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Swimmers' functional readiness monitoring for model values of physical working capacity creation

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Abstract: The article deals with the issues of swimmers functional training. The following functional components of physical fitness were identified: physical working capacity, aerobic productivity, absolute and relative power of the performed work, pulse and heart rate coefficient. Indices monitoring allows to determine the exact amount of work performed, to control heart rate and other indices before work during and after work during the recovery period. The volume of the functional capabilities of swimmers' organism helps to define timely the volume of the specific training effects at training sessions. Modern high-class swimmers show high results due to the retention of oxygen consumption at the level of 80-85% of MOC and more. **Materials.** As model values of physical working capacity among swimmers we chose absolute and relative physical working capacity, aerobic productivity indices. They characterize the level of athletes' organism development energetic processes. **Research methods.** Information sources analysis, testing and statistical research results handling. **Results.** Scientific-methodical sources analysis showed that indices monitoring helps to define precisely the number of the fulfilled work, control heart rate and other indices before work, during and after work during recovery period. Correctly organized regular control helps to gather valuable information about swimmers' functional indices dynamics. The amount of general work fulfillment is defined. We underline general amount of the fulfilled work increase by highly qualified swimmers. Model lessons of complex character use with aerobic and mixed regimen of work in terms of the average heart rate values 120-140 beats per minute and 140-160 beats per minute and also the level of 180 beats per minute achievement provide functional capacities of swimmers' organism development. For the effectiveness characteristic of swimmers training it is necessary to study the level of their physical working capacity. It helps to realize the control over physical state and the degree of physical loads handling. It also helps to control over adaptive mechanisms of an organism depending on the stages of training. The received results of highly qualified swimmers' functional state can be the index of physical working capacity integral model. **Conclusion.** For training control and optimization at all stages it is necessary to estimate maximum possible levels of functional readiness at rest and during physical load fulfillment. Swimmers' functional readiness regular monitoring helps to correct training and competitive loads and individualize the training process. **Keywords:** swimmers, functional training, power of work, heart rate, maximum oxygen consumption, physical working capacity, model characteristics.

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INTRODUCTION

Swimming has a great influence on functional state of an organism cardiovascular and respiratory systems. An important condition for the effectiveness of training increase among swimmers of different qualification is a rational training process organization. From all kinds of training functional training should play the main role. It is a well-known fact that everyday trainings provide physical functional readiness and physical development improvement.

Scientific-methodical works analysis concerning the problems of functional training in cyclic kinds of sport showed that indices monitoring helps to define precisely the amount of the fulfilled work, control heart rate and other indices before work, during work and after work during recovery period. Correctly organized regular control helps to gather valuable information about swimmers' functional indices dynamics. Control helps to register not only indices, but reveal the factors of physical and emotional load, to reveal timely pathological

disorders in an organism [11,12,13].

It is known that modern swimming undergoes the process of participants "rejuvenation" due to pre-school children and junior age schoolchildren involvement.

It is necessary to pay special attention to functional training. It is vital in terms of training swimmers. We should underline constant hydric environment, pressure, simultaneous hands and legs work influence on swimmers' organism. The conditions of training make a swimmer's heart work in an intensive regimen [14].

Specialists pay great attention to functional readiness control using different test methodologies. The dynamics of the studied functional readiness indices helps to control the level of athletes' functional readiness in a chosen kind of sport [1,2,3,4,5,6,7,8,9,10].

The aim of this research work is the indices study. They characterize functional side of different qualification swimmers training.

MATERIALS AND METHODS

Highly qualified swimmers took part in our research work. On the basis of cycle test results during 6 minutes of constant pedaling 6-62 rpm we defined the following indices: general amount of the fulfilled work (P); An absolute power of the fulfilled work (Wabs.); relative power of work (W rel.); maximum oxygen consumption indices (MOC); MOC rel.; oxygen pulse (OP).

The average power of the fulfilled work among swimmers was defined using the following formula: $Wabs. = P/t(kgm/min)$, where P- amount of the

fulfilled work, t- time of work fulfillment. The average relative power of swimmers was defined with the help of the following formula: $Wrel. = (Wabs.)/(F body) ((kgm/min)/kg)$.

Physical load was set at a cycle ergometer. For general physical working capacity determination the following formula was used:

$$N_1 + (N_2 - N_1) \frac{f_2 - f_1}{170 - f_1} = PWC_{170}, \text{ where}$$

N2 and N1 – power of the first and the second load in kgm/min;

f2 and f1 – heart rate at the end of the first and the second loads.

PWC 170 calculation was held according to nomogram.

Picture 1 presents the nomogram for a quick physical working capacity determination. At a vertical scale we can see heart rate indices. At a horizontal scale we see the volume of the fulfilled loads. The upper horizontal scale helps to define physical working capacity indices.

Nomogram application instructions. The lower scale presents the load of the first and the second degree. Then heart rate indices of the first and the second degree are mentioned. The line crossing at HR level 170 beats/min we define the index of physical working capacity by means of extrapolation method. MOC among swimmers was defined taking into account the results of physical working capacity according to the following formula:

$$MOC = PWC_{170} \times 2,6 + 1070.$$

Picture 1 – Normogram for PWC 170 calculation: f1– f2 – heart rate; N1-N2 – power of the first and the second loads

RESULTS AND DISCUSSION

Functional readiness monitoring and preliminary estimation help to define their ability to show high results. Functional readiness is characterized by the system of muscle activity energy supply, by the ability to provide oxygen and by the indices of the whole organism system effective work.

The value of swimmers' organism functional abilities helps to define timely the volume of the definite training effects. Modern high class

swimmers show high results owing to oxygen consumption keeping at the level 80-85% from MOC and more. It defines that swimmers can use oxygen for about 5-5,5 l/min. There is the hypothesis that if a swimmer doesn't have high level of MOC values, he wouldn't be able to achieve high results. It appears probable that these are the factors, which provide functional readiness effectiveness improvement.

Table 1 presents the results of highly-qualified swimmers' functional readiness held studies.

Table 1 – Absolute average values of functional readiness among highly qualified swimmers

The studied indices	Stages of the research		
	September	December	March
P, kg/m	13670	13680	14800
Wabs, kgm/min	22,78	23,48	25,68
W rel., kgm/min/kg	28,87	29,67	31,57
PWC 170, kgm/min	1334,5	1400,4	1458,9
PWC 170 rel.	19,8	21,3	22,6
MOC, l/min	5,56	5,78	6,38
MOC rel.	47,3	48,9	52,39
OP, ml/beats	22,4	23,0	24,5
HR, beats/min	68,4	68,7	64,2

Table 1 shows that the amount of general fulfilled work (P) at the beginning of the preparatory period was 13670 kg/m, in December- 13680 kg/m and in March - 14 800 kg/m. We see general amount of the fulfilled work increase by highly qualified swimmers. It means that model lessons of a complex character use with aerobic and mixed regimen of work at average values of HR 120-140 beats/min and 140-160 beats/min, and also the level of 180 beats/min achievement provide functional abilities of swimmers' organism development.

An absolute power of the fulfilled work (Wabs.) in swimmers had the tendency of increase since September till March.

If in September this index was 22,78 kg/min, in December it was 23,48 kg/min, in March-25,68 kg/min. To the competitions there is the power of the fulfilled work increase in swimmers as the index of sports training effectiveness increase. Relative power (Wrel.) of swimmers also has the tendency of increase from stage to stage. In September Wrel. was 28,87 kgm/min/kg, in December - 29,67 kgm/min/kg, in March – 31,57 kgm/min/kg. It characterizes

physical readiness improvement.

For the effectiveness of swimmers training characterization it is necessary to study the level of physical working capacity. It helps to realize timely the control over physical state and the degree of physical loads handling and also control over adaptive mechanisms of an organism depending on the stage of training.

In swimmers' physical working capacity indices, especially in individual indices, we registered high values among candidate masters of sport and masters of sport - 1780,5 kgm/min. With the level of swimmers' readiness decrease absolute indices PWC 170 decrease. As a result of the average absolute values of physical working capacity analysis we stated their increase from stage to stage in the micro cycle of training. If in September PWC 170 was 1334,5 kgm/min, in December and March - 1400,4 kgm/min and 1458,9 kgm/min. We also underline special physical working capacity increase to the period of the main starts.

PWC 170 relative among swimmers also had the tendency to increase from stage to stage and was

19,8 kgm/min/kg in September; in December - 21,3 kgm/min/kg; in March– 22,6 kgm/min/kg.

Received by us results of swimmers' functional state prove the necessity to realize fundamental training, directed toward swimmers' general and special physical readiness development.

Maximum oxygen consumption (MOC) indices are used as the main index. It characterizes functional energetic capacities of athletes' organism development.

MOC results analysis in absolute and relative values also improved: in September MOC indices were 5,56 l/min, in December– 5,78 l/min, in March – 6,38 l/min. Relative MOC values also have the dynamics of increase.

OP and HR indices characterize the activity of swimmers' cardiovascular system. In the opinion of coaches, the studied indices improvement is connected with complex lessons use. It is directed toward functional abilities of swimmers increase. Functional training effectiveness increase happened owing to complexes of speed-power, special endurance, general endurance use, where intensity was 40-60%, 60-70%, 85-90% from maximal. 50% of lessons time was given for the training tasks fulfillment at generally preparing stage; at especially preparatory stage – til 35% of general time.

Received by us results of highly qualified swimmers' functional state can be the index of physical working capacity integral model.

The model of training creation at different stages helps to plan the objectives of the training stage for swimmers. There appears the aim: how to train and what is the final aim? In previous works we wrote about the importance of swimmers fundamental functional training. Nowadays it is important to control and calculate loads indices at training lessons and competitions. Many coaches forget that load has inner and outer side of its influence on athletes' organism. All sides of load study and competitive and training loads modeling help to judge the degree of athletes' functional capacities mobilization.

The most important step in training swimmers in general system of training is model characteristics of kinds of training creation. Model characteristics of a functional state and physical working capacity should be oriented at the characteristics of the main sides of swimmers' readiness for competitive activity.

Table 2 presents model characteristics of swimmers' functional readiness, presented in different research works, with own research works results inclusion.

Table 2 – Model values of swimmers' functional state and physical working capacity (male)

Age groups of swimmers	Indicators of model values of the functional state and physical performance of swimmers(boys)		
	PWC 170, kgm/min	PWC 170, kgm/min/kg	MOC, ml/min/kg
14-15 years-old	1200,4-1280,5	13,9-17,1	45,9-49,9
16-18 years-old	1300,7-1345,6	14,9-18,5	49,3-52,8
19-22 yearsoold	1390,3-1567,3	17,5-20,0	51,6-55,0
Men	1550,6-1890,7	18,0- 24,5	51,8-60,0

It is stated that model values of physical working capacity and aerobic productivity, selected by us for 14-15, 16-18 and 10-21 year-old male swimmers become closer to the values of highly-qualified swimmers (men). Training process creation at training stage should be oriented toward model values fitting.

Thus, preliminary study of swimmers' functional readiness help to define, that mentioned above indices can be used for the level of functional

readiness characteristic and can be used for the training loads optimization at all stages of sports training.

We would continue experimental research works in this direction.

CONCLUSION

The results of the preliminary studies help to formulate the following practical recommendations:

- for swimmers' training control and optimization at all stages it is necessary to estimate maximum

possible levels of functional readiness at rest and during physical load fulfillment;

- for functional readiness estimation it is necessary to hold test regularly with the help of maximum incrementally increasing load at cycle ergometer. During ergometric tests organization it is necessary to realize the control over heart rate indices and power of the fulfilled work. Regular monitoring of swimmers' functional readiness helps to correct training and competitive load and individualize training process;

- training process control should be realized taking into account the volume of maximum training loads parameters and the reaction of an organism to the load.

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