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## Sports Selection-Based Optimisation of Physical Exercise Load for Finswimmers

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*It is proposed to consider optimal management of the exercise load for 10-year-old school children attending Youth Underwater Sports School. Exercise load optimisation is based on the factors that influence the efficiency of finswimming training in the initial training groups and methods of sports selection.*

*In order to evaluate the factors that influence the efficiency of training we have selected research methods considering age peculiarities. During a one-year experiment some initial notions of the optimisation theory and ideas about different approaches to the problem of optimal management of the training process have been formed.*

*Anthropometric examinations allowed to determine indicators of physical development and their contribution into the results of control distances using correlation analysis.*

*A correlation analysis-based complex of special exercises for finswimmers has been developed. Out of all possible options of influence those have been chosen that more efficiently allow to learn finswimming. Such a method of training is offered that is based not only on development of a general physical and swimming base, but also on learning coordination techniques in accordance with the sensitive period of development. Special attention is paid to technical training at the initial stage, to the method of starting, turning and distance speed in particular. For the first time it has been proposed to consider a summary indicator of success in young sportsmen training.*

*Keywords: finswimming, sports selection, optimisation, training process, special exercises, swimming technique, correlation analysis.*

### Introduction

The problem of physical exercise optimisation based on preliminary sports selection is very up-to-date. This is due to the fact that world records at the international and Olympic arenas are set up by young athletes. Maximum physical and psychological loads are extremely increasing, thus demanding much not only from the athletes' health, but from their behavioural response and

ability to mobilize the resources at the important start.

In numerous studies (Bril, 1980; Bryankin, 1982; Bulgakova, 1978; Bulkin, 1975; Guzhalovsky, 1986; Zelichenok, 2000; Moskovchenko, 2005 et al.) it is highlighted that the training process can be optimized by qualitative selection and sports orientation. Hence, it is necessary to study in detail individual peculiarities of children

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and teenagers who aim for top sports results. Moreover, in the process of sports selection those missing links can be identified that can prevent from achieving significant results in the future even if the athlete has doubtless motorial abilities. This point of view is also shared by the authors (Filin, 1987; Shwartz, 1984), who think that for sports and optimisation of the training exercise load it is necessary to consider the criteria of selection, state of health and analyser systems of the organism, morphological features, the level of physical fitness and coordination capabilities.

According to the opinion of N. Bulgakova and A. Vorontsov (1990) forecasting of the result is an important element of the optimal approach to the sport fitness and potential of swimmers. Forecasting of the swimmer's potential should be done in two stages. At the initial stage of selection morphological, strength, bioenergetic and sensory-motor indicators are studied that limit the level of sports achievements. Afterwards basing on the obtained statistic material, estimation scales or tables are built and summary estimation of the sports potential is derived.

V. Bulkin (1975) considers that optimisation should be understood as a system merger of the results of pedagogic control, modeling and forecasting in which all the above mentioned components are considered as system forming structural elements. Yu. Kurashmin (1986) is of the same opinion. He considers the problem of optimisation in swimmers' training as the object of system analysis based on the tendency of sports results improvement. Comparing the time spent for doing standard exercises (from the third class to the master of sport levels) the author determines potential abilities of an athlete. Herewith, special attention is paid to age and time of performing each standard exercise depending on the training stage.

Information analysis showed that sports selection is considered as a long-term multi-stage

process. Optimisation of the training process and the level of the athlete's proficiency depends thereupon. Therefore, solving the problem of the sports selection is one of the most important areas of modern sports science.

Notwithstanding certain success in studying the problem in specific kinds of sports (M.S. Bril, N.Zh. Bulgakova, G.S. Tumanyan et al.) and development of general methodology of sports selection (M.S. Bril, A.I. Bryankin, V.M. Volkov, V. P. Filin, V.B. Shwartz, S.V. Khrushchev et al.), materials on the issues of selecting swimmers and finswimmers are almost absent.

Moreover, anthropometric indicators of physical development and ontogenetic dynamics of individual type peculiarities of the organism of children and teenagers who practice speed kinds of underwater swimming depend much on the sports kind and practicing of the movement technique. This has served as the subject of this study.

Objective of the study. To optimize physical exercise load for beginning finswimmers basing on the correlative dependence of the indicators of sports selection and their contribution into the result at control distances.

### **Materials and methods of study**

In a one-year experiment 30 10-year-old children (15 girls and 15 boys) took part. They did not know how to swim and were trained in initial training groups 6 hours per week. The training programme corresponded to the programme of Youth Underwater Sports School; 90% of the training time was devoted to training and mastering of crawl and dolphin finswimming, exercise of the main elements of starting and turning techniques.

One of the objectives of the experiment was aimed at selection of methods, which determine medical, biological and pedagogical criteria of

selection in order to forecast sports abilities and potential of an athlete.

During the experiment anthropometric measurements were done in accordance with the methods of obtaining information about physical development method (Moskovchenko, 1998). Criteria of physical development were height, weight, weight-height index, chest circumference, vital lung capacity, vital index, hand and back strength dynamometry, power index, shoulder joint flexibility. Previously we have developed centile ranges for each indicator. According to these indicators the assessment was done. To obtain the information about the level of the functional condition of the respiratory system and organism's resistance to oxygen deprivation, hypoxic tests of Stange and Genche were applied; functional capabilities were assessed by criteria (Kulba, 1999). Maximum oxygen consumption was calculated according to the formula (Dembo, 1986). Nervous processes and indicators of psychomotor abilities (accuracy of reproducing movements' amplitude, muscular efforts and time periods) were assessed using O.N. Moskovchenko's method (1999).

An omegametric method is measuring of an indicator of difference of potentials between the points of head vertex and tenor of the right and the left hands, vector of the potential dynamics by the first minutes after a standard physical exercise expressed in millivolts. Registration of the omega-potential was done according to the currently accepted method (Sychev, Ilyukhina, 1980, modified by Moskovchenko, 1996, 1997, 2004).

To assess the specific power of a finswimmer the "Dynamometry of the tractional force" method was applied using a dynamometer and O.N. Moskovchenko's method (1976). Athletes were offered to extend the elastic tractional force by working with their legs using crawl and

dolphin methods. The dynamometer registered the maximum tractional efforts when the sportsmen were swimming dolphin or crawl on chest.

The following special exercises were used as control tests in order to assess the development of the finswimming technique:

- sliding on the chest underwater pushing off the swimming pool's wall without any hand or leg strokes;
- dolphin diving. This exercise is performed by pushing off the board with two legs simultaneously; an athlete moves under the water surface with breath holding 15 m., performing dolphin stroke with his legs in fins.

### Results of the study and discussion

To optimize the physical exercise the correlation between the result showed at the control start and tests' indicators was studied. We have determined how each of the tests influences the result: to solve this task we used the method of correlative analysis. Reliability of differences was determined with the help of multidimensional statistics. The range of accepted values has been determined by weight coefficients of the main components.

The amount of assessment test was determined by the Spearman–Brown reliability index:

$$\hat{r}_{xy} = \frac{\hat{r}_{xy}}{\sqrt{r_{xx} \cdot r_{yy}}} \quad (1)$$

where  $\hat{r}_{xy}$  is the correlation between true values of  $x$  and  $y$ ;  $r_{xy}$  stands for the correlation between empiric data;  $r_{xx}$  and  $r_{yy}$  is the assessment of reliability of  $x$  and  $y$ .

The values of  $r$  from 0.85 to 0.99 were accepted as highly reliable and were used to determine tests' objectivity. Rigid criteria of assessment allowed

Table 1. Indicators of the correlation link of the studied indicators with the results of finswimmers (girls)

Dolphin finswimming (50 m)		Crawl finswimming (200 m)	
Studied indicators	Correlation coefficient	Studied indicators	Correlation coefficient
Omega-potential, 30 – 40 mV.	0,96	Omega-potential, 28 – 42 mV.	0,97
Physical development	0,95	Physical development	0,95
Tractional effort in water, dolphin swimming	0,92	Tractional effort in water, crawl swimming	0,92
Starting technique	0,92	Turning technique	0,89
Stange test, s.	0,88	Stange test, s.	0,89
Genche test, s.	0,86	Genche test, s.	0,85
Nervous processes activity	0,94	Nervous processes activity	0,87
Indicators of psychomotor capabilities	0,88	Maximum oxygen consumption (design coefficient)	0,92

Table 2. Indicators of the correlation link of the studied indicators with the results of finswimmers (boys)

Dolphin finswimming (50 m)		Crawl finswimming (200 m)	
Studied indicators	Correlation coefficient	Studied indicators	Correlation coefficient
Omega-potential, 30 – 40 mV.	0,98	Omega-potential, 28 – 42 mV.	0,97
Physical development	0,96	Physical development	0,95
Tractional effort in water, dolphin swimming	0,94	Tractional effort in water, crawl swimming	0,94
Starting technique	0,90	turning technique	0,92
Stange test, s.	0,90	Stange test, s.	0,86
Genche test, s.	0,87	Genche test, s.	0,88
Nervous processes activity	0,85	Nervous processes activity	0,87
Indicators of psychomotor capabilities	0,85	Maximum oxygen consumption (design coefficient)	0,86

to describe correlation of studied indicators at quite a reliable level. Moreover, the coefficient of determination  $D$  was calculated. This coefficient showed how the value of the function corresponds to its real values. The closer  $D$  is to 1, the higher is the adequacy of the test.

In Tables 1 and 2 correlation links of selected specific tests are given that influence sportsmen's results.

Analysis of Tables 1 and 2 shows that the main factors determining the success of realisation of the sports result of finswimmers at

the initial training stage, as for girls, so for boys, are as follows: indicators of the omega-potential, physical development, tractional efforts in water and technique of starting and turning.

The omega-potential is an integral indicator of neurohumoral and endocrine regulation of the body. The optimal values are the initial level values of the omega-potential ranging from 20 to 44 mV preserving inter-system interactions at different levels of adaptation as defined by seven-minute dynamics of the omega-potential after a standard exercise (Moskovchenko, 1997, 2004).

Data of the omega-potential allow to judge about safety or failure of adaptive self-regulation mechanisms of the organism's states, tolerance to physical and mental stress, which further helps to forecast success or failure of an athlete.

Physical development is one of the informative parameters indicating the level of formation of morphological and physiological parameters of the body under exposure to various factors (living conditions and nutrition, hereditary factors, etc.), including physical exercise. The high correlation ( $r = 0,95, 0,96$ ) of summary indicators of physical development with the results at control distances points at sufficient morpho-functional features of the organism. This implies that the method of preparation was adequate to the functional capabilities of young sportsmen's bodies. The method of training was based on creating a base of general physical training, systematic increase in the total exercise load, learning the technique of starting, turning and distance speed at the initial stage of training.

N.Zh. Bulgakova (1978) points out that only independent anthropometric characteristics out of the complex of functional and anthropometric indicators among young 10-year-old swimmers displays sufficiently high correlation with the achievements in swimming. Further dynamics in the growth of results in swimming is associated with learning physical actions.

Muscular performance in its any form is, above all, the improvement of functional capabilities of various systems of the body, activity of the nervous system and coordination capabilities. The leading role in correlation coefficients belongs to Stange and Genche tests, which allow to assess functional capabilities of the respiratory system in conditions of oxygen deprivation.

For girls the maximum correlation of this indicator with the result ( $r = 0,90$ ) is observed for

50 m distance dolphin finswimming, for boys the maximum correlation of this indicator with the result was registered for 200 m distance crawl finswimming. It should be noted that breath holding at breathing-in by the average group values was evaluated ambiguously. Moreover, this test shows the indirect expression of volitional qualities of an athlete. The body tolerance to oxygen deprivation was judged upon the Genche test results. Calculation of the correlation between this indicator and the results showed that no significant differences in the group of girls and boys were observed.

The mobility of nervous processes and psychomotor performance indicate that girls have higher indicators in manifestation of coordination capabilities than boys. Especially such types of coordination capabilities as differentiating, rhythmic, orienting and the capability to balance the body in space, which, in our opinion, affect the quality of turning performance. This situation is fully explained by the fact that coordination abilities of girls reach their maximum by the age of 10, as their nervous system is more plastic than the nervous system of the boys of the same age. Other researchers (Gorskaya, 1993; Lyakh, 1991; Blume, 1983; Hirtz, 1982 et al.) also note that for girls the age of 10-12 and for boys the age of 11-13 is the best period for developing their coordination capabilities.

For 200 m crawl finswimming high correlation with the indicator of the maximum oxygen consumption ( $r = 0,92, 0,86$ ) was observed for boys and girls correspondingly, which characterizes aerobic capacity of the body.

While one of the most important factors influencing the result of an athlete is the indicator of the sports technique perfection, we have analyzed the correlation between special tests and elements of the sports technique of an underwater swimmer (Table 3).

Table 3. Ratio of correlation structures of forming characteristics of finswimming technique depending on special tests

Special tests	Characteristics of finswimming techniques					
	Starting technique	Turning technique	Front crawl diving technique 15 m with pulling off	Front crawling technique 15 m from the start	Swimming technique 50 m dolphin	Swimming technique 200 m crawl
Sliding on the chest underwater	0,80	0,98	0,93	0,83	0,82	0, 89
Tractional efforts in water at crawling on the chest	0,96	0,96	0,94	0,92	0,89	0, 93
Tractional efforts in water at dolphin swimming	0,92	0,88	0,89	0, 90	0,94	0, 86
Dolphin kick diving 10 m	0,87	0,85	0,83	0, 79	0,96	0,72
Back strength	0,72	0, 75	0,84	0,85	0,78	0, 97
Shoulder joint flexibility	0,61	0,82	0,68	0,76	0,88	0, 56

Correlation studies have provided the data about the information value of special test exercises with probability ( $p < 0,05$ ) for all characteristics of finswimming techniques. The dynamic component of the finswimming technique can be judged upon the maximum traction of a swimmer in water while crawl finswimming or dolphin finswimming. Both the tractive power during crawl finswimming and the tractive power during dolphin finswimming have high correlation coefficients ( $r = 0,88 - 0,96$ ). This suggests that for a finswimmer these tests are specific in the conditions of the water environment and do not determine the absolute power and his/her power capabilities, which should be taken into consideration in technical training. The exercise "sliding on the chest under the water" is universal for crawl and dolphin swimming, while it allows to create a streamlined position in the water. This exercise has the maximum correlation with the technique of turning and crawl swimming on the chest ( $r = 0,98, 0,89$ ). The exercise "dolphin kick diving" has a greater degree of correlation with dolphin swimming performance at the distance of 50 m

and the technique of turning ( $r = 0,96, 0,85$ ). The lowest indicators of correlation are between the shoulder joint flexibility and sports results, which can be easily explained. Excessive flexibility of the shoulder joint can lead to the failure of the best swimming technique both for crawling and dolphin.

Alexander Shumkov, the USSR honoured coach, master of sports of the international class (2008, p. 33), considers the efficient technique to be very important in finswimming. "Good swimming technique is the ability to move in the water with optimal efforts and most effectively by the result."

With the help of special exercises not only specific qualities of a finswimmer are developed, but the following physical characteristics as well: special and general endurance, speed-strength qualities, coordination capabilities, specific flexibility and strength abilities.

In the final part of the experiment the last control test was performed. The objective of the test was summing up a year-long training course and selection of promising athletes for further improvement of their sportsmanship.

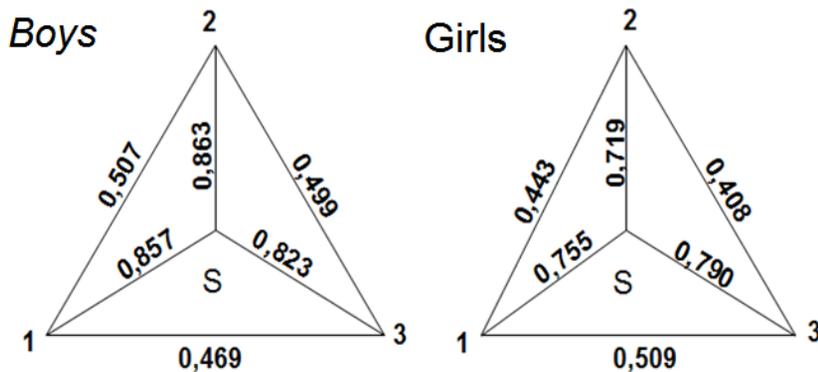


Fig.1. Structural correlation of criteria of success in finswimming training: S – summary indicator of training success; 1– result in 50 m dolphin swimming; 2 – expert assessment of the technique; 3 – result in 200 m crawl swimming

The potential was estimated by the following indicators:

- time of swimming 50 m distance by dolphin finswimming method;
- summary expert evaluation of the dolphin technique performance, technique of starting and turning;
- time of swimming 200 m distance by crawl finswimming method;

We considered the summary of all three above mentioned indicators, which was considered as a summary indicator of the training success (Fig. 1).

The summary indicator (S) of the successful training is closely correlated with the time of overcoming distances of 50 m and 200 m, as well as the expert evaluation of the technique both of boys and girls, while the correlation of these individual indicators between each other is uncertain. In our opinion, the annual success indicator should have not group but individual differences in the studied parameters, or the result itself does not really matter at the initial training stage at this age. Thereafter the summary indicator is accepted as the criterion for successful training.

### Conclusion

In summary, we propose the following factors that determine the success of finswimmers training at the initial training stage. The indicators of the omega-potential should be considered as informative criteria, while they characterize functioning of the body's systems of adaptation to physical and psycho-emotional stress and mental readiness of an athlete. Physical development (constitutional and morphological features), technical training (technique of starting, turning and distance swimming), peculiarities of the mobility of nervous processes and psychomotor functions.

The main objective of this stage is development of general physical fitness, aerobic capacity and coordination capabilities in accordance with the sensitive period. In addition, a coach needs to know the state of health, personal characteristics and behaviour in extreme situations of an athlete.

Practical implementation of the proposed approach to the selection at the initial training stage ensures efficiency and reliability of optimisation of the training process at the next stages of training.

## References

- Бриль М. С. [M.S. Bril] Отбор в спортивных играх / М.С. Бриль. – М.: ФиС, 1974. – С. 24.
- Брянкин С. В. [S.V. Bryankin] Отбор и ориентация спортсменов: автореф. дис. ... канд. пед. наук. / С. В. Брянкин. – Малаховка: МОГИФК, 1982.
- Булгакова Н. Ж. [N.Zh. Bulgakova] Отбор и подготовка юных пловцов / Н. Ж. Булгакова. – М.: ФиС, 1978. – С. 17.
- Булгакова Н. Ж. [N. Zh. Bulgakova] Методология разработки комплексной оценки плавательной перспективности / Н. Ж. Булгакова, А. Р. Воронцов // Теоретические и методологические аспекты проблемы отбора в спорте (результаты совместных исследований специалистов ГДР и СССР по проблеме «одаренность – отбор»). – М., 1990. – С. 113.
- Булкин В. А. [V.A. Bulkin] Отбор квалифицированных спортсменов и диагностика состояния их готовности для участия в ответственных соревнованиях / В. А. Булкин // Отбор и подготовка квалифицированных спортсменов к ответственным соревнованиям: Сб. науч. тр. – Л.: ЛНИИФК, 1975. – С. 5.
- Горская И.Ю. [I.Yu. Gorskaya] Базовые координационные способности школьников с различным уровнем здоровья: монография /И.Ю. Горская, Л.А. Суянулова. – Омск: СибГАФК, 2000. – 212 с.
- Гужаловский А. А. [A.A. Guzhalovsky] Проблемы теории спортивного отбора / А. А. Гужаловский // Теория и практика физической культуры. – 1986. – № 8. – С. 24.
- Дембо А. Г. [A.G. Dembo] Новое в исследовании системы кровообращения спортсменов / А. Г. Дембо, Э. В. Земцовский, Ю. М. Шапкайц // Теория и практика физической культуры. – 1986. – № 11. – С. 42.
- Зеличенко В. Б. [V.B. Zelichenok] Легкая атлетика: Критерии отбора / В. Б. Зеличенко, В. Г. Никитушкин, В. П. Губа. – М., 2000. – 238 с.
- Иваницкий В. В. [V.V. Ivanitsky] Влияние систематических занятий подводным плаванием на физическое развитие, функциональное состояние и умственную деятельность подростков 14-16 лет / В. В. Иваницкий, О. Н. Московченко // Пути совершенствования физического воспитания школьников. Красноярск, 1980. Вып. 2. – С. 41-49.
- Иваницкий В. В. [V.V. Ivanitsky] Факторы, влияющие на эффективность обучения плаванию в ластах в группах начальной подготовки / В. В. Иваницкий // Педагогическое и медико-биологическое обоснование физического воспитания, спортивной тренировки и здорового образа жизни: межвузовский сборник / Отв. ред. О.Н. Московченко; КрПИ. – Красноярск, 1990. – С. 136-141.
- Илюхина В. А. [V.A. Ilyukhina] Омега-потенциал – количественный показатель состояний структур мозга и организма: сообщение / В. А. Илюхина, А. Г. Сычев, Н. И. Щербакова, Г. И. Барышев, В. В. Денисова // Возможности и ограничения использования омега-потенциала для экспресс-оценки состояний организма человека // Физиология человека. – 1982. – Т. 8. – № 5. – С. 721.
- Коган О.С. [O.S. Kogan] Медико-биологические проблемы спортивного отбора профессионалов / О.С. Коган// Теория и практика физической культуры. – 2003. № 8. – С. 43-46.
- Кульба С.Н. [S.N. Kulba] Физическое развитие. Оценка состояния соматических систем организма человека в онтогенезе / С.Н. Кульба, Л.А. Бугаев, И.С. Хусаинова// Учебная

литература по валеологии под ред. профессора Г.А. Кураева; РГУ. – Ростов на Дону, 1999. – 72 с.

Курамшин Ю. Ф. [Yu.F. Kuramshin] Исследование эффективности индикаторного прогнозирования при отборе в ДЮСШ: автореф. дис. ... канд. пед. наук / Ю. Ф. Курамшин. – Л., 1974.

Лях В.И. [V.I. Lyakh] Двигательные способности школьников: основы теории и методики развития / В.И. Лях. – М.: Терра-Спорт, 2000 – 192 с.

Мартынов Н. Н. [N.N. Martynov] К проблеме отбора способных детей для занятий спортом / Н. Н. Мартынов, П. З. Сирис, В. А. Стрельцов // Теория и практика физической культуры. – 1986. – № 6. – С. 32.

Московченко О.Н. [O.N. Moskovchenko] Исследование вопросов оптимизации тренировки пловца-подводника: дис...канд. пед. наук / О.Н.Московченко. – М.: ГЦОЛИФК, 1978. – 180 с.

Московченко О.Н. [O.N. Moskovchenko] Оптимальная стратегия в годичном цикле подготовки / О.Н. Московченко/ Спортсмен-подводник. – М.: Изд. ДОСААФ СССР, 1979. № 57. – С.10-15

Московченко О. Н. [O.N. Moskovchenko] Современные пути оценки адаптивных возможностей спортсменов как критерий спортивной перспективности / О. Н. Московченко // Физкультурное образование Сибири. – Омск: СибГАФК, 1997. – Вып. 1 (5). – С. 93-105.

Московченко О. Н. [O.N. Moskovchenko] Практикум по валеологии: учебное пособие / О. Н. Московченко. – Красноярск: КГТУ, 1999. 228 с.

Московченко О. Н. [O.N. Moskovchenko] Омегаметрия-метод экспресс-диагностики в оценке адаптивных возможностей организма человека (прикладные аспекты): Сообщение первое/ О. Н. Московченко // Валеология. 2004. № 2. – С. 14-20.

Московченко О.Н. [O.N. Moskovchenko] Валеологический подход к отбору и управлению подготовкой борцов греко-римского стиля на этапе углубленной специализации: монография. / О.Н. Московченко, А.В. Шумаков. – Красноярск: ИПЦ КГТУ, 2005. – 158 с.

Московченко О.Н. [O.N. Moskovchenko] Оптимизация тренировочного процесса пловцов-подводников на основе анализа зависимости «мощность – предельная работа» // Физическая культура и спорт в системе образования: Сборник материалов IX Всероссийской научно-практической конференции 17-19 апреля 2006 г. Отв.ред. В.М. Гелецкий // О.Н. Московченко, В.В. Иваницкий. – КГУ: Красноярск, 2006. – С. 172–177.

Московченко О. Н. [O.N. Moskovchenko] Научные основы управления тренировочным процессом // Подводный спорт: современное состояние и перспективы развития: материалы международной научно-практической конференции / О. Н. Московченко – М. : Светотон, 2009. – С. 134-141.

Московченко О. Н. [O.N. Moskovchenko] Оптимизация физических нагрузок пловцов-подводников // подводный спорт: современное состояние и перспективы развития: материалы международной научно-практической конференции / О. Н. Московченко, В.В. Иваницкий, И.А. Толстопятов – М. : Светотон, 2009. – С. 148-156.

Московченко, О.Н. [O.N. Moskovchenko] Контрольные упражнения для оценки различных сторон подготовленности пловцов-подводников: Материалы Международной научно-практической конференции специалистов подводного спорта (5-6 мая 2010, г. Красноярск);

под общ. ред. О.Н. Московченко // О.Н. Московченко, В.В. Иваницкий, Е.К. Михайлова. – Красноярск: Сибирский государственный аэрокосмический университет, 2010. – С. 88-92

Сычев А. Г. [A.G. Sychev] Оценка адаптивных возможностей организма по данным гальванометрии: метод. указания / А.Г. Сычев, Н.И. Щербакова, О.Н. Московченко, В.И. Зыкова, В.В. Костенко, А.В. Шумаков. – Красноярск, 1988. – 28 с.

Тимакова Т. С. [T.S. Timakova] Значение морфо-функциональных показателей и индивидуальных темпов полового развития юных пловцов для отбора и спортивной ориентации / Т. С. Тимакова // Теория и практика физической культуры. – 1973. – № 2. – С. 45.

Травин Ю. Г. [Yu.G. Travin] Система отбора и спортивной ориентации юных бегунов: уч. пос. для слушателей ФПК и ВШТ / Ю. Г. Травин. – М., 1980. – С. 36.

Филатова Н. П. [N.P. Filatova] Отбор квалифицированных хоккеистов с учетом их психологических особенностей / Автореф. дис. ... канд. пед. наук. / Н.П. Филатова. – Омск: СибГАФК, 1995. – 23 с.

Филин В. П. [V.P. Filin] Система отбора юных спортсменов / В.П. Филин // Теория и методика юношеского спорта. – М.: ФиС, 1987. – С. 64.

Шварц В. Б. [V.B. Shwarts] Медико-биологические аспекты спортивной ориентации и отбора / В. Б. Шварц, С. В. Хрущев. – М.: ФиС, 1984. – С. 27.

Шумков А. [A. Shumkov] Азбука плавания в ластах. Ч.1 Основные упражнения на воде, применяемые в тренировке пловцов в ластах / А. Шумков, Л. Шумкова. – М.: ООО «Азбука-2000», 2008. – 85 с.

Фомин Н. А. [N.A. Fomin] Критерии отбора детей для специализированных занятий спортом / Н. А. Фомин // Физиология человека: учеб. пособие. – М.: Просвещение, 1982. – С. 309.

Blume D. D. Grundsätze und methodische Maßnahmen zur Schulung Koordinationer// Körpersichtung. – 1978. # 2.-S. 503-510.

Blume D. D. Einige aktuelle Probleme des Diagnostizierens Koordinativer motorischen Test // Theorie und Praxis des Körperkultur. – 1984. # 2.-S. 122-124.

Hirtz P., Ludwig G., Wellnitz I. Entwickelung Koordinativer Tätigkeiten? Aber wie?// Körperersichtung. – 1982/# 8-9.-S. 386-391.

Hirtz P. Koordinative Fähigkeiten im Schulsport. – Berlin: Volk und Wissen. – 1985. – 152 s.

Wutscherk H. Grundlagen der Sportanthropometrie / H. Wutscherk. – Leipzig, DHFK. – 1988. – 160 s.

## **Оптимизация физической нагрузки пловцов в ластах на основе спортивного отбора**

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*С целью оценки факторов, влияющих на эффективность обучения, проведен подбор методов исследования соответствующий возрастным особенностям. За период годичного эксперимента сформулированы некоторые исходные понятия теории оптимизации, терминологически оформились представления о разных подходах к проблеме оптимального управления тренировочным процессом.*

*Антропометрические обследования позволили выявить с помощью корреляционного анализа показатели физического развития и их вклад в результат на контрольных дистанциях.*

*Разработан комплекс специфических упражнений для пловцов в ластах на основе корреляционного анализа. Из всех возможных вариантов воздействий на результат выбраны те, которые наиболее эффективно ведут к овладению техникой плавания в ластах. Предлагается методика подготовки, которая базируется не только на создании базы общей физической и плавательной подготовки, но и овладении координационными способностями в соответствии с сенситивным периодом развития. Особое внимание уделено на начальном этапе обучения технической подготовке, и в частности, технике старта, поворота и дистанционной скорости. Впервые предлагается учитывать суммарный показатель успешности обучения юных спортсменов.*

*Ключевые слова: плавание в ластах, спортивный отбор, оптимизация, тренировочный процесс, специальный эксперимент, техника плавания, корреляционный анализ.*

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