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## Comparative Characteristics of Functional Capability of 11–12 year-old Swimmers Connected with Their Gender and Possibilities of Its Improvement

### Abstract

In the initial stages of the long-term swimmers' training, the age-related functional capability of athletes should be taken into account. The improvement of young swimmer' skills should be done in terms of an integrated approach to the promotion of physical fitness. The article presents the results of the study of aerobic and anaerobic capacity of 11–12-year-old swimmers under the condition of maximum oxygen consumption (VO<sub>2</sub>max), the maximum amount of external mechanical work for 10s (VanT10), 30s (VanT30), 60s (MKMMD). For the scientific substantiation of the expediency of implementing the method of interval hypoxic training and elements of aquafitness in the training process of 11–12 year-old swimmers, it is necessary to investigate the indexes of functional preparedness of 11–12 year-old swimmers, depending on their gender. It has been found out that the level of aerobic productivity of the boys' bodies equals "good", and the girls' – "excellent" according to Y.P. Pyarnat. Elements of aquafitness and interval hypoxic training are recommended to be applied to improving aerobic and anaerobic capacity of swimmers at the stage of initial basic training.

**Keywords:** interval hypoxic training, aquafitness, aerobic capacity, anaerobic capacity.

### The problem of research

The most topical problem of the sport of the highest achievements is the problem of training of sports reserve, especially in swimming. Therefore, during

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the initial stages of long-term preparation of swimmers the training process should take into account the age of functionality athletes (V. Bohuslavskaya, Y. Furman, N. Gavrilova, Y. Rimar, I. Hruzevych). It has positive impact on the adaptive restructuring of the organism (V. Platonov, 2004).

The part of fitness is using in training of sportsmen such exercises that enhance power capacity (K. Sahnovskiy, 1995). However, the abuse of power exercises in such conditions could adversely affect the functional state of the cardiovascular system of young swimmers (L. Volkov, V. Platonov). Therefore, the improvement of the skills of young swimmers must be characterized by a complex approach to the process of improving physical training (V. Platonov, I. Glazyrin, K. Sahnovskiy).

### **The analysis of recent sources and publications**

The analysis of minutes of the Olympics Games, World Championships and other competitions demonstrates the dynamics of raising the results in all kinds of sports. This phenomenon is caused by increasing the efficacy of training by means of introducing new technology in the systematic training of sportsmen.

According to some scholars, physical exercises in water positively affect different functional systems of the organism. Thus, according to V. Platonov, during the first 20–30 minutes of training in water, which occurs immediately after a training session in the room of dry swimming, sportsmen experience deterioration of the so-called “water feeling”.

The effects of physical exercises in water are due to the high energy expense of work, the phenomenon of gravitational unloading of the body, positive effects on the cardiovascular and respiratory systems and, which is the most important, the available effect of hardening.

Recently, it is the use of aids and methods that increase the effectiveness of physical exercises in the practice of physical education when dealing with people of different ages.

In particular, the results of scientific research of A. Penchuk show that the use of different methods of hypoxic training and physical activities in the training process of sportsmen of different qualification, regardless of their gender, improves physical capacity for work, aerobic and anaerobic capacity of the body, and improves functional possibility of the respiratory system.

The results of research of Y. Furman, N. Gavrilova, I. Hruzevych demonstrate the feasibility of using the method of creating the condition of a state of moderate hypercapnia hypoxia in the process of physical training in the organism of sportsmen.

Besides, the researches made by Y. Furman and S. Salnikova have proven the effectiveness of complex application of aqua fitness and of the method of en-

dogenously-hypoxic breathing when dealing with women coming of age, which was confirmed by improvement of their physical condition.

Given the above, we offer to integrate the elements of aqua fitness and the method of interval hypoxic training (IHT) using apparatus "Endohenik-01" (H. Hodorovskyi) in the program of training swimmers. Breathing through the apparatus in a state of relative muscle's calm hypercapnia hypoxia at the constant parameters of oxygen and carbon dioxide occurs in the organism. It is known that the air contains about 21% oxygen and 0.045% carbon dioxide.

After the first exhalation the air in the apparatus contains 16–18% of oxygen and 3–4% of carbon dioxide. In the next breath of air, this proportion of gases, which is held throughout the procedure, enters the lungs. This condition causes the state of moderate hypoxia and distinct hypercapnia in the organism. Given the fact that the technology of breathing through the "Endohenik-01" would increase the duration of inhalation and exhalation through the narrowed union gradually increasing the possibility of lung ventilation (through the increasing functional capacity of the respiratory muscles) and improve the adaptation of organism to hypoxia.

If the supply of oxygen to the organism is limited, the alveolar net of the capillaries grows with the increase of the efficiency of the pulmonary ventilation and the diffusion of gases improves through the alveolar-capillary barrier that promotes oxygenation of arterial blood.

Due to the artificially created additional resistance of the air while breathing through the apparatus not only the functional possibilities of the respiratory muscles increase, but due to high internally bronchia pressure the bronchi widen and their capacity improves as well.

Besides, the aim of using this method is to increase the number of red blood cells in the blood, saturated 2,3-dyfosfohlitserat (2, 3-DFH, which acts in the body as a hemoglobin modulator. Combined with hemoglobin, 2, 3-DFH improves oxygen hemoglobin dissociation, reducing the possibility of oxygen deficiency in the body. The scientists found that the rapid impact of EGD in conjunction with metered physical activity appears to increase the function of cardio respiratory system.

The results of the investigations, which studied the effect aqua fitness on the physical development of children and adolescents have shown that such training contributes to the development of physical qualities and improving functional training.

Despite the presence of a series of research projects related to using special additional means to enhance the effect of exercise in physical education, nowadays, there is no scientific information about the applicability of using of interval hypoxic training in combination with aqua fitness in the training process of young swimmers. Therefore, taking into account the experience of previous researchers, we hypothesize that the complex application of IHT and the elements

of aqua fitness in the training process of young swimmers will improve their functional and physical training.

### **The purpose of research**

The purpose of our scientific research is to substantiate the feasibility of implementing the method of interval hypoxic and the elements of aqua fitness in the training process of swimmers 11–12 years of age.

To achieve this goal, we solved the following tasks:

1. We studied the state of matter of the research topic.
2. We investigated the functional readiness of swimmers 11–12-year old.

### **Methods and organization of research**

Methods and organization of our research:

- theoretical analysis and generalization of scientific sources;
- pedagogical experiment;
- testing the functional training of organism on performance indexes in aerobic and anaerobic mode power supply;
- methods of mathematical statistics.

The research was conducted in the laboratory of biomedical foundations of physical education and physical rehabilitation Vinnytsa State Pedagogical University named after M. Kotsiubynskyi. Physiological tests were conducted in the morning (between 10 a.m. and 1 p.m.) not earlier than 1–1,5 hours after eating at a relative humidity of 80% and temperature between and 19°C–21°C. The room where the investigation was conducted was well aired.

The experiment involved the students of youth sports schools male and female swimmers of 11–12 years of age, with sports experience of 2–3 years. The total number of studying sportsmen was 126 people (64 boys and 62 girls).

### **The results and their discussion**

The comparison of aerobic and anaerobic capacity of 11–12-year-old swimmers revealed differences between indexes of physical capacity, maximal oxygen consumption, anaerobic alactate and lactate capacity of the body and the volume of anaerobic lactate energy mechanisms (Table. 1).

**Table 1.** Aerobic and anaerobic capacity of 11–12-year-old swimmers

Indexes	Mean values, $\bar{x} \pm S$		T
	boys (n=64)	girls (n=62)	
VO <sub>2max</sub> , ml·min <sup>-1</sup>	2021,45 ±8,93	1989,33 ±5,05*	3,13
VO <sub>2max</sub> , ml·min <sup>-1</sup> ·kg <sup>-1</sup>	50,27 ±0,35	50,24 ±0,23	0,07
Van T <sub>10</sub> kgm·min <sup>-1</sup>	897,00 ±19,12	845,32 ±16,36*	2,05
Van T <sub>10</sub> kgm·min <sup>-1</sup> ·kg <sup>-1</sup>	22,55 ±0,57	21,34 ±0,33	1,83
Van T <sub>30</sub> kgm·min <sup>-1</sup>	883,70 ±18,38	808,69 ±16,20*	3,06
Van T <sub>30</sub> kgm·min <sup>-1</sup> ·kg <sup>-1</sup>	22,16 ±0,54	20,42 ±0,36*	2,67
MXQEMW kgm min <sup>-1</sup>	849,00 ±15,33	799,35 ±15,38*	2,29
MXQEMW kgm min <sup>-1</sup> ·kg <sup>-1</sup>	21,31 ±0,49	20,22 ±0,41	1,70
Body weight, kg	40,39 ±0,41	39,65 ±0,25	1,56

Note \* – statistically significant differences relative performance of 11–12-year-old boys.

According to the results, the average rate of relative measure VO<sub>2max</sub> for boys and girls of 11–12 years of age are not different and they are 50,27 ±0,35ml·min<sup>-1</sup>·kg<sup>-1</sup> and 50,24 ±0,23 ml·min<sup>-1</sup>·kg<sup>-1</sup>, respectively. According to the criteria of Y. Pyarnata the level of aerobic capacity is, “good” for boys, and “excellent” for girls.

Average value ratios VAN<sub>T10</sub> for boys were 22,55 ±0,57 kgm·min<sup>-1</sup>·kg<sup>-1</sup> and for girls – 21,34 ±0,33 kgm·min<sup>-1</sup>·kg<sup>-1</sup>, respectively (p>0,05).

Relative value MXQEMW for boys and girls is 21,31 ±0,49 kgm·min<sup>-1</sup> and 20,22 ±0,41 kgm·min<sup>-1</sup>.

It was also established that the average VO<sub>2max</sub> absolute figures, VAN<sub>T10</sub>, VAN<sub>T30</sub>, MXQEMW and relative measure VAN<sub>T30</sub> for boys are higher than for girls, up to 1,62%, 6,11%, 9,28%, 6,21% and 8,51%, respectively.

## Conclusion

The results of our research of the functional training swimmers of 11–12 years of age showed that the level of aerobic capacity of the organism (to the Pyarnata’s criteria) for boys is “good”, and for girls is “excellent”. The majority indexes of anaerobic capacity for boys of 11–12 exceed the results of girls. To improve the aerobic and anaerobic capacity of the organism of swimmers it is possible to use elements of aqua fitness and interval hypoxic training in the training process of young swimmers.

## Prospects for further research

Further research will be conducted to study the effect of using the elements of aqua fitness and interval hypoxic training in the functional and physical training of young swimmers.

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## **Charakterystyka porównawcza wydolności czynnościowej jedenasto- i dwunastoletnich pływaków i pływaczek w zależności od ich płci oraz możliwości jej poprawy**

### **Streszczenie**

W początkowym okresie długofalowego treningu pływaków i pływaczek należy uwzględnić wydolność czynnościową zawodników związaną z wiekiem. Poprawę umiejętności młodych pływaków i pływaczek należy osiągać poprzez zintegrowane podejście do sprawności fizycznej. W artykule przedstawiono wyniki badań wydolności w aerobiku i anaerobiku jedenasto- i dwunastoletnich pływaków i pływaczek w warunkach maksymalnego zużycia tlenu (VO<sub>2</sub>max), maksymalnego zewnętrznego wysiłku przy pracy mechanicznej przez 10 s (VanT10), 30 s (VanT30), 60 s (MKMMD). W celu uzasadnienia praktycznych korzyści zastosowania metody przerywanego treningu w warunkach hipoksji (*interwal hypoxic training*) z elementami aquafitnessu w cyklu treningowym jedenasto- i dwunastoletnich pływaków i pływaczek konieczne jest zbadanie wskaźników przygotowanej wydolności czynnościowej jedenasto- i dwunastoletnich pływaków i pływaczek, w zależności od ich płci. Stwierdzono, że – według Y.P. Pyarnata – poziom wydajności organizmów chłopców można określić jako „dobry”, a dziewcząt jako „doskonały”. Elementy aquafitnessu oraz przerywanego treningu w warunkach hipoksji zaleca się stosować w celu poprawienia wydolności aerobicznej i anaerobicznej pływaków i pływaczek w początkowym etapie treningu podstawowego.

**Słowa kluczowe:** przerywany trening w warunkach hipoksji, aquafitness, wydajność aerobikowa, wydajność anaerobikowa.