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Original article

THE ROLE OF TECHNICAL TRAINING IN THE DEVELOPMENT OF CHILDREN'S LATERALITY IN SWIMMING THROUGH BIOMECHANICAL ANALYSIS IN THE FREE STROKE

ANDRA-IOANA SINGURAN[1,2], SILVIA TEODORESCU[1], KAMER-AINUR AIVAZ[2], OANA MARIA BALTAG[1], PETRESCU ANDREI[2], CAZAN FLORIN[2] MELENCO IONEL[2]

Abstract

Aim. Considering the complexity and accelerated pace of achieving performances among children, we approached this study to capitalize and develop laterality as a component of human psychomotricity by applying a training plan aimed at their technical training.

Methods. The research was attended by 30 children, swimmers, aged between 10-11 years (n = 30), selected in the performance groups following the skills demonstrated and the fulfillment of the selection criteria. The training lessons occured in six sessions per week, lasting approximately 90 min.

Results. In the 50 m freestyle event, progress of 1.65 sec (mean = 1.65) was registered at the group level between the two periods of the championships (March, respectively, December). Both the one-sided (One Sided p) and two-sided (Two-Sided p) levels of significance indicate that there are significant differences between the two tests (T0 and T1), where p<.001 in both cases.

The T-test marks the presence of significant differences between the joints on the right and left sides of the body.

Conclusions. The development of laterality through technical training that ensures longevity in performance sports and obtaining notable results in competitions is important in the training process of children because, through its specificity, the cyclicity of movements and their symmetry can be improved.

Keywords: technical training, laterality, swimming, freestyle

Introduction

Nowadays, if we talk about swimming, we refer to a sport with a fascinating evolution, where even the smallest difference in time can influence the result in competitions, especially in sprint events (Kwok, Lung, Ting, Mei, 2021). Such a case was recorded at the Olympic Games in Rio de Janeiro, 2016, where there were only 0.01 sec. between the gold and silver medals.

Compared to other sports, swimming presents specific particularities such as: the horizontal position of the swimmer's body during training and races, the active use of arms and legs for propulsion, the pressure exerted following the immersion of the body in the water, or changes in breathing, the application the athlete's forces on a moving element at any time (Fione and Van den Tillaar, 2022). According to experts in the field, swimming performance is determined by physiological and anatomical factors (Toussaint and Hollander, 1994).

From a biomechanical perspective, swimming involves evaluating the human being in the aquatic environment, an environment in which it is necessary to consider certain physical principles. The biomechanical analysis of a swimming process (freestyle/crawl, breaststroke, backstroke, butterfly/dolphin) can be divided into four phases, respectively: the start, the actual swimming phase, the return and the finish. During any swimming event, the swimmer spends most of his time, absolutely or relatively, in the actual swimming phase. Therefore, this phase represents the defining moment of swimming performance (Barbosa, Marinho, Costa, Silva, 2011).

Abdalimova (2022) claims the technique is one of the basic components to achieve outstanding results in sports. In swimming, technical training is an integral part of the training system of swimmers at all levels. Simultaneously, the technique contributes to obtaining the maximum yield in the competitive activity (Cossor and Mason, 2001). Among the specific technical peculiarities, we meet swimmers with a developed joint mobility, which allows them to adopt a technique with a wide range of movements, and swimmers with reduced joint mobility, who have a narrower range of movements, but the starting point of all athletes it represents the example of the classical technique (the model).

[1] National University of Physical Education and Sport, Bucharest, Romania & Ovidius University, Constanta, Romania. singuran.andra@yahoo.com
[2] Ovidius University, Constanta, Romania

The freestyle involves coordinating alternately cyclic movements of the arms and legs to move the swimmers through the water compared to the breaststroke and butterfly, which require simultaneous and bilaterally symmetrical movements. To initiate propulsion, one arm applies force to the water, while the second arm returns to begin the next motion. These alternating cycles of propulsion and return are accompanied by the rotation of the swimmer's body around the longitudinal axis (Yanai, 2003). In other words, it is necessary to implement some methods aimed at improving the underwater path of the upper limbs, which with the locomotor apparatus, lead to efficient swimming with the reduction in excessive energy consumption (Zaton and Szczepan, 2014).

Since our study focuses on the development of laterality in children, we refer to the fact that, although "the anatomical construction of the human body is characterized by global body symmetry, it is doubled by functional asymmetry" (Rigal, 2007). In other words, laterality is manifested by the predominant use of one or the other of the dominant parts of the body, causing an inequality between the two halves of the body: left or right.

Neagu (2012) describes, as defining elements of psychomotricity, the references of the human in relation to his body, with the spatiality and temporality of his own movements, combined with their mental representations. The author continues by highlighting the functions and dysfunctions of a psychomotor nature that can be interpreted and subsequently developed.

Learning by discovering his own body, the daily bodily experiences that the child goes through lead to mastering his own body and to its desirable and constructive use, in the most diverse situations. Gradually, he will move on to the discovery of the environment around him: physical, in the first instance, then, affective and, finally, social. (Piaget and Inhelder 2005) This evolutionary process will constitute the foundation of his psychic development (affective and intellectual).

From the study of the specialized literature, regarding the development of the child, the idea crystallizes that the main starting point of everything he learns in the first years of life and then, one of the important points of reference for "learning to become sustainable and transferable, it starts from the child's body and emotions" (Gravel and Tremblay, 2004). Compared to the description of other fields, the sphere of knowledge and child development is constantly expanding. If over time a great emphasis was placed on the discovery of certain knowledge in fields such as physiology, biochemistry, anatomy, medicine and human behavior sciences, nowadays scientists have turned their attention to the discovery of the child and its role in society.

We have approached the biomechanical analysis of freestyle movements, which we consider to be an essential part in improving swimming techniques, as well as in the process of obtaining notable and sustainable performances. This also contributes to recording the parameters necessary for developing children's laterality, a fundamental component of human psychomotricity. As stated by Toussaint et al. (2000), a 10% improvement in the technique can provide the greatest gain in performance (valid for all distances), underscoring its importance in the training process.

Materials and Methods

Participants

The research was attended by 30 children, swimmers, aged between 10-11 years (n = 30), selected in the performance groups following the skills demonstrated and the fulfillment of the selection criteria. The training lessons occured in six sessions per week. Each performance training lasts approximately 90 min, as the target group subjects also participate in national competitions for children. They are members of Atena Sport Club and Delphin Swimming Club in Constanța.

Study design

The study occured during ten months of training (March – December 2022), in which we applied a special program designed to optimize the technical training of children, with the aim of developing laterality and improving the results in the 50m Free.

Considering the complexity and accelerated pace of achieving performances among children, we approached this study to capitalize and develop laterality as a component of human psychomotricity by applying a training plan aimed at their technical training.

Before the start of the program, the preliminary testing was carried out at the National Regional Children's Championship, held in Bacău, on March 19-20, 2022, in the 50m freestyle event, and after the ten months, the final testing occured at the National Championship of Children's Polyathlon, organized in Târgu Mureș, between 02-04 December 2022, at the same event.

The biomechanical analysis was carried out in the week before the National Regional Championship, respectively, in the week of March 6-13.

Intervention program

To choose the most effective aids and preparatory means in the process of learning the technical elements, we focused our attention, in particular, toward establishing an organizational plan. We mention the fact that the means used are aimed at optimizing technical training and, simultaneously, developing children's laterality.

The representation of each exercise is put into practice through the video presentation of the model, on land, computerized and through the demonstration made by the coach, following the direction and the most effective ways to master the technique, as well as through a rational approach with the aim of perfecting techniques in reproducing the mastery model.

In the organizational planning of the program, the following was taken into account:

- The structure of the basic exercise should be found in as high a percentage as possible.
- The choice of exercises should follow the capacities that influence basic motor qualities, coordination capacity, psycho-physiological components. In other words, the regime of efforts involved in the process received special attention.
- Systematization of the exercises in the work plan in order of gradual intensity of effort, to obtain a maximum yield.

The sports training process must be carried out at the level of the current international requirements for the age group to which it is addressed. It must be designed in such a way that the valuable elements resulting from this process are at the level of demand that allows their successive promotion in the youth and Olympic groups with a real potential to obtain medals at the European, World Championships and even the Olympic Games. In the study, the program applied to young swimmers was structured into three categories as follows:

- ✓ *Category I* of exercises aims at the quantitative and qualitative development of the movement of the lower limbs, a basic component in the execution of the Free procedure.
- ✓ *The* II category of exercises develops motor symmetry (using both parts of the body – left, right – as similar as possible).
- ✓ *The III* category of exercises aims to perfect the free process by performing natural movements, with minimal energy consumption and maximum efficiency.

In the following, we present one exercise from each category described previously:

- ✓ Category Ist:
  - ➢ <u>Exercise no. 1</u>

Initial position (I.P.) – ventral decubitus (face down), one arm extended forward with the palm resting on the surface of the water and the other arm extended by the body:

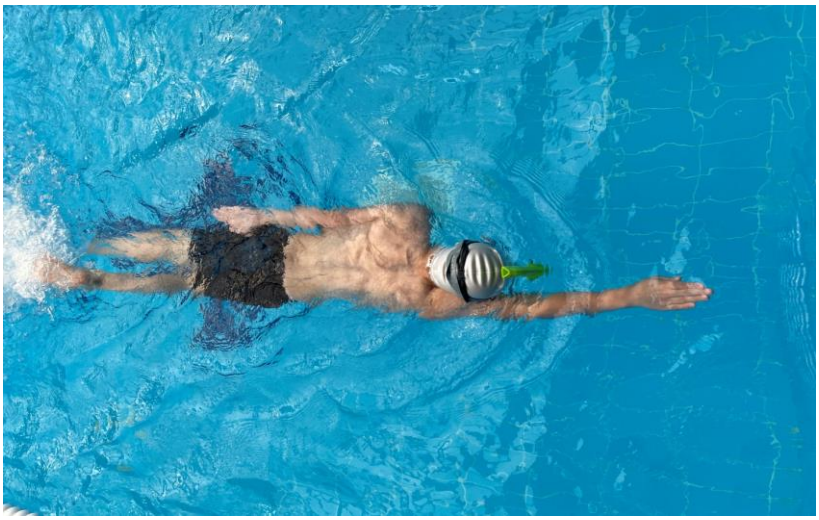
Auxiliary materials: swimming tube

Execution:

- the right arm extended forward, the left arm extended next to the body, perform six kicks with the left shoulder above the water, the body turned slightly to the left, without changing the position of the head and the gaze; return.

Purpose:

-development of the muscles of the lower body;
- improving body position;
- twisting the trunk, allowing the shoulder to be lifted above the water;
- preparation of the air route.



Imag.1 Freestyle kicks with tube

- ✓ The II[nd] category :

➢ Exercise no. 1

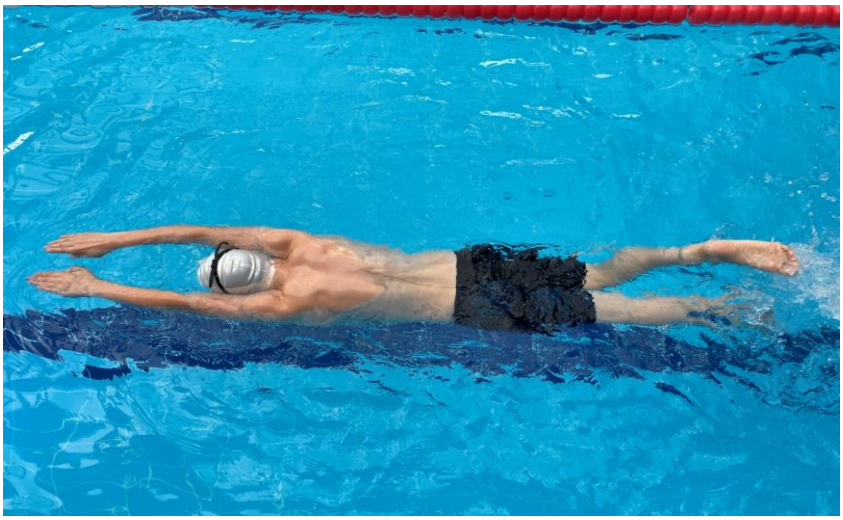
I.P. – ventral decubitus (face down), arms extended forward, with hands resting on the water.

Execution:

- body lying on the surface of the water, arms stretched forward, palms parallel to the surface of the water.
- every three-foot beat, the arm makes the water path and the air path, reaching the P.I.
- the movement of the legs must be fast and strong.
- breathing is unilateral.

Purpose:

- it is aimed that both arms perform similar movements, direction and trajectory of the left arm should be, if not identical, as close as possible to those of the right arm and vice versa.



Imag. 2 Body position

✓ The III[rd] category:

➢ Exercise no.1

I.P. – face down, with arms outstretched forward, with hands resting on the water/surface of the water
Auxiliary materials: fins
Execution:

- one arm remains on the surface of the water and the other arm travels the

underwater path, followed by the aerial one, pointing the fingers in the armpit area, returning the execution arm to the initial position;

- it is executed alternatively;
- a cycle of arms has six foot beats;
- at the moment of scoring in the armpit area, the trunk turns toward the side of

the executing arm, so that the shoulder position is above the surface of the water.

Purpose :

- improving the balance of the body on the surface of the water;
- improving the gliding of the body;
- improving the airway trajectory of each arm.

Imag.3 – Tehnică în procedeul Liber

Methods

To analyze the effect of the importance of technical training in the development of children's laterality in swimming by recording the results in the 50 m free trial and the biomechanical analysis of the process, we used the paired samples T test.

Results

During the first test, the following parameters were recorded during the biomechanical analysis:

Tabel 1

Paired Samples Test

Paired Differences				t	df	Significance	
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			One-Sided p	Two-Sided p

					Lower	Upper				
Pair 1	mana-d - mana-s	-1.4200	6.3756	1.1640	-3.8007	.9607	-1.220	29	.116	.232
Pair 2	cot-d - cot-s	.9133	4.5875	.8376	-.7997	2.6263	1.090	29	.142	.284
Pair 3	sc-hum-d - sc-hum-s	1.3167	9.9496	1.8165	-2.3986	5.0319	.725	29	.237	.474
Pair 4	cox-fem-d - cox-fem-s	.7167	4.9834	.9098	-1.1442	2.5775	.788	29	.219	.437
Pair 5	gen-d - gen-s	1.0267	3.8628	.7053	-.4157	2.4691	1.456	29	.078	.156
Pair 6	pic-d - pic-s	.0133	4.9663	.9067	-1.8411	1.8678	.015	29	.494	.988

The T-test marks the presence of significant differences between the joints on the right and left sides of the body. We can see that in five of the six joints tested, the T-test registered values of p<.001 and only in the scapulo-humeral joint, at the initial moment, no significant differences were registered p>0.05 (p = .057). These measurements indicate that at the five joints (hand, elbow, coxo-femoral, knee and leg) there is a difference between the right and left sides of the body, and the recorded angles do not have approximately equal values.

Tabel 2

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Two-Sided p
Pair 1	mana-d & mana-s	30	.573	<.001	<.001
Pair 2	cot-d & cot-s	30	.914	<.001	<.001
Pair 3	sc-hum-d & sc-hum-s	30	.295	.057	.114
Pair 4	cox-fem-d & cox-fem-s	30	.641	<.001	<.001
Pair 5	gen-d & gen-s	30	.937	<.001	<.001
Pair 6	pic-d & pic-s	30	.777	<.001	<.001

For the program effect size to be significant, Cohen's d value (Table 3) must be greater than 0.50 and greater than or equal to 0.80 for the magnitude to be considered strong. The results obtained between the two parts of the body (right, respectively left) are impressive, because the variables recorded values well above 0.80 (d = 10.21 at the scapulo-humeral joint).

Tabel 3

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	95% Confidence Interval Upper
Pair 1	mana-d - mana-s	Cohen's d	6.3756	-.223	-.583	.142
		Hedges' correction	6.5466	-.217	-.568	.138
Pair	cot-d - cot-s	Cohen's d	4.5875	.199	-.164	.559

2		Hedges' correction	4.7106	.194	-.160	.544
Pair 3	sc-hum-d - sc-hum-s	Cohen's d	9.9496	.132	-.228	.491
		Hedges' correction	10.2165	.129	-.222	.478
Pair 4	cox-fem-d - cox-fem-s	Cohen's d	4.9834	.144	-.217	.502
		Hedges' correction	5.1171	.140	-.211	.489
Pair 5	gen-d - gen-s	Cohen's d	3.8628	.266	-.101	.628
		Hedges' correction	3.9664	.259	-.098	.611
Pair 6	pic-d - pic-s	Cohen's d	4.9663	.003	-.355	.361
		Hedges' correction	5.0995	.003	-.346	.351

Following these initial measurements, the children achieved the following results in the 50m freestyle at the two national championships:

Tabel 4

Paired Samples Test

		Paired Differences							Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	T0 - T1	1.65067	.84589	.15444	1.33481	1.96653	10.688	29	<.001	<.001

Table 4 highlights the improvement in the group mean = 1.65, i.e., the group improved by 1.65 s between the two championships in the 50m freestyle. Both the one-sided (One Sided p) and two-sided (Two-Sided p) levels of significance indicate that there are significant differences between the two tests (T0 and T1), where p<.001 in both cases.

Tabel 5

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
Pair 1	T0 - T1	Cohen's d	.84589	1.951	1.331	2.560
		Hedges' correction	.86858	1.900	1.296	2.493

The size of the effect, or its magnitude, was calculated using the Cohen d value, whose interpretation is as follows: around 0.20 - the effect is low; 0.50 means the effect is medium; and above 0.80 symbolizes a strong effect. This method shows the effectiveness of the technical training program to develop laterality and optimize the results of the children participating in the study, in the 50m freestyle event.

Discussions

Following the application of a program focused on the implementation and assimilation of technical elements specific to swimming with the aim of improving psychomotricity components, especially balance, coordination and awareness of cor-

rect body posture, Constantinescu and Rîșneac (2016), obtained positive results between testing initial and final at the level of a group of 30 children. The hypothesis is confirmed according to which of the application of a specific means of swimming in children produces positive effects in the sphere of psychomotricity.

Ninicu. and Goncearuc (2020) state about the human psychomotor sphere that it is structured in a component of psychomotor skills and in a component of psychomotor ability. The child's motor activity develops his skills, strengthening the musculoskeletal system. After practicing swimming lessons, the child develops coordination and rhythmic movements and involves all muscle groups of the body, contributing to its harmonious development.

Conclusions

Following the aspects followed in the specialized literature and presented in this study, technical training is a fundamental component in obtaining outstanding results and contributes to obtaining the maximum yield in the competitive activity. Simultaneously, technical training creates a basic support that ensures longevity and obtaining exceptional results in terms of performance.

The study highlights the importance of the development of children's laterality in swimming because by its specificity, namely, the cyclicity of movements and their symmetry, to record notable performances, a swimmer is efficient when the parts of the body work at approximately the same capacity.

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