supply modes)	Increasing the coordination of work in team boats and individual adjustment of the technique of movements in singles. Reduction of volume and intensity of loads; restorative measures; maintenance of special capacity; modeling of remote work in segments lasting up to 90 seconds in auxiliary training sessions for aerobic sessions;	Working out an individual technical and tactical model of passing a distance of 1000 meters in singles and team boats; decrease in volume and intensity of loads; restorative measures
Content block (MTS)	MTS 1-MTS 3	MTS 4-MTS 8	MTS 9-MTS 12	MTS 5-MTS 6	MTS 1, MTS 2, MTS 13, MTS 14
Criterion-evaluation block (tests)	Determination of the average work power in a 10-second maximum test, W10s, W	Determination of the average work power in the 30-second maximum test, W30s, W	Determination of the average work power in the 90-second maximum test, W90s, W	-	Control passing of the competitive distance

Commentary: *- one session with a heavy load during the microcycle;

** - three sessions with a heavy load during the microcycle;

*** - four sessions with a heavy load during the microcycle.

The basis of the program was the application of 14 models of training regimes, developed taking into account the features and characteristics of overcoming a competitive distance of 1000 m by qualified athletes in kayaking (Table 2).

Table 2

Characteristics of training load modes, which are aimed at improving the efficiency of the functional support of special working capacity, athletes who specialize in the distance of 1000 m in kayaking

MTS	Specialized orientation	Intensity parameters	Criteria determining the beneficial immediate training effect of MTS	
			Characterization of the reactions of the sportsman's cardiorespiratory system under the influence of load	Changes in the level of a rower's special working capacity under the influence of load
MTS 1	The development of rapid reaction kinetics of the cardiorespiratory system in accordance with the conditions for overcoming the initial segment of the distance	Average work power registered in a 10-second maximum test, W10s, W	Increase in HR during acceleration	Increase in performance indicators during acceleration
MTS 2		The average work power registered in the 30-second maximum test, W30s, W		
MTS 3	The development of rapid reaction kinetics of the cardiorespiratory system in accordance with the conditions for overcoming the initial segment of the distance		Achievement of individual indicators of HR aerobic threshold and growth of HR during acceleration	Increase in performance indicators during acceleration
MTS 4	The development of the kinetics of cardiorespiratory system reactions according to the anaerobic-aerobic transition in the conditions of overcoming the initial segment		Increase in HR during acceleration	Maintenance of power for 30 s.

	of the distance			
MTS 5	Development of the capacity of anaerobic energy supply in accordance with the conditions for overcoming the average stationary segment of the distance of 1000 m (MTS 6 - with an emphasis on increasing the speed of lactate removal from working muscles)	The average work power registered in the 90-second maximum test, W90s, W	Increase in HR during acceleration	Maintenance of power for 30 s
MTS 6			Gradual increase and maintenance of stable values of HR, gradual decrease of HR when transitioning to work of moderate intensity	Maintenance of power for 90 s
MTS 7	The development of the capacity of aerobic energy supply and the formation of the VO ₂ max "plateau" in accordance with the conditions for overcoming the average stationary segment of the distance of 1000 m.	Work power at the level of VO ₂ max, registered under conditions of step-increasing load, W VO ₂ max, W	Increase in HR during acceleration	Increase in performance indicators during acceleration for 90 s
			Maintenance of stable values of HR	Maintenance of power for 30 s
MTS 8			Increase in HR during acceleration	An increase in performance indicators during acceleration of 120 s
			Maintenance of stable values of HR	Maintenance of power for 30 s
			Increase in HR during acceleration	Maintenance of power for 60 s
MTS 9	Development of stability and power of aerobic energy supply in conditions of hidden (compensated) fatigue in the second half of the 1000 m distance	Aerobic (ventilator) threshold heart rate ± 5 beats·min ⁻¹	Maintenance of stable values of HR	Maintenance of power for 240 s
MTS 10			Increase in HR during acceleration	An increase in performance indicators during acceleration for 30 s, then a gradual decrease
MTS 11		Heart rate of the aerobic (ventilator) threshold ± 5 beats·min ⁻¹ , work power at the level of VO ₂ max, registered under conditions of step-increasing load, W VO ₂ max, W	Increase in HR during acceleration	An increase in performance indicators during acceleration for 30 s, then a gradual decrease
MTS 12	Development of the capacity of anaerobic energy supply in accordance with the conditions for overcoming the distance of 1000 m	The average work power registered in the 90-second maximum test, W90s, W	Increase in HR during acceleration	Maintenance of power for 30 s, 45 s, 60 s
MTS 13	Realization of individual tactical scheme for overcoming the distance of 1000 m.	The average work power registered in the 30-second maximum test, W30s, W	Increase in HR during acceleration	Maintenance of power for 150 s
MTS 14		Average work power registered in the 30-second maximum test, W30s, W and in the 90-second maximum test, W90s, W	Increase in HR during acceleration	Maintenance of individual power levels for 120 s

To determine the effectiveness of the developed program, two groups of athletes were formed: BGK (the basic group of kayakers), n = 8, which used the modes of training sessions according to the author's program in the training process, and a control group of athletes - CGK (the control group of kayakers), n = 8. The initial indicators of the studied parameters in the athletes of the formed groups did not differ statistically significantly ($p > 0.05$).

Table 3 presents the individual and average group indicators of the functional support of the special working capacity of qualified kayakers (BGK and CGK) who specialize in the distance of 1000 m. The table shows that before the application of the author's program, the power characteristics (La max 30 s) and capacity (La max 90 s) of anaerobic energy supply, performance indicators recorded in 10-s and 30-s tests had no significant differences ($p > 0.05$).

Table 3

Indicators of functional support of special performance of qualified kayakers specializing in a distance of 1000 m, before the use of MTS (N = 16), $p < 0.05$

Athletes	W10s, W	W30s, W	La max 30 s, mmol·l ⁻¹	La max 90 s, mmol·l ⁻¹	W10s, W	W30s, W	La max 30 s, mmol·l ⁻¹	La max 90 s, mmol·l ⁻¹
	Indicators to execute the program							
	BGK				CGK			
1	368	398	9.85	15.8	461	378	7.63	14.42
2	498	491	12.38	18.45	474	423	9.22	12.98

3	412	354	9.3	15.39	441	357	11.01	15.08
4	484	391	9.05	13.38	368	328	9.5	13.93
5	457	350	11.57	14.89	470	443	10.79	14.26
6	447	440	9.54	14.26	469	397	8.6	15.32
7	497	424	11.33	14.79	467	429	7.83	13.7
8	421	321	8.06	13.04	384	333	8.64	13.93
$\bar{X} \pm S$	448.0 $\pm$ 45.83	396.12 $\pm$ 55.13	10.13 $\pm$ 1.47	15.0 $\pm$ 1.68	441.75 $\pm$ 42.02	386.0 $\pm$ 37.0	9.15 $\pm$ 1.24	14.20 $\pm$ 0.75
Me (25 % / 75%)	452.0 (416.5/490.5)	394.5 (352.0/432.0)	9.69 (9.17/11.45)	14.84(13.82/ 15.59)	464.0 (412.0/469.5)	387.5 (345.0/426.0)	8.93 (8.21/10.14)	14.09(13.81/ 14.75)
Min	368.0	321.0	8.06	13.04	368.0	328.0	7.63	12.98
Max	498.0	491.0	12.38	18.45	474.0	443.0	11.01	15.32

Commentary: * - The differences are reliable at $p < 0.05$

After implementing the program at the BGK athletes relative to the SGK athletes, a tendency to increase by ergometric load in 10-second test was recorded, the registered indicators were, 469.12 $\pm$ 38.9 W ($\bar{X} \pm S$) and 441.37 $\pm$ 38.35 W ($\bar{X} \pm S$).

Table 4

Indicators of functional support of special performance of qualified kayakers specializing in a distance of 1000 m, after applying MTS (n = 16), $p < 0.05$

Athletes	Indicators after execution of the program							
	BGK				CGK			
	W10c, W	W30 s, W	La max 30 s, mmol·l ⁻¹	La max 90 s, mmol·l ⁻¹	W10s, W	W30s, W	La max 30 s, mmol·l ⁻¹	La max 90 s, mmol·l ⁻¹
1	412	410	10.6	16.1	465	380	8.1	14.6
2	514	500	13.05	18.8	472	435	9.4	13.2
3	431	389	10.4	16.2	448	354	10.7	15
4	502	424	10.3	15.1	375	336	9.6	14.2
5	479	384	13.2	15.8	452	440	10.4	14.5
6	470	461	11.7	15.9	460	415	8.5	15.1
7	509	453	13.4	16.3	472	431	8.2	13.8
8	436	358	10.2	14.1	387	345	8.4	14.1
$\bar{X} \pm S$	469.12±38.9*	422.37±46.81	11.6±1.41*	16.03±1.33*	441.37±38.35	392.0±43.31	9.16±1.01	14.31±0.62
Me (25 % / 75%)	474.5 (433.5/505.5)	417.0 (386.5/457.0)	11.15 (10.35/13.12)	16.00(15.45/16.25)	456.0 (417.5/468.5)	397.5 (349.5/433.0)	8.95 (8.3/10.0)	14.35(13.95/14.8)
Min	412.0	358.0	10.2	14.1	375.0	336.0	8.1	13.2
Max	514.0	500.0	13.4	18.8	472.0	440.0	10.7	15.1

Commentary: * - The differences are reliable at $p < 0.05$

The tendency to increase performance in the performance of a 30 -second test was recorded: BGK (+26 W by average) -422.37 ± 46.81 W ($\bar{x} \pm S$), and CGK (+6 W by average) 392.0 ± 43.31 W ($\bar{x} \pm S$) respectively (Table 4.5).

Under the influence of the proposed preparation program, an increase in blood lactate concentration by $1.4 \text{ mmol} \cdot \text{L}^{-1}$ (La max 30 c) and $1.03 \text{ mmol} \cdot \text{L}^{-1}$ (La max 90 c) in BGK athletes ($p < 0.05$), in SGK athletes The studied indicators are not reliable. Statistically significant differences ($P < 0.05$) by power (La max 30 c) BGK- $11.6 \pm 1.41 \text{ mmol} \cdot \text{L}^{-1}$ ($\bar{x} \pm S$), CGK- $9.16 \pm 1.01 \text{ mmol} \cdot \text{L}^{-1}$ ($\bar{x} \pm S$) and anaerobic capacity energy supply (La max 90 c) $16.03 \pm 1.33 \text{ mmol} \cdot \text{L}^{-1}$ ($\bar{x} \pm S$), $14.31 \pm 0.62 \text{ mmol} \cdot \text{L}^{-1}$ ($\bar{x} \pm S$) BGK and CGK athletes, respective The conditions of overcoming the first half of the competitive distance of 1000 m and confirms the effectiveness of the proposed program in the practice of training athletes-kayakmen.

Table 5. Present individual and medium -group (BGK and CGK) indicators of functional support of special performance in conditions of increasing fatigue, characteristic of the second half of the distance, qualified kayakers specializing in 1000 m.

Table 5

Indicators of functional support of special performance of qualified kayakers specializing in a distance of 1000 m, before the use of MTS (N = 16), $p < 0.05$

Athletes	W VO2 max, W	W 90 s, W	EqCO ₂ VO ₂ max*, c.u.	EqCO ₂ 90 s**, c.u.	W VO2 max, W	W 90 s, W	V _E ' CO ₂ ⁻¹ VO ₂ max*, c.u.	V _E ' CO ₂ ⁻¹ 90 s**, c.u.
Indicators to execute the program								
	BGK				CGK			
1	187.6	221	29	31	461	378	26	32
2	188	227	31	34	474	423	37	40
3	188	223	32.5	35	441	357	36	38
4	178.6	198	30	33	368	328	33	34
5	178.4	190	32	35	470	443	36	33
6	189	258	29	30	469	397	36	37
7	195	222	42	41	467	429	32	39
8	180	216	32	31	384	333	33	34
$\bar{x} \pm S$	185.57±5.94	219.37±20.36	32.18±4.19	33.75±3.49	182.12±24.72	205.87±21.4	33.62±3.58	35.87±2.99
Me (25 % / 75%)	187.8 (179.3/188.5)	221.5 (207.0/225.0)	31.5 (29.5/32.25)	33.5 (31.0/35.0)	183.5 (165.5/192.5)	208.0 (195.5/213.5)	34.5 (32.5/36.0)	35.5(33.5/38.5)
Min	178.4	190.0	29.0	30.0	143.0	169.0	26.0	32.0
Max	195.0	258.0	42.0	41.0	227.0	244.0	37.0	40.0

Commentary: * - The differences are reliable at $p < 0.05$

Table 5 shows that before the use of the author's program, the performance indicators registered in the step-growing and 90-s tests and the characteristics of athletes' capabilities to compensate for increasing fatigue in the conditions of overcoming the second half of the competitive distance of 1000m (EqCO₂VO₂ max, c.u. and EqCO₂ 90 s, c.u.) did not have reliable differences ($p > 0.05$). Following the implementation of the BGK athletes, the CGK athletes were recorded statistically significant differences ($p < 0.05$), the 90-second test was 260.25 ± 13.59 W ($\bar{x} \pm S$), and $213.0. \pm 15.9$ W ($\bar{x} \pm S$), respectively. Statistically significant differences ($p < 0.05$) of ergometric capacity of work, at which the level of maximum oxygen consumption is achieved when performing the steppe BGK 221.87 ± 16.89 W ($\bar{x} \pm S$) and CGK 188.5 ± 17.51 . W ($\bar{x} \pm S$) respectively (Table 6.).

Under the influence of the proposed training program, trends to increase the ventilation equivalent of CO₂ by 0.19 c.u. are recorded. (EqCO₂VO₂ max, c.u.) and 1.5 c.u. (EqCO₂ 90 s, c.u.) In BGK athletes, the SGK athletes are not reliable. Statistically significant differences ($p < 0.05$) are recorded by the average performance of ergometric power in 90-second test (W 90 s) BGK- 40.88 W ($\bar{x} \pm S$), CGK- 5 W ($\bar{x} \pm S$) and ergometric

indicators The capacity of the work at which the level of oxygen consumption is reached when performing the steppe test (W VO₂ Max) on average 36.3 W ($\bar{x} \pm S$) and 6.38 W ($\bar{x} \pm S$) BGK and CGK athletes, respectively, which is convincing It testifies to the improvement of the efficiency of functional support of the special performance of rowers in the conditions of overcoming the second half of the competitive distance of 1000 m and confirms the effectiveness of the proposed program in the practice of training athletes-kayakmen.

Table 6

Indicators of functional support of special performance of qualified kayakers specializing in a distance of 1000 m, after applying MTS (n = 16), p < 0.05

Athletes	W VO ₂ max, W	W 90 s, W	EqCO ₂ VO ₂ max*, c.u.	EqCO ₂ 90 c**, c.u.	W VO ₂ max, W	W 90 s, W	V _E · CO ₂ ⁻¹ VO ₂ max*, c.u.	V _E · CO ₂ ⁻¹ 90s**, c.u.
Indicators after execution of the program								
BGK					CGK			
1	242	271	30	33	189	222	27	32
2	226	267	31	35	200	218	35	40
3	220	265	33	36	185	205	34	38
4	195	241	31	34	180	214	33	35
5	198	238	32	36	220	235	33	36
6	229	273	30	32	186	212	34	37
7	234	269	39	41	190	218	32	37
8	231	258	33	35	158	180	31	34
$\bar{x} \pm S$	221.87±16.89*	260.25±13.59*	32.37±2.92	35.25±2.71*	188.5±17.51	213.0±15.9	32.37±2.5	36.12±2.47
Me (25 % / 75%)	227.5 (209.0/232.5)	266.0 (249.5/270.0)	31.5 (30.5/33.0)	35.0 (33.5/36.0)	187.5 (182.5/195.0)	216.0 (208.5/220)	33.3 (31.5/34.0)	36.5 (34.5/37.5)
Min	195.0	238.0	30.0	32.0	158.0	180.0	27.0	32.0
Max	242.0	273.0	39.0	41.0	220.0	235.0	32.0	40.0

Commentary: * - The differences are reliable at p < 0.05

Discussion.

The study (Coelho A.B. et al. (2021)) demonstrated that well-trained young kayakers, cardiorespiratory fitness could be assessed during a time-trial test that mimics the actual performance attained in flat water. In conclusion, we found that V·O_{2max}, stroke distance and stroke rate during the a maximal graded exercise test (GXT) were not different from the corresponding variables (V·O_{2peak}, stroke distance and stroke rate) observed during the time-trial performance (TT), and that MAP and the corresponding stroke rate were strong predictors of 1,000 m TT performance. The results confirmed that V·O_{2max}, chronological age, the speed at VT₁ and VT₂, stroke rate and power output are significantly correlated with the performance in a 1,000 m time-trial.

The study (Gomes B. B. et al. (2012)) demonstrated that the lactate concentration values found in this study highlights the contribution of the anaerobic energy pathway to kayak TT performance and reinforces the role of the significant contribution of anaerobic energy sources in sprint kayak performance.

The study (Papandreou A. et al. (2020)) compared physiological adaptations with HIIT and CT in flat water kayak athletes. Twenty-four national-class kayakists were divided into 3 groups (n = 8 per group), 2 of which participated in an 8-week CT or HIIT program, whereas the third one served as control (C). An incremental maximum oxygen uptake (VO_{2max}), a maximal anaerobic Wingate-type, as well as 1,000-m (T1,000 m) and 200-m (T200 m) time test were performed before and after the training period on a kayak ergometer, to determine changes in VO_{2max}, peak blood lactate ([La]_{peak}), paddling speed at VO_{2max}, heart rate at VO_{2max} (HR_{peak}), paddling economy speed (PEs; speed at 75% of VO_{2max}), paddling speed at anaerobic ventilatory threshold (PSVT₂), maximal paddling speed (PS_{peak}), and reduction of PS_{peak} (PSR). VO_{2max}, [La]_{peak}, HR_{peak}, and PSR did not change after the 8-week training compared with baseline in either training group (p > 0.05). However, significant changes were found in PSVT₂ and T200 m (HIIT), , PEs,

PSpeak, and T1,000 m (CT and HIIT) ($p < 0.05$ - 0.0001) as compared to baseline. Moreover, percent changes were different between the training groups in PEs, and between control and training groups in PSpeak and ($p < 0.05$ - 0.01). Both training programs improved physiological and performance variables; however, HIIT resulted in significant changes of PSVT2 and T200 m and higher improvement of PEs with 15 times less training time compared with CT. Thus, HIIT seems more time-efficient than CT for improving paddling economy of kayaking performance. The study (Sheykhlouvand M. et al. (2018)) demonstrated the effects of kayak paddling-based sprint interval training (SIT) on cardiorespiratory fitness and anaerobic performance. Sixteen professional female canoe polo athletes (age = 27.6 ± 1.9 years; height = 165.7 ± 5.2 cm; body mass = 62.6 ± 8.5 kg; body mass index = $22.8 \text{ kg}\cdot\text{m}^{-2}$; body fat = $23.8 \pm 4.9\%$) were randomized to either an intense exercise training consisting of sets of 5×5 -second maximum sprint efforts interspersed by a 10-second recovery between each sprint (3, 4, 5, and 6 sets/session from first to fourth week, respectively, with 3 minutes of rest between each set), performed 3 times per week for 4 weeks ($n = 8$), or a usual training control group ($n = 8$). Before and after the training period, aerobic and anaerobic measurements were assessed using a kayak specific test and Wingate protocol, respectively. Training increased VO₂peak, O₂ pulse, anaerobic threshold, peak, and mean power output in the SIT group compared with the control group ($p \leq 0.05$) who showed no changes in these variables when tested 4 weeks apart without SIT. Paddling-based SIT was a potent stimulus and time-efficient strategy to induce rapid adaptations in aerobic and anaerobic performances in professional female canoe polo athletes who can use this training method to achieve fitness in a short period.

Conclusions:

The research on the study of the efficiency of the developed program confirms the data on its reliable advantage over the traditional training program. The data obtained during the pedagogical experiment indicate that the use in the training process of the rowing of the developed program made it possible to achieve better results in the athletes of the main BGK group, according to the research, compared to the athletes of the CGK control group.

Following the implementation of the BGK athletes, the CGK athletes were recorded statistically significant differences ($p < 0.05$), the 90-second test was $260.25 \pm 13.59 \text{ W}$ ($\bar{x} \pm S$), and $213.0 \pm 15.9 \text{ W}$ ($\bar{x} \pm S$), respectively. Statistically significant differences ($p < 0.05$) of ergometric capacity of work, at which the level of maximum oxygen consumption is achieved when performing the stepped BGK $221.87 \pm 16.89 \text{ W}$ ($\bar{x} \pm S$) and CGK $188.5 \pm 17.51 \text{ W}$ ($\bar{x} \pm S$) respectively. Thus, the application of the developed program has made it possible to increase the efficiency of the training process of athletes specializing in a distance of 1000 m in rowing on kayak and canoe.

Prospects for further research consist in the implementation of the developed theoretical provisions to the management system of training and competitive loads of athletes in kayaking.

Conflict of Interest Statement. Authors declare no conflict of interest.

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