Tests and criteria for assessing the anaerobic workability of sprinter athletes

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Abstract

Objective of the study was to evaluate the effect of multiple maximum power exercises on the anaerobic performance of sprinters.

Methods and structure of the study. The experiment involved 11 sprinters of qualification Candidate for Master of Sports and I category. To assess anaerobic performance in the laboratory, athletes underwent repeated bicycle ergometric tests in the test of maximum anaerobic power (MAP). In the field, to study the dynamics of speed in sprinting, the subjects completed a ten-fold run of a distance of 60 m from a low start at full strength after 1 min of rest.

Results and conclusions. The maximum speed in sprinting is reached at the sixth second from the start. During this time, oxidative processes in the tissues practically do not have time to unfold to a significant extent. This time is not enough for a significant increase in anaerobic glycolysis in working muscles. The energy supply of maximum muscle activity in these first 5-6 seconds is carried out mainly due to the alactic anaerobic process, that is, due to the breakdown of intramuscular reserves of organophosphorus compounds ATP and creatine phosphate. At the same time, as a result of multiple repetitions of maximum power exercises, a very strong acidification of the intramuscular environment occurred, which led to a decrease in the leading criteria for sprint performance.

Keywords: *sprint, sprint performance criteria, bicycle ergometry, maximum anaerobic power, maximum running speed.*

Introduction. In sprinting, the main factor leading to a decrease in performance, to a drop in the maximum power of the exercise, is the factor of local muscle fatigue due to a decrease in intramuscular energy substances, mainly creatine phosphate, as well as acidification of the intramuscular environment due to the anaerobic formation of lactic acid [2, 3, 5-8]. In sprint practice, control exercises in 20, 30 and 60 m runs with maximum speed from low and high starts are used to assess alactic anaerobic power. For a more accurate analysis of the measurements, it is recommended to continuously record the running speed at these distances, as a result of which it is possible to identify the main criteria for sprint performance [1, 4, 5, 7].

Objective of the study was to evaluate the effect of multiple maximum power exercises on the anaerobic performance of sprinters.

Methods and structure of the study. The experiment involved 11 sprinters of qualification Candidate for Master of Sports and I category. To assess anaerobic performance, athletes were tested in the laboratory in the test of maximum anaerobic power. During the test, the athletes performed a ten-fold series of exercises with the aim of achieving the maximum pedaling frequency with an effort duration of 10 s with a constant resistance value. The load on the wheel was set at the rate of 75 g per kilogram of the subject's body weight. Rest between repetitions was 1 min. The test was performed on a Monark bicycle ergometer (Sweden). An example of a power curve recording is shown in Figure 1.

To study the dynamics of speed in sprinting, the subjects performed a ten-fold run of a distance of 60 m from a low start at full strength after 1 min of rest. An example of running speed recording using a speedograph is shown in Figure 2 [4].

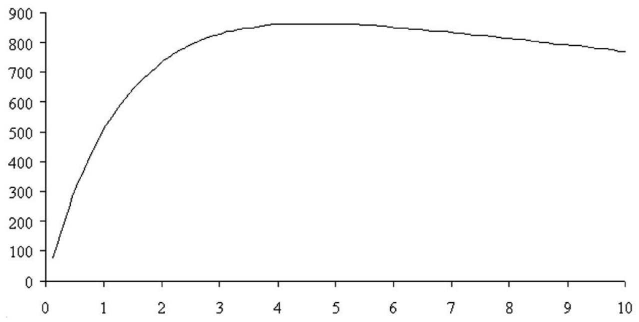

Figure 1. *Power-time dependence, on the abscissa - time (s), on the ordinate - power (W)*

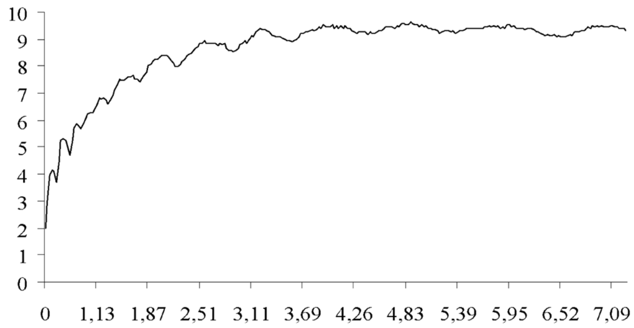

Figure 2. *Speedogram of a 60 m run, on the abscissa - time (s), on the ordinate -running speed (m.s‾1)*

To determine the acid-base balance in each test, blood samples were taken at rest before starting work, after the fifth, tenth repetition and after stopping work.

Results of the study and their discussion. The indicators of anaerobic performance of athletes in the repeated MAP test are presented in Table 1.

As can be seen from the presented data, the developed power decreases from 803.14 to 694.00 W. Looking at the change in power from repetition to repetition, you can see that in the first repetition the average power value is 803.14 W, then it decreases slightly in the second repetition to 792.00 W and in the third repetition it reaches its maximum value. Then there is a decrease in the average value of this indicator up to the ninth attempt, and in the tenth there is a slight increase in it. Such an indicator as the total power of work varies from 803.14 to 7378.39 W. The average blood pH at rest before the start of work is 7.411 mEk. l^{-1}, after the fifth repetition it is 7.242 mEk.l^{-1}, after the tenth it is 7.215 mEk. l^{-1}. A decrease in such an indicator as the buffer capacity of the blood occurred from -2.73 to -16.83 mEk. l^{-1}.

The criteria for anaerobic performance, calculated on the basis of the analysis of speedograms, are presented in Table 2.

As can be seen, the average value of the maximum running speed (Vmax) in the first attempt was 10.05 m·s^{-1}, in the sixth it increases to 9.54 m·s^{-1}, in the seventh and eighth it decreases to 9.33 m·s^{-1}, and in the ninth and tenth attempts it increases to 9.60 m·s^{-1}. In the dynamics of the average value of the time to reach the maximum running speed (Tmax), there is a high variability: from 5.03 s in the second attempt to 6.50 s in the eighth attempt. The average value of such an indicator as the time to hold maximum running speed also varies widely: from 1.81 s in the third attempt to 1.01 s in the first attempt. The dynamics of the indicators of the starting acceleration constant (K1) and the rate constant of the decrease in efficiency (K2) is insignificant. The average value of the running time at a distance of 60 m (T60m) decreases from 7.31 s in the second attempt to 8.09 s in the tenth. The average value of the indicator of acid-base balance of blood (pH) at rest before the start of work was 7.397 mEk. l^{-1}, after the fifth attempt - 7.101 mEk. l^{-1}, and after the end of work 7.046 mEk. l^{-1}. The average value of the buffer capacity of the blood at rest is -2.37 mEk. l^{-1}, after the fifth attempt – -21.86 mEk. l^{-1}, and after the cessation of work -24.66 mEk. l^{-1}.

Table 1. Dynamics of performance indicators of sprinters in the test of maximum anaerobic power

Repetitions	Indicators				
	Number of turns	Power, W	Total power Σ W, W	pH, mEk·l^{-1}	BC, mEk·l^{-1}
1	20,57±1,90	803,14±93,73	803,14±93,73	7,411±0,007	-2,73±0,98
2	20,29±1,38	792,00±76,92	1595,14±153,17		
3	20,71±1,38	807,00±50,62	2402,14±181,98		
4	19,57±1,51	762,43±55,90	3164,57±215,02		
5	18,71±1,70	728,57±57,54	3893,14±251,34	7,243±0,013	-13,97±1,58
6	18,43±1,99	717,00±65,20	4610,14±293,81		
7	18,33±1,97	707,00±70,15	5317,14±339,47		
8	18,00±1,22	690,00±25,72	6007,14±278,21		
9	17,75±1,71	677,25±42,73	6684,39±276,85		
10	18,33±2,52	694,00±66,36	7378,39±235,85	7,215±0,066	-16,83±2,89

Table 2. Dynamics of indicators of special performance of sprinters in the repeated run at a distance of 60 m

Repetitions	Indicators								
	V_0, m·s^{-1}	V_{max}, m·s^{-1}	T_{max}, s	T_{hold}, s	K_1, s^{-1}	K_2, s^{-1}	T_{60m}, s	pH, mEk·l^{-1}	BC, mEk·l^{-1}
1	12,13± 0,64	10,05± 0,37	5,93± 0,79	1,01± 0,05	0,487± 0,065	0,022± 0,003	7,34± 0,27	7,397± 0,029	-2,37± 1,60
2	12,25± 0,53	10,14± 0,37	5,03± 0,84	1,78± 0,09	0,516± 0,068	0,024± 0,004	7,31± 0,28		
3	11,81± 0,58	9,86± 0,59	5,57± 0,19	1,81± 0,06	0,529± 0,076	0,022± 0,004	7,99± 0,58		
4	11,51± 0,67	9,68± 0,57	5,50± 0,41	1,68± 0,07	0,517± 0,065	0,023± 0,004	7,89± 0,61		
5	11,24± 0,67	9,45± 0,66	5,64± 0,75	1,32± 0,05	0,507± 0,075	0,022± 0,006	8,04± 0,75	7,101± 0,041	-21,86± 2,20
6	11,29± 0,70	9,54± 0,24	5,70± 0,27	1,17± 0,06	0,502± 0,050	0,022± 0,005	8,06± 0,15		
7	11,28± 0,70	9,33± 0,33	5,50± 0,50	1,72± 0,05	0,519± 0,077	0,025± 0,003	8,08± 0,25		
8	11,90± 0,81	9,28± 0,45	6,50± 0,32	1,03± 0,08	0,420± 0,057	0,027± 0,005	8,07± 0,51		
9	12,20± 0,89	9,44± 0,57	5,50± 0,75	1,71± 0,05	0,042± 0,054	0,027± 0,006	8,06± 0,70		
10	12,50± 0,97	9,60± 0,67	5,50± 0,57	1,09± 0,07	0,414± 0,068	0,030± 0,007	8,09± 0,31	7,046± 0,071	-24,66± 3,13

Conclusions. According to the results of the study, the maximum speed in sprinting is reached at the sixth second from the start. During this time, oxidative aerobic processes in tissues practically do not have time to unfold to a significant extent. At the same time, as a result of repeated maximum efforts, both in bicycle ergometric tests and in running, a very strong acidification of the intramuscular environment occurred, resulting in fatigue, decreased power and speed of muscle contractions, running speed. It was found that a more pronounced decrease in the average value of the acid-base balance index occurred in the running test compared to bicycle ergometry: 7,101 versus 7,243 mEk·l^{-1} after the fifth attempt and 7,046 versus 7,215 mEk·l^{-1} after the end of the work. The same pattern can be traced in the indicators of blood buffer capacity: -21.86 vs. -13.97 mEk·l^{-1} after the fifth attempt and -24.66 versus -16.83 mEk·l^{-1} after the end of the work.

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