

IMPROVING THE START IN SWIMMERS WITH THE HELP OF PLYOMETRIC EXERCISES

C. ȚĂRȚĂLEANU¹ D. ORȚĂNESCU²

Abstract: *Physical preparation is one of the most important factors of sports training in achieving great performance. In this material, the problem of developing the skills of swimmers to improve their start with the help of plyometric exercises as well as strength circuits is studied. The experiment was carried out with performance athletes, 13-14 years old. The methodical ways related to the volume and content of the use of exercises on land and in water were established by using modern technical means of preparation, the developed method proving effective and can be applied in the training process.*

Key words: *swimming, cadets, physical training, plyometric exercises.*

1. Introduction

Physical preparation is one of the most important factors in achieving great performance. In an organized training program, physical training develops in the following sequence:

- ✓ general physical training (PFG)
- ✓ specific training (PFS)
- ✓ a high level of biomotor qualities [3]

The general physical training aims to improve the effort capacity, the better it is done, the higher the level the athlete reaches.

The specific physical training is built on the basis of the general physical training and continues it according to the particularities of the respective sport.

By perfecting the biomotor qualities, the athletes' potential is identified for the demands of the practiced sport.

The theory and methodology of sports training states that training is "the systematically and continuously graded instructional-educational process of adapting the human body to intense physical and mental efforts, in order to obtain high results in one of the forms of competitive physical exercise practice" [5]

In swimming, we meet general physical training (on land) and specific physical training (on land and in water). Swimming is a complex sport that requires a high level of cardiovascular capacity, muscular strength, flexibility and effective technique. To improve the level of motor

¹ PhD student, University of Craiova, Romania, Doctoral School in Social Sciences and Humanities, cristian_tartaleanu@yahoo.com

² University of Craiova, Romania, Doctoral School in Social Sciences and Humanities, odorina2004@yahoo.com

capabilities, swimmers can use various training methods. In the specific water conditions, the following categories of exercises can be worked on:

- Forward weighted exercises (parachute, socks, belt, raft, bungee cord)
- Exercises with materials that increase the force application surface (palms, paws)
- Anaerobic exercise (maximum intensity repetitions)
- ✓ Physical training in water and on land:
- Combinations of exercises performed in the water, followed by exercises performed on the beach of the pool: exercises with maximum intensity + exercises with the medicine ball/exercises from hanging on the fixed bar/exercises on the inclined bench.

As effects we find:

- ✓ Increases propulsive force
- ✓ The force is developed in the speed regime
- ✓ Decrease the times in the 50 m events

Physical training on land:

- Exercises with weights
- Plyometric exercises
- Inclined bench exercises
- Exercises performed on the simulator

The effects of these exercises are:

- ✓ Development of leg muscle strength and improvement of turning time
- ✓ Development of explosive strength
- ✓ Development of maximum strength

Swimming performance can also be improved by land training (strength/power) [9], the ability to exert force in the water is a decisive factor in sprint [13] swimming it has been recommended that swimming coaches and physical trainers includes a dry workout focused on strength-related actions [1]. In sprint events, the start contributes up to 30% of the race time,

the shorter the race, the more important an explosive start becomes. [8]

Plyometrics have been used for many decades in Russian and Eastern European training of track and field athletes [7]. Verkhoshanski, a track and field coach in Russia, started the concept of jump training. However, Purdue University coach Fred Wilt first coined the term plyometrics in 1975. The word plyometrics is actually a derivation from the Greek words ply the in or plyo, meaning to increase, and metric, meaning to measure. Accordingly, the purpose of plyometrics can be considered "to increase measurement".

Usually measuring sports performance results demonstrated in tests or competitions, such as throwing speed, service speed, jump height, or sprint speed [10]. A study on the effect of plyometric training on explosive performance improvements showed dramatic changes in sprinting and agility [17].

Plyometrics are characterized by explosive exercises that increase speed, quickness and power. Most exercises include jumping, where the muscles exert maximal effort and force for short periods or intervals of time, a combination of plyometric and balance activities improve static balance, dynamic balance, and strength. A physical movement characterized by forceful contractions in response to myostatic stretch of active muscles, plyometrics is a means of encouraging the muscle to rapidly reach maximum force [2].

The cycle begins with an eccentric muscle action, followed directly by a concentric shortening of the same muscle [12]. Plyometric training can produce varying effects depending on the characteristics of the training program (e.g., training surface, training volume,

and training period) [6], [14,15]. There is compelling evidence of substantial improvements in performance after plyometric training [4], [16]. Several studies [2] have examined the effects of training performed outside the pool on swimming performance. This type of training has been shown to be effective compared to regular swimming training in improving specific swimming performance in prepubertal male swimmers.

2. Methodology of Research

2.1. The purpose of the research

The purpose of the research is to determine the training methods on land, based on the development of strength in the lower limbs, adapted to pubertal swimmers.

2.2. Research objective

The objective of the research is to discover the most effective plyometric exercises, to improve the start, on a group of adolescent swimmers. Using the Kinovea application to determine the reaction speed as well as the length of the flight until entering the water, will lead the preparation to make the start more efficient. Kinovea is a video annotation tool designed for sports analysis.

It has utilities to capture, slow down, compare, annotate and measure motion in videos.

2.3. Description of the Kinovea application

Kinovea is a video annotation tool designed for sports analysis. It has utilities to capture, slow down, compare, annotate

and measure motion in videos [11]. The athletes were filmed at the beginning and end of the experiment, and the recordings were analyzed with the help of the application, the data being compared.

2.4. Sampling

Twenty participants in this study are students/ performance athletes, boys, aged between 13 and 14, from the *Emil Racoviță* National College in Bucharest. (see Table 1).

3. Materials and Methods

3.1. Research methods used

- Studying the specialized bibliography
- The method of the experiment
- Graphic method
- Video method
- The statistical-mathematical method
 - Deviation / standard deviation
 - Median
 - The coefficient of variability
 - The independent t-test

3.2. Experimentation program development

The 2 groups were defined, the experimental EG (10 subjects E1...E10) and the control group CG (10 subjects

C1...C10) and the initial and final tests were performed. The experiment took place over 6 weeks, from May 8 to June 16, 2023, and consisted of the introduction of 2 sessions of physical training on land, each week, lasting 45 minutes each, outside of water training.

Only the athletes from the experimental group participated in these physical training sessions. Program and means of action, as follows. (see table 2)

Study participant data

Table 1

ID	Year of birth	Height (cm)	Arms span (cm)
E1	2010	158	165
E2	2010	167	170
E3	2010	174	181
E4	2010	165	168
E5	2009	180	181
E6	2009	168	168
E7	2009	152	154
E8	2009	174	180
E9	2009	164	169
E10	2009	155	158
C1	2010	172	175
C2	2010	165	165
C3	2010	178	183
C4	2010	156	162
C5	2010	166	170
C6	2010	172	180
C7	2010	163	167
C8	2009	177	179
C9	2009	153	155
C10	2009	170	174

Actuation systems

Table 2

No.	Period	Number of workouts x duration	Actuation systems	
			Development of speed of reaction and execution	Strength development through plyometric exercises
1	Week 1 and 2	2 x 45 minutes	<p>Starts from different positions:</p> <ul style="list-style-type: none"> - from the legs (facing, side, back); -from crouching (facing, back); - from sitting (facing, back); - from before lying down. <p>At the beep, get up or turn quickly and run the distance of 5 meters.</p>	<ul style="list-style-type: none"> - Jumping on (from) the box; -Jumps to the side, jumps in place, jumps on one leg; -Shear jumps; - Vaults with jumping; <p>*the box is 20 cm high and the working time is 20 seconds with a 40 second break.</p>
2	Week 3 and 4	2 x 45 minutes	<p>Starts from different positions:</p> <ul style="list-style-type: none"> - from the legs (facing, side, back); - from crouching (facing, back); - from sitting (facing, back); - from before lying down. 	<ul style="list-style-type: none"> - Jumping on (from) the box; -Jumps from squatting on the box; - Squats with jumping; -Burpees (an exercise that includes a push-up, a lift of the knees to the chest from the push-up position and a squat

No.	Period	Number of workouts x duration	Actuation systems	
			Development of speed of reaction and execution	Strength development through plyometric exercises
			At the beep, get up or turn quickly and run the distance of 5 meters.	with a jump) -Jumps from squat to squat, with trunk extension and arms extended as high and forward as possible. *the box is 30 cm high and the working time is 30 seconds with a 30 second break.
3	Week 5 and 6	2 x 45 minutes	Starts from different positions: - from the legs (facing, side, back); -from crouching (facing, back); - from sitting (facing, back); - from before lying down. At the beep, get up or turn quickly and run the distance of 5 meters.	- Jumping on (from) the box; -Jumps from squatting on the box; - Squats with jumping; -Burpees (an exercise that includes a push-up, a lift of the knees to the chest from the push-up position and a squat with a jump); - Squats with the 2 kg medicine ball; -Jumps from squat to squat, with the extension of the trunk and taking the arms outstretched as high and forward as possible and with the hands holding a medicine ball of 2 kg; -From bent over, throwing the medicine ball (2 kg) between the legs towards the front. *the box is 30 cm high and the working time is 30 seconds with a 30 second break.

4. Results

At the beginning and at the end of the 6 weeks, the 2 tests were applied, which consisted in determining the speed of reaction and execution, (see Table 3 and Table 4) as well as the length of the start, i.e. the distance traveled by the athlete from the starting block to the contact with water. (see Table 5 and Table 6), the documentation being as follows:

In data processing we used the error threshold $\alpha = 0.05$, meaning that we accept a 5% error probability or a 95% probability that the test result is not random; the significance threshold p gives us the possibility to state that the null hypothesis is rejected or accepted:

- if $p > \alpha(0.05)$, it means that the error threshold determined based on the data recorded in the respective test exceeds the accepted error threshold. In this case,

the null hypothesis is accepted, the difference between the results of the two tests is not statistically significant.

-if $p < \alpha(0.05)$, it means that the error threshold determined based on the data recorded in the respective test is lower than the accepted error threshold, In this case the null hypothesis is rejected and the research hypothesis is accepted, the difference between the results of the two testing is statistically significant.

Reaction and execution speed: in the case of the control group, even if they did not participate in the training program, an improvement of 0.1 seconds is seen, and the experimental group of 0.2 seconds. The difference between the averages of the two groups is very small. The independent t-test for equal dispersions shows that this difference is statistically insignificant, the null hypothesis is accepted. (see tables 3 and 4)

Initial test results speed of reaction

Table 3

Test speed reaction		Mean	Standard deviation
	EG	0,59	0,03
	CG	0,62	0,03

Final test results speed of reaction

Table 4

Test speed reaction		Mean	Standard deviation	the difference of the medians
	EG	0,57	0,02	0,02
	CG	0,61	0,03	0,01

Start length: in the case of the control group, an improvement of 1 cm is observed in the median difference determined after the initial test 288 cm and that obtained after the final test 289 cm. In the case of the experimental group, the difference is 3 cm, 287 cm the initial

test and 300 cm the final test. The difference between the means of the two groups is very large. The independent t-test for equal variances shows that this difference is statistically significant, the null hypothesis is rejected. (see tables 5 and 6)

Initial test results start length

Table 5

Start length		Mean	Standard deviation
	EG	297	11,19
	CG	288	14,80

Final test start length

Table 6

Start length		Mean	Standard deviation	the difference of the medians
	EG	300	11,11	3,00
	CG	289	14,81	1,00

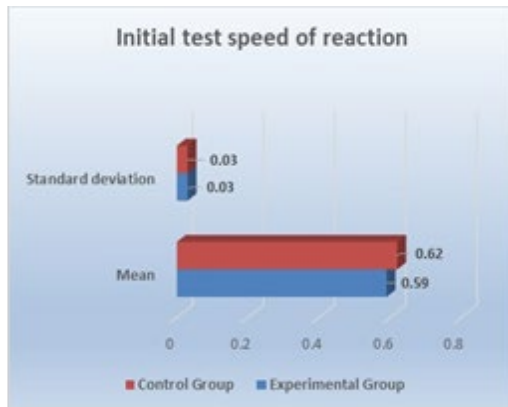


Fig. 1. *The results of the initial testing of the 2 groups*

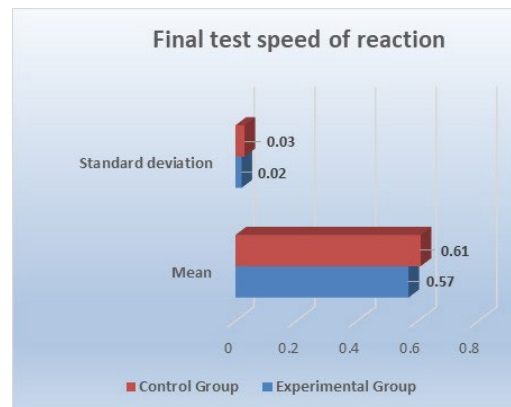


Fig. 2. *The results of the final testing of the 2 groups*

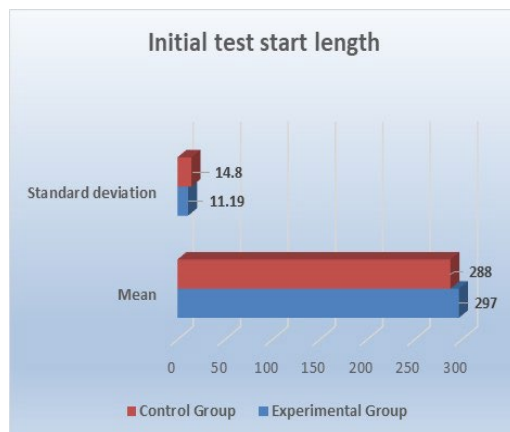


Fig. 3. *The results of the initial testing of the 2 groups*

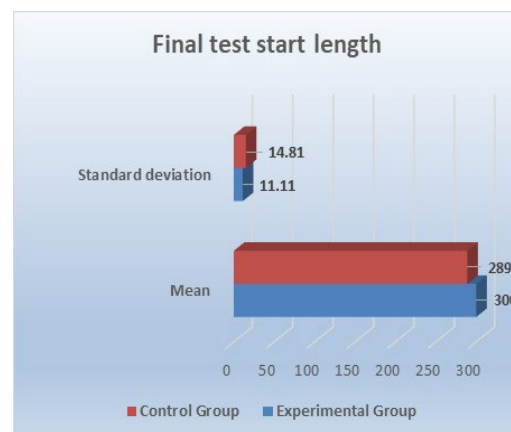


Fig. 4. *The results of the final testing of the 2 groups*

5. Conclusions

Our research began by analyzing and accumulating information about the theoretical notions realized on the discussed problem. We have presented the essential aspects regarding somatic and physiological characteristics. To complete the experiment, the final tests were applied. The results obtained at the initial and final tests by comparison between them and between the participating groups are presented in the figures below. The progress recorded is

also due to the athletes' constant participation in training, their dedication and determination, and I had the opportunity to accumulate direct experience in terms of presenting and interpreting some data.

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