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THE EFFECTS OF GYMNASTICS TRAINING ON STATIC BALANCE AMONG CHILDREN AGED 4 TO 8

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Abstract: *Balance, along with the other motor skills, have an important role in the execution of sports habits. The purpose of the study was to design and apply a system of actuation means improving the static balance of gymnasts. The study was carried out on a sample of 35 children, aged from 4 to 8, while the tests used were the following: the Flamingo Test, the Unipodal Test and The Bruininks-Oseretsky Test. After interpreting the results, using the ANOVA statistical analysis test, the following values were obtained: the Flamingo test p<0.0001, on the right leg -3.714 and of the left leg -3.829; the unipodal test p<0.0001, on the right leg -4.086, on the left leg -3.829; the Bruininks-Oseretsky Test p<0.0001, on the right leg -3.457 and on the left leg -3.657. Considering the results obtained, it may be stated that the actuation means used in the study were efficient and they led to an improvement of the balance capacity.*

Key words: *gymnastics, static balance, training*

1. Introduction

Balance is defined as the complex process concerning the reception and organisation of sensory input, as well as the program and execution of movements, elements ensuring the upright posture, i.e. the permanent preservation of the barycentre within the support base (Sbenghe T. cited by Gagea, 2010). [9]. The author Tiron C. concludes that most bibliographic references admit that postural stability and dynamic balance are ascribed to senso-neuromotor instances with a marked genotypic character, but educable from a phenotypic perspective 9].

Specialists in the field believe that the aptitude of maintaining a controlled position through the compensatory movements of one's own body represents balance. In his transformation, children must preserve their sense of balance and the capacity of orienting their movements in space, allowing them to appraise the position of the head compared to the body and of the body compared to the

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environment. In this context, in their opinion, we can work around the following notions: balance; verticality and body inclination; rectilinear movement; rotation of segments, separately or considered as part of a whole [1]. In gymnastics, the concept of balance expresses an athlete's capacity of maintaining balance in dynamic or static conditions [8]. In the practice of sports training, there are two main forms of balance manifestation: static balance and dynamic balance [19].

In his study, Gavojdea (2016) highlights the role of balance in gymnastics. In his opinion, static balance entails the maintaining of landings. Due to the interaction of muscles, joints, breathing movements, heart rate while maintaining the body balance, static balance becomes complicated dynamic balance. To restore the muscular balance, it has to intervene with muscular strength [10].

Balance, along with other motor skills, plays an important in the success of executing motor aptitudes and in the prevention of sports injuries [17].

Balance is an important factor for success in many sports, particularly in gymnastics, because even minimal distortion affects the final score. During the development of motor skills, coaches need to be very systematic and conscious of the fact that motor efficiency is one of the most important issues. Only physically well-prepared gymnasts will be able to perform gymnastic elements and compose technically correct exercises without injuries. Compensatory movements of the body are essential for maintaining balance in order to bring the body's centre of gravity above the supporting surface. If these movements are more pronounced and accompanied by additional hand, legs or torso movements, in order to prevent the fall of the apparatus during competitions, they are sanctioned by the judges [20].

As for the sensory information related to movement, balance, and spatial orientation, it is provided by vestibular organs: the saccule, the utricle, and three semi-circular canals in the ear. While the saccule and utricle perceive the gravity and linear motion, the semi-circular canals specify the rotational movements. The balance information acquired from these peripheral sensory organs is transmitted to the brain stem [7].

Posture and balance control are fundamental in daily life to safely accomplish any type of movement and motor task that involves displacement of body segments or the entire body [5].

Gymnastics is a sport entailing and involving a set of movements requiring flexibility, balance, physical power, resistance, grace and kinaesthetic awareness. It is a sports discipline comprising natural and designed exercises, chosen and scientifically structured, to be used in both physical education and mass and performance sports activity [18].

Gymnastics by nature is a balance sport requiring both static and dynamic stability. To our knowledge, the centre of pressure (COP) movement of collegiate gymnasts has not been compared to other collegiate athletes and healthy controls during static and dynamic postural stability tasks [18].

According to Atilgan et. al. (2012), training in gymnasts stimulates the development of balance and allows almost perfect stability, even under extreme [4].

Other studies – such as the one by Carrick et al., apud. Albuquerque, 2007 – show that gymnastics as basic sport

contributes to the development of motor abilities: power, coordination, flexibility and balance [2].

Joung (2019), in his research study, underlines that the idea that balance is essential in gymnastics. His research has proven that the incidence of practicing sports activities, i.e. gymnastics, may improve the balance of practitioners, being also a way of improving the performances and of obtaining notable results in competitions [13].

In a research conducted by Hordi, 2016, the idea is presented that the process of balance is based on two factors, good sense and muscle function. Strengthening muscles can improve their function; in fact, balance is the result of interaction of sensory components such as vestibular, visual and proprioception systems which coordinates the contractions of leg muscles [11].

Furthermore, the studies by Bayramoglu, 2011, apud. Kayapinar, 2008, show that numerous factors affecting balance, the most important of which being: genetic orientation, vestibular apparatus state, age, support area, body balance amount, number of motor aptitudes, physical state, power, coordination, flexibility, emotional state, muscle fatigue [13].

Balance training is also used as a part of a rehabilitation programme after injuries to the ankle and knee [12].

A potential connection between balance and injuries has led to increased interest for developing the tools (tests, duties, exercises) to create programmes for improving balance [17]. For instance, existing data indicate that the actuation programmes should be developed in order to provide enough time to practice and to develop motor skills [15].

2. Objectives

The goal of the study was to design and apply a system of actuation means for improving the static balance of the female gymnasts.

3. Material and Method

Starting from the data featured above, this study aims to determine whether there are differences in the values of balance between the tests applied in the initial and final evaluation, at the level of both the right and the left leg.

The subjects within our research study are children aged 4-8, practicing gymnastics at the Children's Palace in Iaşi. The evaluation included the application of 3 tests to assess static balance, namely the Flamingo Test, the Unipodal Test and the Bruininks – Oseretsky Test.

We have used the following means in the experiment: standing on one leg, the other stretched or bent to the front, to the back or to the side; handstand, on the knees, extend the arm and the opposite leg on the same side; standing on tiptoes, legs apart – bending the torso to the horizontal, back straight, taking the outstretched arms to the front, to the sides or to the back; standing on tiptoes, legs apart – bending the torso to the horizontal, back straight, taking the bent arms to the shoulders; forward lunge on tiptoes – taking the arms obliquely to the front, bring the torso forward with the left arm to the front and the other to the back, and extend the torso and take the right arm up to the back, back to the initial position and repeat the exercise, changing the lunge and arm position; squatting on tiptoes, right leg forward – alternating arm swing back and forth, while moving forward and bending

the knees; one leg balance on the right leg slightly bent, extending the torso and taking the arms obliquely back or forth; on the right knee bent and the left leaning against the floor – lifting the left leg bent forward, bending the torso to the side, leftward and taking the arms up diagonally, then leaning the foot against the floor and taking down the arms, slipping on the knee and getting the other leg to the front; the initial position: two by two on tiptoes, facing the main direction, grabbing the hands, arms up diagonally: T_{1-2} bending the torso forward, knees bent, taking the arms obliquely to the back,; T_{3-4} back on tiptoes, arms obliquely up; T_{5-8} the same as T_{1-4} ; T_{5-8} the same as T_{1-4} ; walking on the gym bench, may be executed with intermediate steps, simple rotations of 90^o and 180^o degrees (the other turns are more difficult on the reversed bench).

4. Findings

The Table and Figures below feature comparatively the results obtained after conducting the three tests by the gymnasts within the experiment. The Tables comprise the differences of the values recorded between the initial and the final testing. It may be noted that the ***p*** value recorded indicates a difference between the two values of balance and it is statistically significant.

Table 1

Values obtained at the evaluations for the Flamingo test

Statistical indicators	FLAMINGO test			
	Right leg		Right leg	
	T.I.	T.F.	T.I.	T.F.
Aritmetic mean	14.37	18.08	16.37	20.20
Standard deviation	±10.433	±10.257	±13.782	±13.629
Variability coefficient	72.59%	56.73%	84.19%	67.47%

In case of static balance assessment using the Flamingo Test, the data recorded indicate statistically significant differences between the two evaluations (initial and final): 14.37-18.08 in arithmetic mean, ±10.433 - ±10.25 in standard deviation and 72.59% - 56.73% in variability coefficient at the level of the right leg and 16.37-20.20 in arithmetic mean; ±13.782 - ±13.629 in standard deviation and 84.19% - 67.47% in variability coefficient for the left leg.

The Graph below illustrates the statistical results, using the ANOVA test applied to data series.

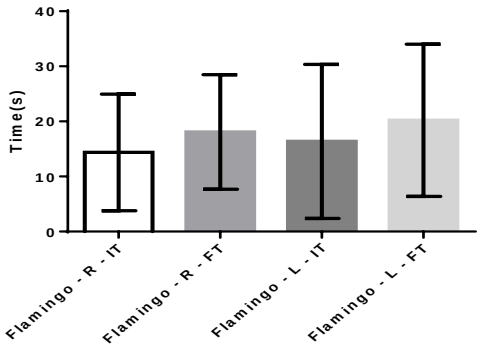

Fig. 1. *Results Flamingo Test - ANOVA Test*

After interpreting the results using the ANOVA statistical analysis test, in case of the Flamingo test, the following values were obtained: p<0.0001, on the right leg - 3.714 while on the left leg -3.829.

As for the Unipodal test, the following modifications were pointed out between the initial and the final evaluation: 12.51-16.60 in arithmetic mean; ±7.240 - ±7.051 in standard deviation and 57.87%-42.47% in variability coefficient for the right leg and 14.74-18.57 in arithmetic mean, ±7.023 - ±6.521 in standard deviation and 47.64% - 35.11% in variability coefficient for the left leg.

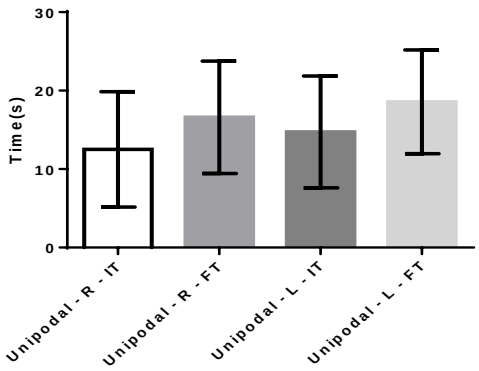

Fig. 2. *Results of the Unipodal test- ANOVA Test*

Table 2

Values obtained in the two evaluations at the Unipodal Test

	FLAMINGO test			
Stastical indicators	**Right leg**		**Right leg**	
	T.I.	**T.F.**	**T.I.**	**T.F.**
Arithmetic mean	12.51	16.60	14.74	18.57
Standard deviation	±7.240	±7.051	±7.023	±6.521
Variability coefficient	57.87%	42.47%	47.64%	35.11%

After interpreting the results using the ANOVA statistical analysis test, for the Unipodal test, the following values were obtained: p<0.0001, for the right leg - 3.714 and on the left leg -3.829.

Table 3

Values obtained in the two evaluations at the Bruininks-Oseretsky Test

	FLAMINGO test			
Statistical indicators	**Right leg**		**Right leg**	
	T.I.	**T.F.**	**T.I.**	**T.F.**
Arithmetic mean	8.00	11.45	10.11	13.77
Standard deviation	±5.601	±5.384	±7.202	±6.841
Variability coefficient	70.01%	47.02%	71.23%	49.68%

The values obtained after the two evaluations are clearly different for the Bruininks-Oserestsky, highlight also by teh statistical data provided: 8.00-11.45 in arithmetic mean, ±5.601-±5.384 in standard deviation and 70.01%- 47.02% for the right leg and 10.11-13.77 in arithmetic mean, ±7.202 - ±6.841 in standard deviation and 71.23%-49.68% in the variability coefficient for the left leg.

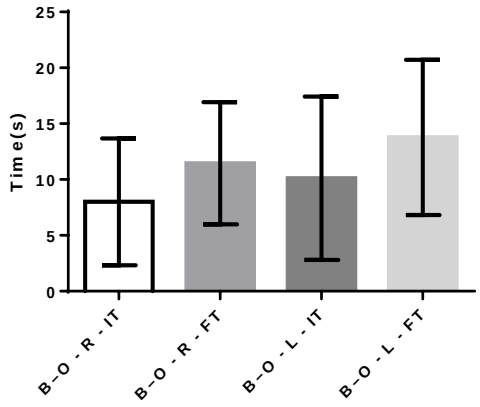

Fig. 3. *Results Bruininks-Oseretsky test - ANOVA Test*

Upon interpreting the results using the ANOVA statistical analysis test, for the Bruininks-Oseretsky test, the following values were obtained: $p<0.001$, for the right leg -3.457 and the left leg – 3.657.

5. Discussions

Gymnastics, is a sport that demands maintain balance while preserving the aesthetic value of the exercise. To help meet these stringent demands, balance training should be a significant part of gymnastics training [6]. Also, most teachers would agree that gymnastics is an important activity for the healthy growth and development of children. In another view, one of the main components of coordinative abilities is balance. This ability is influenced by a complexity of factors that are sensory information (from somatosensory, visual and vestibular systems), joint range of motion (ROM), and strength and it is responsible for the correct execution of complex sport movements, as well as for protection against injuries [3].

Scientific literature features numerous studies assessing the balance of gymnasts. In this respect, Paillard and his collaborators, apud. Kayapinar, 2011, [14] studied aspects related to balance and to the impact of applying systems of actuation means to improve the balance of gymnasts. Researchers found dynamic balance increases according to different sports participation.

In a different study, Through apud. Kayapinar, 2011, it was revealed that as the number of years of training increase, the ability to control balance is also affected positively. Similarly, to the literature in our study disequilibrium and slalom dynamic values of 12 weeks trained gymnastics group increased when compared with those in the control group. However, at some other branches of sports, the number of years of training has no effect at all [13].

Other studies adress training on balance, leg strength and balance in children 6-7 years of age in order to assess the impact of parameters given by a 4-week balance training, but in these studies did not find a statistically significant improvement.

In our study, too, we have assessed the training effect on gymnasts aged 4-6; the differences found suggest that by practice, the static balance of gymnasts improves. The advantage of the actuation means that we have used is provided by the diversity of exercises.

6. Conclusions

The research carried out and the data analysed enable us to draw the following conclusions:

1. There are statistically significant differences between the values of balance between the initial and the final evaluation, using the three balance

tests: the Flamingo Test, the Unipodal Test and the Bruininks-Oserestksy test, and those determined by using the ANOVA statistical test ($p<0.0001$);
2. The values of balance recorded by using the three balance tests are close to the other values found in various research studies across literature;
3. The actuation means used in the study were efficient and they led to an improvement of balance capacity.

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