

## Optimization of the speed-strength training technique for highly qualified swimmers

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### Abstract

The aim of the study is to optimize the modern methodology for improving the means and methods of speed-strength training of highly qualified swimmers. *Material.* The following research methods were used: theoretical analysis of scientific and methodical literature; pedagogical testing of strength and speed and power qualities; anthropometric measurements; determination of functional capabilities of swimmers in water and swimming technique; mathematical processing of the experimental data. The method of improving the means and methods of speed-power training of highly qualified swimmers is based on the study of the laws of adaptation of the body to competitive activity. Based on theoretical analysis of scientific and methodical literature the concept of methods of increasing speed and power qualities with the use of special equipment in water was developed and scientifically substantiated. In order to approve the author's method a pedagogical experiment consisting of: dynamics of speed and power qualities; dynamics of swimmers' functional abilities in water; stability of swimming technique in different speed modes was organized. Carrying out of the research was carried out in groups of the highest sports mastery and the youth swimming team of the Republic of Kazakhstan. *Results.* Improving speed and power qualities in swimmers of high qualification level was achieved by using in the preparatory phase 400 m free + 6 to 50 m exercises and 6 series of 75 m + 25 m with flippers; basic phase - 5 series of 125 m + 75 m + 2x25 m using flippers and shoulder blades and final phase - 8 series of 100 m + 50 m using flippers + shoulder blades. *Conclusions.* An important factor when using the technique of improving speed and power qualities is stability of swimming technique. The use of this technique in groups of initial training and sports improvement may not cause the expected effect and have a negative impact on improvement of swimming technique.

**Key Words:** swimming, high-performance sport, speed and strength training, dynamic development.

### Introduction

The relevance of the study is determined by the fact that to date in the Republic of Kazakhstan is an acute problem in the preparation of highly qualified athletes, able to represent the country on the international arena with dignity. One of the reasons for this problem is the low qualification potential of the coaching staff, specializing in the training of highly qualified sports reserve (Venâncio, Tacani, & Deliberato, 2012; Kalieva, et al, 2015; Yerlan, et al., 2020).

Due to the fact that the current process of training of Kazakhstan's highly qualified swimmers is chaotic and unsystematic due to the lack of a unified training methodology, there is a need to develop a scientifically justified special modern training methodology to improve sportsmanship (Rouse, & Yakavets, 2014; Karabassova, 2020; Gussakov, et al., 2021). In the world practice of training highly qualified swimmers, there is an increasing trend towards a decrease in the volume of swimming and an increase in the level of intensity of training loads (Davies, et al., 2018; Forte, et al., 2020). This trend is based on the need to improve the speed-strength training of swimmers, since these qualities play a key role in fulfilling the maximum level of physical activity lasting up to two minutes (Yapici-Oksuzoglu, 2020; Wirth, et al., 2022).

Both coaches and researchers are working to identify new, more effective methods of training athletes based on world experience, which would be based on increasing the level of functioning of various body systems. These actions create the basis for the development of a modern methodology for improving speed-strength qualities in the preparation of highly qualified swimmers (Rasulovich, 2021; Mykhaliuk, & Horokhovskiy, 2022).

In the scientific and methodological literature on the issue of special speed-strength training in swimming over the past 30 years, the process of increasing the level of physical qualities is described quite briefly. In many respects, the analysis of literature data shows that the peculiarity of the methodology for training swimmers in the countries of the USSR and the GDR was mainly aimed at increasing the level of maximum oxygen consumption and increasing the volume of swimming in order to hone the swimmer's technical skills (Sperlich, et al., 2010; Schaal, et al., 2013).

However, today swimming as a sport of the highest achievements is a cyclic complex of complex special technical speed-force elements in the aquatic environment. Thus, the problem is to find modern means and methods of increasing the level of development of speed-force qualities in qualified swimmers (Shtsterova, et al., 2017; Alrabadi, 2021). The relevance of solving this problem and determined the sides of our research. *The aim of the study* is to optimize the modern methodology for improving the means and methods of speed-strength training of highly qualified swimmers.

## **Material & methods**

### *Participants*

32 qualified swimmers (18 male, 14 female). 16 – 20 years old.

*Date and place of research:* Kazakhstan, Almaty. From November 2019 to December 2020.

The instrumental study was approved by the Ethics Committees of Kazakh Academy of Sport and Tourism with accordance the ethical standards of the Helsinki Declaration.

### *Procedure and research methods*

The following research methods were used: theoretical analysis of scientific and methodical literature; pedagogical testing of strength and speed and power qualities; anthropometric measurements; determination of functional capabilities of swimmers in water and swimming technique; mathematical processing of the experimental data.

The method of improving the means and methods of speed-power training of highly qualified swimmers is based on the study of the laws of adaptation of the body to competitive activity. Based on theoretical analysis of scientific and methodical literature the concept of methods of increasing speed and power qualities with the use of special equipment in water was developed and scientifically substantiated. In order to approve the author's method a pedagogical experiment consisting of: dynamics of speed and power qualities; dynamics of swimmers' functional abilities in water; stability of swimming technique in different speed modes was organized. Carrying out of the research was carried out in groups of the highest sports mastery and the youth swimming team of the Republic of Kazakhstan.

### *Pedagogical testing of strength and speed and power qualities:*

In order to determine the level of general strength qualities on land, a test was conducted on three basic exercises (bench press, squat with barbell on the back, and pull-up on the bar). In all three exercises three attempts were performed (80%, 90% of PM and maximum repetition), the speed and rest interval were chosen by the athletes individually according to their own feeling; the time of the test was not recorded. In each exercise the weight of the lifted apparatus for one maximum repetition was recorded with the condition of correct technical execution. Tests for determination of speed-power qualities on land were performed in the gym using the equipment of the Italian company Powerzer TENDO.

### *Anthropometric measurements:*

Bioelectrical impedance analysis using a Medass ABC 01 bioimpedance analyzer was used to identify the component composition of the body of swimmers. The body composition analyzer was used to measure skeletal muscle mass, fat mass, fractions of active muscle mass, total fluid, intracellular fluid and extracellular fluid.

### *Determination of functional capabilities of swimmers in water and swimming technique:*

For the study we used a hardware-software complex, which includes a dynamic system equipped with video cameras DJI OSMO, following the athlete on the side of the pool at the moment of the swimming segment. All the pool parameters were preliminarily marked and calibrated for further processing of the results; a personal computer adapted for processing the video signal into a digital format was used. After the testing was finished, the obtained video materials were processed in the computer programs Rein Haljand program and Objectus Video Analysis program.

These programs allow to trace the dynamics of underwater kinematic indicators, i.e. stroke rate, stroke length, stroke frequency and angular deviation. Athletes were instructed and prepared for this test. The test included six swims of 50 meters in the main style with a full rest interval. Each athlete was given an individual speed for each section, the last two sections the athlete swam at the highest possible intensity level, while the first through the fourth sections the athlete swam in progression. The test was performed in competition mode, using starting wetsuits. Beforehand the athletes continued to perform a warm-up set of exercises on land and in water swimming not more than 1500 m in the same conditions.

### *Special equipment used in the development of the author's methodology.*

The use of various special equipment is widespread in the global swimming community. Every year more and more companies, both large and small, produce new special simulators. All of them are arranged according to two main principles: resistance (English - resist) and help (English - assist). Simulators that provide a certain level of resistance are aimed at complicating the movement of a swimmer in the water, while others are directed, on the contrary, to help in progress, for example, fins. In the author's methodology, we used simulators that meet these two principles.

Figure 1 shows a special sports equipment used in the training process of the author's methodology, with the development of speed-strength qualities.



Fig 1. Inventory used in the method of increasing speed and strength qualities  
(1 - hydraulic brake; 2 - Small shoulder blades for hands; 3 - parachute; 4 - socks)

Hydraulic brake is a sports equipment, which is sports swimming trunks made of mesh material and the presence of several open pockets in front and behind. The design of this inventory provides additional resistance when swimming.

Small shoulder blades for hands - sports equipment designed on the principle of classical swimming blades, but having a small area and located in the area of fingers of the hand. This equipment allows you to develop a high frequency of rowing movements with little resistance.

A parachute is a sport equipment consisting of a belt, a 1.5 m long rope and a mesh parachute. The belt is attached to the belt of the athlete and swim sections are performed, the parachute at the other end of the rope provides additional resistance.

The socks are a special equipment, which are two small mesh bags that are fixed with elastic bands on the athlete's ankle. The trainer provides additional resistance when performing rowing movements with the legs.

## Results

Table 1 shows an example of building an educational and training session, aimed at improving speed and power qualities in swimmers of high qualification level.

Table 1. Example of building an educational and training session aimed at the development of speed and strength skills

ETS phase	Contents sessions	Rest interval, sec	Level intensity, %	General methodological guidelines
Preparatory	400 m free + 6 to 50 m exercises	30	400 m – 60% 50 m – 80%	The warm-up is carried out at an active pace of 400 m without stopping, and with the smallest rest interval you need to perform the main exercises 6 to 50 m.
	6 series of 75m + 25 m with flippers	20	75 m – 80% 25 m – 95%	The segments of 75 m are performed as: 25 m dive underwater + 25m on the back with the dolphin leg work while keeping the arms vertical + on the feet of the main way quickly. The sections of 25 m are performed quickly in coordination with the basic method
Basic	5 series of 125 m + 75 m + 2x25 m using flippers and shoulder blades	20	125 m – 70% 75 m – 80% 25M – 90%	The 125 m sections are performed as follows: 50 m holding the blades in the palm of the hand at forearm level + 75 m with increasing speed after 25 m Sections of 75 are performed in full coordination Lengths of 25 m are performed: 2 m in coordination fast + 5 m swimming on feet fast
Final	8 series of 100 m + 50 m using flippers + shoulder blades	30	100 m – 60% 50 m – 70%	The sections of 100 m should be done by crawl on the chest with counting the number of strokes for 50 m. The sections of 50 m should be done by the basic method of swimming, concentrating on technique, trying to swim the entire distance without breathing

Thus, the developed author's methodology of improving speed and power qualities of highly qualified swimmers is based on the use of positive experience of leading countries in swimming in the world arena. It is built on the principle of periodization of ultra-short competitive swimming segments the aim of which is to increase the level of competitive performance.

The technique includes four main components, their purpose is an accentuated development or improvement of certain physical qualities, which influence competitive activity of a swimmer. The suggested author's technique suggests mainly swimming high-intensity swimming segments, which correspond to individual characteristics of the competitive distance. In order to ensure the maximum level of intensity it is necessary to use small sections of distance of 15-25 m.

## Discussion

We believe that at this stage of development of swimming in Kazakhstan in the context of sport of the highest achievements and achievement of maximum results new innovative methods are needed. In sports science revealed a sufficiently large amount of experimental data, allowing to make a theoretical review and make a choice among various training tools and methods (Laursen, 2002; Buchheit, 2010; Gussakov, et al., 2021). In accordance with the purpose of this research work to develop the author's methodology to improve speed and strength training of highly qualified swimmers, we identified the most promising, modern means and methods used in the training of highly qualified swimmers.

Periodization of the training process should be characterized as a division of the annual training plan into smaller and more manageable stages (Arroyo-Toledo, et al., 2013; González-Ravé, et al., 2021). This approach allows you to focus on one or more aspects of physical fitness while supporting the development of other physical qualities (Nosko, et al., 2019). One of the objectives of the methodology is to increase the level of physiological capabilities at the peak of competitive form in the planned period. This aspect is demanded in the training of highly qualified swimmers, because very little literature describes in detail the principles of building pre-competition programs that aim to achieve the peak of physical capabilities in the competitive periods (Holliday, 2008; Hatzigeorgiadis, et al., 2014).

One of the fundamental principles that underlies the author's methodology is that when building a training program, the level of intensity plays a key role, not the total volume of swimming as in the traditional training methodology (Pugliese, et al., 2015; Szczepan, et al., 2020). That is why the method is based on the method of using a large number of ultra-short competitive sections, which is described in foreign literature as Ultra-short race pace. This method implies the use of short sections corresponding to the individual competitive speed of the swimmer (Nugent, et al., 2019; Williamson, et al., 2020; Ullsperger, 2021). Proceeding from it the author's method of preparation of swimmers has essential differences from traditional methods of preparation, which are based on use of mixed interval swimming segments and mainly raise the level of aerobic systems only (Peake, & Farrell, 2004; Bakayev, V., & Bolotin, A. (2021). The main concept of the technique is to swim a large number of ultra-short swimming segments at a competitive pace should be combined with sufficiently long rest intervals, which contributes to the development of both anaerobic and aerobic energy supply systems. It should be noted that rest intervals should be at least 20 seconds when performing even the shortest swimming segments (Rodríguez, & Mader, 2011; Hruzevych, et al., 2017).

Aerobic capacity also plays an important role in the training of highly skilled swimmers, which is why it seems impossible to train even sprinters without the use of aerobic loads. As we said before, our method is based on the use of short stretches of less than 30 seconds, but also includes aerobic loads (Deminice, et al., 2010; Czuba, et al., 2017).

The technique of improving speed and power qualities of swimmers is based on swimming segments using the characteristics of the competitive distance. We recommend this technique to be used in the period of pre-competition training (Kilding, et al., 2010; Scortenschi, 2019; Pang, 2022).

Increasing the speed and power qualities in swimming is based primarily on the performance of short sections with a high level of intensity. It is important to note that rest intervals when performing high-intensity sections should be 1:2, for example, at 30 seconds of work rest should be 60 seconds, etc. Many literature sources on sports physiology indicate that this interval is sufficient to restore the creatine-phosphate energy supply mechanism (Counsilman, B., & Counsilman, J., 1991; Gatta, Cortesi, & Di Michele, 2012; Loebbecke, & Mittal, 2012). When drawing up a training program aimed at increasing speed and strength qualities with the use of the author's methodology, the following principles should be followed:

- swimming of short sprint segments should be performed at the maximum pace of swimming in order to involve as many fast muscle fibers as possible, which play a key role in high-speed loads (Volkov, 1969);
- it is necessary to use the optimal number of swimming segments, the number of which will allow maintaining the highest possible rate of movement, the average number of segments of 20 seconds with a maximum rate of movement should not exceed 16 times;
- when planning swimming segments aimed at the development of speed and strength qualities, it is necessary to consider sufficiently long (in relation to the work) rest intervals, on average, the duration of rest should be three times longer than the duration of the work performed;

Despite the fact that literature describing the principles of sports training indicates the need to use relatively long rest intervals (Little & Williams, 2007), swimming coaches in their practice neglect this recommendation and often reduce the rest intervals to a maximum of 1 to 0.5 in relation to the amount of work and rest.

### Conclusions

An important factor when using the technique of improving speed and power qualities is stability of swimming technique, that is why we recommend to use the technique only for swimmers of high qualification level. The use of this technique in groups of initial training and sports improvement may not cause the expected effect and have a negative impact on improvement of swimming technique, because the improvement of technique occurs mainly at a lower swimming pace.

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