

Effect of swimming with the use of aqua fitness elements and interval hypoxic training on the physical fitness of boys aged 11-12 years

Furman Yu. M.^{1 ABCDE}, Holovkina V.V.^{1 ABCDE}, Salnykova S.V.^{2 ABDE}, Sulyma A.S.^{1 ABDE}, Brezdeniuk O.Yu.^{3 ABDE}, Korolchuk A.P.^{1 ABDE}, Nesterova S.Yu.^{1 ABDE}

¹Department of Biomedical Foundations of Physical Education and Physical Rehabilitation, Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, Ukraine;

²Department of Philosophy and Economic, Vinnytsia institute of trade and economics of Kyiv national university of trade and economics, Ukraine;

³Department of Physical Education, Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, Ukraine

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Abstract

Purpose: to establish the integrated effect of training sessions using elements of aqua fitness and interval hypoxic training on the special physical fitness of swimmers.

Material: young swimmers participated in the study (n = 64, age 11-12, sporting experience - 2-3 years). The research was carried out in stages: before the experiment began, and then in 8, 16 and 24 weeks later. Frequency of classes in all groups was 6 times a week.

Results: the ability to work in anaerobic alactatic, lactate and aerobic energy supply zones was studied. It was established that such training sessions help to improve the performance and capacity of the anaerobic alactatious system. The feasibility of such combination is proved by the growth of performance indicators in areas of aerobic, anaerobic alactatic and lactate energy supply.

Conclusions: The feasibility of such training sessions is explained by: minimizing the negative impact on the children's body of exercises on the development of force in conditions of the aquatic environment; improving the functional capabilities of the body.

Keywords: disability, anaerobic, aerobic, alactatic, lactate, energy supply, hypoxia, aqua fitness, swimming.

Introduction

The results of the competitions (Olympics, World Championships, etc.) indicate the dynamics of the growth rates of performance from different sports. Such a phenomenon is conditioned by an increase in the efficiency of training sessions by introducing new technologies into the multi-year training of athletes [1-3].

An essential role in the training of young swimmers is to improve the strength of qualities [4]. Power training, [5] when working with swimmers, is carried out in the dry-swimming area. However, performing power exercises under such conditions can negatively affect the functional [6] preparedness of young swimmers. Therefore, we propose a part time program (force training in the dry-swimming area) to replace aqua fitness [7].

There is evidence that physical exercising in water has a positive effect on various functional systems of the body [8]. Such an effect of physical exercises in water is due to the following: phenomenon of gravity unloading of the body [9]; positive influence on the function of the cardiovascular system [10], respiratory systems [11] and vestibular apparatus [12].

Recently, in the physical education of people of different ages, auxiliary agents are used which increase the effectiveness of physical exercises [13-15]. It has been proved that the use of endogenous-hypoxic breathing techniques in cycling [16] and swimmers [17] positively

influences the dynamics of physical fitness. Other studies are evidence of the effectiveness of endogenous-hypoxic respiration when working with skilled hockey players on grass [18] and on ice [19]. Interval hypoxic training is used in practice of other sports: rugby [20, 21]; cycling [22]

Other authors [8, 11] proved the effectiveness of complex application of aqua fitness and endogenous-hypoxic respiration techniques when working with women of mature age. This is confirmed by the improvement of their physical condition [7]. Different breathing techniques are used in the preparation of swimmers [23-25]. The authors state:

- The effects of intermittent hypoxia training on blood, serum and other indicators and the effect of swimming training were analyzed. The practice has proved that the intermittent hypoxia training method was an economical and practical method, which can replace the traditional altitude training and improve the oxygen transport ability of the swimming athletes effectively [9];
- This study demonstrated that VHL (VHL group – low lung volume) training, when performed at supramaximal intensity, represents an effective method for improving swimming performance, partly through an increase in the anaerobic glycolysis activity [25];
- RSH-VHL (RSH – repeated-sprint training in hypoxia) improved RSA (RSA – repeated-sprint

ability) in swimming, probably through enhanced anaerobic glycolysis. This innovative method allows inducing benefits normally associated with hypoxia during swim training in normoxia [24].

In the program for the training of young swimmers, we propose to integrate the elements of aqua fitness and the method of interval hypoxic training (IHT) using the apparatus “Endogenic-01” [26]. There are no scientific data on the possibility of using ICT in combination with aqua fitness in the training process of swimmers of 11-12 years old.

Hypothesis. We anticipate that the integrated application of the endogenous hypoxic respiration method and the elements of aqua fitness in the training process of young swimmers will enhance their functional, general and special physical fitness.

The purpose of the study: to establish the complex impact of training sessions on elements of aqua fitness and the methods of interval hypoxic training on the special physical fitness of swimmers 11-12 years old.

Materials and methods.

Participants. In the experiment participated students of children’s and youth sports schools – boys aged 11-12 years ($n = 64$, sports experience - 2-3 years). Of these, there are three groups: control (CG, $n = 21$), the first basic (MG1, $n = 22$) and the second main (MG2, $n = 21$).

Organization of research. It was used the following swimming tests: “swimming with free style at a distance of 25 meters”, “freestyle swimming at distances of 4×50 m with a rest interval of 15 seconds”; “swimming with free style at a distance of 800 m”. It was also applied test to record the number of twists of 25 meters in the maximum possible speed (anaerobic mode of power supply). The number of repetitions was limited to an excess of heart rate of 170 beats per minute⁻¹ [17].

The research was carried out in stages: before the experiment begin, and then in 8, 16 and 24 weeks later.

Frequency of classes in all groups was 6 times a week. The content of the classes in the main groups was different from the control. Athletes of the first main group on each training session at the beginning of the preparatory part used interval hypoxic training (IHT) under the program of special “route maps” [26]. For this purpose, the device “Endogenic-01” was used.

Strength training for athletes of the second main group was carried out in water using elements of the aqua fitness power direction [7]. In the process of training used such aids as water belts, gloves, small and large dumbbells, nubs, boots, rubber shock absorbers, swimming boards [27].

Statistical analysis. Summing up are numerical indices that reflect the position of the center of empirical distributions and their scattering: arithmetic mean (\bar{x}); mean arithmetic mean error (m); mean square (standard) deviation (S); dispersion (S^2); coefficient of variation (V).

The values of the sample from the general population were subject to the law of normal distribution, which was verified using Pearson’s criterion. Student’s t-criterion

was used [28]. The difference was considered probable with a difference of 5% ($p < 0.05$).

Results.

Studies of special physical fitness of swimmers from the CG group showed that training sessions during 24 weeks did not cause any significant changes in any of the studied parameters.

Training sessions for swimming for 8 weeks in the group MG1 and the group MG2 did not cause any of the indicators of special physical fitness.

Six weeks after the beginning of classes in boys of the group MG1, an improvement (5.85%, $p < 0.05$) of the results of the first segment gliding recorded in the “4×50m freestyle skating test with a rest interval of 15 sec” was registered (Table 1)

In the group MG2 (after 16 weeks), the “800m freestyle” and “free 25m style flying with the highest possible speed” test dropped by 2.81% and 4.13%. In this group, the time to overcome the first and second segments in the test “4×50 m free-range driving with a rest interval of 15 seconds” decreased by 5.11% and 5.00%, respectively. Also, the number of sailings of 25-meter intervals with maximum intensity (heart rate 150-170 beats per minute⁻¹) has increased (by 21.15%) (Table 1).

Boys of groups MG1 and MG2 (after 24 weeks) improved their results of performing tests that characterize the capacity in aerobic energy supply zone (by 3.42% and 5.66%) and efficiency in anaerobic alactated energy supply zone (by 6.22% and 9.26%). The capacity of an anaerobic alactatic system grew by 25.93% and 38.46% respectively.

Athletes of the group MG1 (after 24 weeks) decreased the time to overcome the first segment in the test “4×50m freestyle diving with a rest interval of 15s” by 6.22%. In the second segment decreased by 5.86%. In the group MG2, the results of the first and second segments in this test improved by 9.48% and 6.23% respectively.

Discussion.

The results of control competitive testing of swimming are confirmed by the results of research by scientists [9, 17] on the limitation of the ability of swimmers of adolescence to perform work under conditions of anaerobic metabolism.

The information of scientists [9, 27] on the effectiveness of using interval hypoxic training in the system training of athletes has been confirmed and supplemented. Other authors [9, 17] used the technique of interval hypoxic training in swimmers. After 16 weeks of training sessions swimmers had a probable increase in work capacity in the area of aerobic and anaerobic lactate energy supply. The results of their own research have shown that the use of IHT in the training process of swimmers aged 11-12 years contributes to improving efficiency in areas of aerobic, anaerobic alactatious and lactate energy supply. The expediency of using our proposed program of training sessions with swimmers of 11-12 years old is also indicated by an increase in the capacity of anaerobic

Table 1. Indicators of special physical fitness of 11-12 years old swimmers at different stages of the study (CG, n = 21, MG1, n = 22, MG2, n = 21)

Indexes	Groups Before exercises start	Mean value, x±S			
		After 8 weeks	after 16 weeks	after 24 weeks	
Freestyle swimming 800 m, sec	CG	798,24±7,28	793,38±8,28	790,19±8,46	776,57±7,99
	MG1	797,82±7,25	790,59±6,68	778,27±6,68	770,55±6,34*
	MG 2	799,71±6,86	790,05±5,50	777,24±5,15*	754,43±4,32*
1st length, sec	CG	35,06±0,51	35,01±0,41	34,86±0,41	33,70±0,44
	MG 1	35,09±0,80	35,06±0,80	33,04±0,59*	32,91±0,60*
	MG 2	35,30±0,67	35,17±0,67	33,50±0,55*	31,96±0,50*
Freestyle swimming 4x50 m with a rest interval 15 sec:	CG	37,86±0,51	37,81±0,51	37,78±0,51	37,38±0,52
	MG 1	37,96±0,83	37,89±0,83	36,69±0,70	35,73±0,67*
	MG 2	38,01±0,68	37,92±0,67	36,11±0,59*	35,64±0,61*
3d length, sec	CG	40,48±0,61	40,37±0,61	40,27±0,62	39,74±0,63
	MG 1	40,84±0,85	40,75±0,85	40,58±0,85	40,04±0,83
	MG 2	40,71±0,71	40,57±0,69	40,36±0,69	39,27±0,59
4th length, sec	CG	43,35±0,78	43,29±0,78	43,21±0,77	42,69±0,77
	MG 1	43,61±0,85	43,52±0,85	43,29±0,86	42,15±0,76
	MG 2	43,42±0,74	43,29±0,75	43,08±0,76	41,64±0,64
Freestyle swimming on 25m, sec	CG	15,80±0,23	15,75±0,24	15,64±0,24	15,50±0,24
	MG 1	15,79±0,35	15,74±0,34	15,15±0,34	14,48±0,31*
	MG 2	15,85±0,26	15,63±0,24	15,20±0,15*	14,39±0,16*
Swim distances 25 m with HR 150-170 bits per minute ¹ , number of length	CG	2,48±0,18	2,71±0,12	2,76±0,12	2,86±0,12
	MG 1	2,45±0,17	2,73±0,11	2,86±0,11	3,09±0,11*
	MG 2	2,48±0,18	2,86±0,12	3,00±0,12*	3,43±0,12*

Note: HR is the heart rate.

alactated energy supply system for young swimmers.

For the first time, elements of aqua fitness and interval hypoxic training were used in the training process of young swimmers. The expediency of such innovation, we explain: minimizing the negative impact on children's body of exercises on the development of force in conditions of the aquatic environment; improving the functional capabilities of the body. The benefits of such combination are evidenced by the results of studies of special physical fitness after the completion of the molding experiment. In athletes of the MG2 group, after 24 weeks, the efficiency in the aerobic energy supply zone was significantly higher compared to the results of the groups of CG and MG1 (2.85% and 2.09%). The capacity of the anaerobic alactatious system of young swimmers by 20.00% and 10.92% exceeded the indicators of the groups of CG and MG1.

The time to overcome the distance of 25 m in free style with the highest possible speed in the group MG2 was

7.21% better than in the CG group. The time of sailing of the first and second segments at a distance of 4 × 50 m free style with an interval of 15 seconds also improved by 5.18% and 4.65% respectively.

The results of the implementation of control tests by the swimmers of the group MG2 supplemented the scientific information of other authors [8, 10, 27] on the effectiveness of the use of aqua fitness in training sessions. The correctness of our approaches to improving the physical condition of children is confirmed by other studies [29, 30].

Conclusions

The results of the research showed that training sessions with swimming with the use of elements of aqua fitness and interval hypoxic training contribute to improving the efficiency of swimmers of 11-12 years old in the zone of aerobic, anaerobic alactatious and anaerobic lactate energy supply.

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Conflict of interest.

The authors state that there is no conflict of interest.

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Information about the authors:

Furman Yu. M.; <http://orcid.org/0000-0002-5206-7712>; furman-dok@ukr.net; Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Ostroz'koho st., 32, Vinnytsia, 21100, Ukraine.

Holovkina V.V.; <http://orcid.org/0000-0001-9912-7754>; akvavita72@gmail.com; Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Ostroz'koho st., 32, Vinnytsia, 21100, Ukraine.

Salnykova S.V.; <http://orcid.org/0000-0003-4675-6105>; aqvaveta@ukr.net; Vinnytsia institute of trade and economics of Kyiv national university of trade and economics; Soborna st., 87, Vinnytsia, 21050, Ukraine.

Sulyma A.S.; <http://orcid.org/0000-0003-1858-0085>; allasulyma16.83@gmail.com; Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Ostroz'koho st., 32, Vinnytsia, 21100, Ukraine.

Brezdeniuk O.Yu. (Corresponding author); <http://orcid.org/0000-0003-0844-8777>; sandrikk86@gmail.com; Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Ostroz'koho st., 32, Vinnytsia, 21100, Ukraine.

Korolchuk A.P.; <http://orcid.org/0000-0003-0372-9246>; korolchuk23.76@gmail.com; Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Ostroz'koho st., 32, Vinnytsia, 21100, Ukraine.

Nesterova S.Yu.; <http://orcid.org/0000-0002-9621-0218>; svetanest01@gmail.com; Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Ostroz'koho st., 32, Vinnytsia, 21100, Ukraine.

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