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Investigating the Influence of Personalized Training on the Optimisation of Some Psychomotor Behaviours Among Junior Gymnasts in the Training Process (Moldavia, Romania)

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Abstract: *The purpose of the study was identified by the effort to complement the standard sports training programme with a portfolio of innovative means and methods to optimise the process of achieving performance in gymnastics competitions. The group of subjects investigated was female and consisted of 19 gymnasts, aged 10 - 12 years. They were tested initially and finally to determine the effects that going through the training program had on the analysed indicators. The Matorin, Flamingo, Balance Plate Position Maintenance and the "Y" tests were used in the research. We used descriptive statistics (Arithmetic Mean, Standard Deviation, Median, Confidence Interval and Coefficient of Variation) and significance tests which were used to assess the statistical significance of the difference between the means for two sets of scores (STUDENT paired sample t-test and Wilcoxon test). Based on the results recorded, we identified a significant difference between the mean values for the two tests. Following the results obtained, we can confirm that they help to form an overall picture from the perspective of motor skills on gymnasts and that there is a significant effectiveness of the motor intervention program in the sports training process.*

Keywords: *psychomotor behaviours; gymnasts; individualised program; psychomotor intervention.*

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1. Introduction

Gymnastics is a well-liked sport that can help athletes improve their strength, flexibility, and personal development. Balance, both static and dynamic, is learned early on and is essential to advanced gymnastics (Xiao et al., 2017).

It is oculo-motor coordination that facilitates the control and refinement of gestures, ensuring awareness of the environment in which we live by broadening visual space. Thanks to the connection between the eyes and the body segments, the gymnast perfects her spatial awareness and structures her environment. Looking at static and dynamic balance, specialists in the field consider the ability to maintain a fixed position through compensatory movements of the body, for balance purposes. In developing balance, the gymnast must develop a sense of equilibrium and the ability to orient her movements in space, which enables her to assess the head's position in relation to the body, and the latter in relation to the environment (Sloanhoffer et al., 2018).

In the literature, notions such as balance, verticality or leaning of the body, segmental rotation (either separately or as part of an ensemble) or rectilinear motion have been defined and explained in detail. Consequently, instability refers both to balance and postural stability and to measurable parameters of oscillations, with perfect balance being characterised by zero instability and unstable balance defining the highest level of instability (Gagea, 2010).

The mechanisms of postural stability are also of great complexity, because stability implies that the body position is in a static equilibrium in 3 dimensions, with the specification that the momentum and the sum of forces are zero for all three directions. On the other hand, the stability of a system in static equilibrium is only achieved under conditions of minimum potential energy, so that the body can maintain its equilibrium even when subjected to some perturbation. It has also been considered that orthostatism comes from the coordinated muscular contraction that determines the mobility of the skeleton and the verticality of the body position, while gravity tends to disturb the stability of the body, maintained under these conditions only by the permanent contraction of the gravitational skeletal muscles (Gagea, 2010).

Balance is absolutely essential in Artistic Gymnastics, especially on certain apparatus and more specifically on the beam. For instance, performing on beam takes a great amount of balance and postural coordination. Balance on the balance beam is one of the most demanding

skills in the world because it requires the ability to perform elements on an extremely small 10 cm, 1.25 m high and 5 m long support. Balance is vital to perform complex acrobatic elements and dance movements necessary in the gymnasts' exercise structure. In highlighting the elements for the beam exercise, it is noted that most elements of the apparatus derive from the floor, but differences in the nature of the apparatus must be taken into account, leading to differences in technique. Thus, there are elements that require balance in the arms and legs, and this ability provides the efficiency of the execution of the elements (Veljković et al., 2014; Veljkovic & Markovic, 2019).

Numerous factors influence balance, i.e., genetic orientation, condition of the vestibular apparatus, age, support areas, the extent of body balance, number of motor skills, their physical condition, strength, coordination, flexibility, emotional state, and, last but not least, muscle fatigue. As a foundation sport, Artistic Gymnastics contributes to the development of motor skills, represented by strength, coordination, flexibility and balance (Cuk et al., 2007).

Considering coordination, the gymnasts' elements are grouped into diverse movements with a high degree of complexity. Regular testing and monitoring of gymnasts is also important for defining the gymnastics and age-specific training programme. This provides a harmonious and healthy mastery of the fundamental motor skills in line with the physical evolution of athletes. In Artistic Gymnastics we find this component of psychomotricity, the general coordination, which manifests itself in the smooth execution of movements. Taking into account this psychomotor component, the exercises in Artistic Gymnastics can be performed with expressiveness, fluency and efficiency (Cuk et al., 2009; Veljković et al., 2014; Hrysomallis, 2011).

Psychomotor education and re-education using motion shape the gymnasts' personality by associating action with the discovery of the environment in order to learn. Specialists in the field (Abalașei, 2014; Abalasei et al., 2018) have agreed that the whole body, including the muscular and nervous systems, needs psychomotor education (Abalașei, 2014).

Since most such factors are related to the specific hemisphere of our brain, we find it unexpected that this aspect has not been studied in gymnasts' performance thus far. The human brain has a left and right hemisphere, both being linked. The movement of the right parts of our body is monitored by the left brain hemisphere, and the movements of the left part by the right brain hemisphere.

Therefore, a person can be left-handed or right-handed; sometimes ambidextrous. Since the psychomotor field is located in the right brain hemisphere, right-brain dominant athletes, i.e. left-handed players, are thought to have an advantage in sports. This fact is also pointed out by Harung et al. (2011), and Baker et al. (2013), even Sorokowski (2014) apud Aghase & Bhanedeo (2018) and reported the relevance of brain laterality in the performance of psychomotor skills (Aghase & Bhandeo, 2018; Oltean et al., 2019).

The ability of the neuromuscular system to produce maximum strength results is crucial in artistic gymnastics, as the optimal combination of muscular strength, balance and flexibility is needed to maximise performance. Flexibility is also essential for competitive athletes, facilitating not only dynamic competitive demands but also the full range of limb movement required to achieve high performance results (Pescari & Popescu, 2012; Dallas et al., 2014).

Balance is a quality that plays a significant role in achieving results in the field of Artistic Gymnastics, both artistically and technically. This skill must be perfectly matched with that of coordination (an indispensable quality for mastering the specific technique of each apparatus) (Akin, 2013; Bobo - Arce & Méndez – Raial, 2013). Gymnastics is essentially a sport of balance, involving both static and dynamic stability. Balance and other motor skills play an essential role in the effectuve execution of technical elements and the prevention of sports injuries (Sloanhoffer et al., 2018; Cottyn et al., 2006; Cotty et al., 2006).

In Artistic Gymnastics it is essential that athletes always maintain their balance, most exercises rely on the harmonious interweaving of static and dynamic balance. The most complex tests are the dynamic balance tests, because they focus on the ability of shifting the vertical projection of the centre of gravity and skill. To maintain a stable position afterwards, under the conditions that the support surface and the participant will have been disturbed (maintaining balance after a change in position is difficult) (Gavojdea, 2016a; Gavojdea, 2016b; Grigore et al., 2016; Grigore, 2003; Grigore, 2002; Grigore, 2001a; Grigore, 2001b, Heller et al., 2014).

Some of the most relevant aspects in Artistic Gymnastics are those related to space and time - essential forms of manifestation of the existence of matter in movement. Space and time shape in a particular way the structure of the external environment by relating to itself and to the other beings and objects that compose it. In psychomotor development it is also important to consider the bodily scheme through which space and time are organised from a cognitive point of view (laterality has a major influence

here), since knowledge of the bodily scheme determines the adequacy of perceptions related to action at the sensory-motor level (Abălasei, 2014; Abălasei et al., 2018; Fullam et al., 2014).

2. Materials and Methods

The aim of the study was identified by the effort to complement the standard sports training program with a portfolio of innovative means and methods to optimize the process of achieving performance in gymnastics competitions and to demonstrate that by applying an individualized program in the training of gymnasts will influence some psychomotor behaviours.

Based on this, since the research design includes two periods of assessment: pre- and post-intervention program (initial and final), in order to observe the differences that arise between the two tests, we used descriptive statistics which included the following indicators: arithmetic mean (Ma) - used as an indicator of central tendency; standard deviation (S), used in order to indicate the variation of individual results from the group mean; median (M) which is that value that divides the series (ordered ascending or descending) into two equal parts; confidence interval (CI) - used to look for confidence limits covering the value of the parameter, for a confidence coefficient and for the objective determination of the results obtained; and coefficient of variation (CV) - indicator reflecting the homogeneity of the group (below 10% - high homogeneity; between 10% - 20% - medium homogeneity; above 20% - no homogeneity.

The following statistical indicators were used to determine the statistical significance of the difference between the means corresponding to two sets of scores: STUDENT t-test, used to compare sample means and to make a meaningful comparison between the two tests, and WILCOXON test, used to highlight differences between the two tests (TI and TF) (Jaba, 2002).

We tested 19 female junior gymnasts, aged 10 - 12 years old, who practice artistic gymnastics performance.

The research was carried out in a practical way, the gymnasts were tested initially in September and finally in August of the following year, after 10 months of training.

The gymnasts included in the study started practicing artistic performance gymnastics at the age of 5 - 6 years.

The following tests were used to evaluate the gymnasts (Tudor, 2013; Balint et al., 2007):

The *Matorin test*, used to determine general coordination, balance and spatial orientation. These involve performing a straight jump with a turn

around the longitudinal axis to the right, followed by a jump with a turn to the left. The athlete remained on the landing until the examiner measured the angle of the turn. The *Flamingo test*, which aimed to establish static balance and required the athlete to maintain the position by standing on the favoured leg which was oriented on the longitudinal axis of the balance support. The hand on the same side grasped the ankle of the other lower limb which was bent from the knee joint, the other arm was extended and held forward. *Maintaining the stance on the balance board*, to establish balance in the landing stance and assumed the athlete to be in the outstretched sitting position (landing position of the backward jump) on the balance board, blindfolded. Without touching the ground with the edges of the balance plate, the athlete maintained this position as long as possible. A stopwatch was used to record the duration of maintaining the correct position. *The Bass test*, to determine the subject's ability to balance in dynamic positions, where the subject was in a standing position with the right foot on the starting mark, the other foot supported and slightly bent. Jumps were performed on the right and left marks, from one foot to the other until the end of the run. The landing position was maintained for five seconds. Five points were awarded for each correct landing and covering of the mark and one point for each second of maintaining balance. *The "Y" test*, in which athletes were asked to move one leg in the anterior, posteromedial and posterolateral directions, from standing on the other leg on a center plate. The athlete had to maintain an orthostatic position while pushing a rectangular block as far as possible in all three directions with the other foot. The distance was measured if it was at least 0.5 cm from the plate to the side where the block was moved. The order of testing was as follows: direction anterior to the right, anterior to the left, posteromedian to the right, posteromedian to the left, posterolateral to the right and posterolateral to the left.

The means employed in the gymnasts' training programme in order to enhance the physical training of artistic gymnastics juniors on the beam were aimed at achieving the proposed objectives, namely: the development of motor and even psychomotor skills, coordination capacities, as well as the development of joint mobility concerning diverse segments involved in the execution of the technical elements on the beam; the development of the main muscle groups; the development of flexibility and optimisation of the execution of some technical elements on the beam.

The proposed training program was developed according to the age distinctions of the athletes included in the study and was adjusted to their extent of training and we have obtained testing agreement from the parents/guardians of the athletes involved. We used didactic strategies to

obtain the applicability of study and the formation of various skills. In order to develop the didactic activities, materials from the targeted sports clubs were used efficiently. The elements of the proposed training programs were enforced in accordance with the objectives set out above and included means specific to Artistic Gymnastics, individualized for the research sample investigated. These included: operational means within the physical training of gymnasts (i.e., the analytical training of muscle groups: arms, abdomen, followed by back and legs), means for improving general coordination, balance and orientation in space, means for the development of static and dynamic balance, means for improving mobility (meant to enhance the mobility of the spine, hip, as well as ankle and shoulder).

Along the investigation, the entire group of subjects within our study was properly supervised; moreover, the proposed training programs were assessed regularly. In order to maintain the interest of the subjects, various open educational resources and games were used in the didactic design activity.

SPSS version 23 was used for statistical analysis of the data.

3. Results

After applying the individualized program in the gymnasts' training, they obtained the following outcomes shown in Tables No. 1 and 2, Figures 1 and 2.

Table 1. Descriptive statistics indicators for psychomotor tests

Feature	Average	Median	Standard Deviation	Coefficient of variation (%)	Lower limit of confidance interval	Upper limit of confidance interval
			Matorin Test (^{0})			
Dominant part_TI	387,10	370	40,08	10,35	367,78	406,42
Dominant part_TF	463,15	450	48,79	10,54	439,68	468,67
Nondominant part_TI	327,63	315	38,41	11,73	309,14	346,14
Nondominant part_TF	384,21	375	39,23	10,21	365,29	403,12
			Flamingo Test (s)			
Right leg_TI	27,71	20,31	16,03	57,87	19,98	35,44

Right leg_TF	40,37	31,47	19,69	48,79	30,87	49,86
Left leg_TI	21,07	17,08	9,73	46,21	16,38	25,76
Left leg_TF	34,61	30,5	14,15	40,89	27,79	41,43
			Maintaining position on the balance plate (s)			
With eyes open_TI	48,70	42,1	25,40	52,17	36,46	60,95
With eyes open_TF	83,40	86	27,88	33,44	69,96	96,84
With eyes closed_TI	12,05	10,58	10,59	87,89	6,94	17,16
With eyes closed_TF	29,50	25,11	17,09	57,92	21,27	37,74
Bass Test (s)_TI	89,89	90	8,23	9,16	85,92	93,86
Bass Test (s)_TF	95,10	95	5,14	5,41	92,62	97,58
			„Y" Test			
			Right leg_TI			
A	54,4	56	4,62	8,50	52,17	56,62
PM	77,02	77,7	9,03	11,74	72,66	81,38
PL	76,79	78	9,11	11,87	72,40	81,18
			Right leg_TF			
A	62,24	63	4,61	7,42	60,02	64,47
PM	88,01	88	7,16	8,14	84,56	91,46
PL	85,67	86,9	8,88	10,37	81,39	89,95
			Left leg_TI			
A	54,41	55	5,30	9,75	55,85	56,96
PM	75,08	77	9,54	12,72	70,48	79,69
PL	76,25	81	10,27	13,48	71,30	81,21
			Left leg_TF			
A	60,21	61	4,89	8,14	57,84	62,57
PM	83,43	85	9,67	11,59	78,77	88,09
PL	83,35	84,3	9,81	11,78	78,62	88,08

**TI - initial testing; TF - final testing; a - anterior; PM - posteromedian; PL – posterolateral*

Source: authors own conception

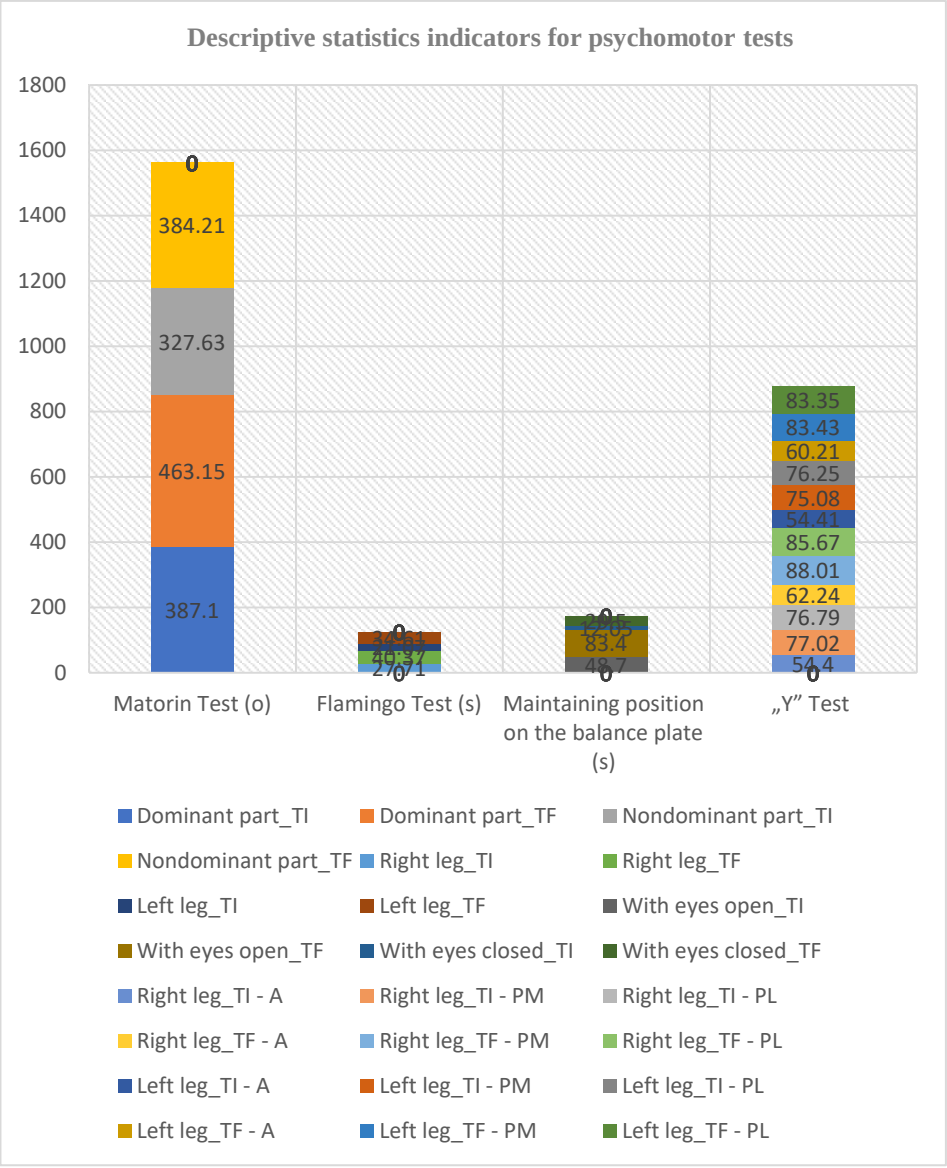

Figure 1. Descriptive statistics indicators for psychomotor tests
Source: authors own conception

Of all the parameters presented, we consider the Matorin Test to be a significant indicator for this category of parameters and therefore choose to statistically interpret the results recorded and presented in the table above.

We note that the athletes have a mean initial level on the dominant side of 387.10^0 with a standard deviation of 40.08^0 and a coefficient of variation of 10.35%, and on the non-dominant side a mean of 327.63^0 with a standard deviation of 38.41^0 and a coefficient of variation of 11.72%. The mean is representative, so we can say that the group of subjects investigated is homogeneous. Considering the median, we can say that half of the athletes at the beginning of the training program had on the dominant side a level up to 370^0 and half had over 370^0, and on the non-dominant side, half had up to 315^0 and half over 315^0. The confidence interval allows us to state that the mean on the dominant side for all athletes in the group of subjects included in the research is between $367,78^0$ and $406,42^0$ on the dominant side and $309,14^0$ and $346,14^0$ on the non-dominant side, taking into account a probability of 95%. After completion of the training programme, the mean level on the dominant side is 463.15^0 and 384.21^0 on the non-dominant side.

Analysing these values, we can state that the homogeneity of the group of subjects investigated increases in terms of this characteristic, so the gymnasts are more similar to each other in terms of this parameter. The reduction in the width of the confidence interval is further evidence of increasing homogeneity. Taking into account a risk of 5%, at the final evaluation the average level considering the whole population, represented by our sample, is between 439.680; 468.670 on the dominant side and 365.290; 403.120 on the non-dominant side.

Table 2. Results of Student's t-test on paired samples to underline the differences between the traits in the gymnasts' psychomotor tests (values obtained initially and at the end of the program applied)

	Pair differences				t	df	Sig.
	Average	Standard Deviation	Confidance interval for differences (95%) Lower limit	Upper limit			
			Matorin Test (⁰)				
Pair 1 Dominant part_TI - Dominant part_TF	-76,053	20,587	-85,975	-66,130	-16,103	18	0,000
Pair 2 Nondominant part_TI -	-56,579	17,955	-65,233	-47,925	-13,736	18	0,000

Nondominant part_TF							
			Flamingo Test (s)				
Pair 3 Right leg_TI - Right leg_TF	-12,66105	8,39669	-16,70813	-8,61398	-6,573	18	0,000
Pair 4 Left leg_TI - Left leg _TF	-13,53824	7,50793	-17,15713	-9,91917	-7,860	18	0,000
			Maintaining position on the balance plate (s)				
Pair 5 With eyes open_TI – With eyes open_TF	-34,70053	9,84223	-39,44433	-29,95672	-15,368	18	0,000
Pair 6 With eyes closed_TI – With eyes closed_TF	17,45421	8,98980	-21,78716	-13,12126	-8,463	18	0,000
Pair 7 Bass Test (s)_TI - Bass Test (s)_TF	-5,211	3,441	-6,869	-3,552	-6,600	18	0,000
			„Y" Test				
			Right leg_TI				
Pair 8 A_TI - A_TF	-7,8474	1,0627	-8,3596	-7,3352	-32,188	18	0,000
Pair 9 PM_TI - PM_TF	-10,9895	4,2603	-13,0429	-8,9361	-11,244	18	0,000
Pair 10 PL_TI - PL_TF	-8,878	2,912	-10,2828	-7,4751	-13,287	18	0,000
			Left leg_TF				
Pair 11 A_TI - A_TF	-5,8000	1,5815	-6,5623	-5,0377	-15,986	18	0,000
Pair 12 PM_TI -	-8,3474	4,1812	-10,3627	-6,3321	-8,702	18	0,000

PM_TF							
Pair 13	-7,0947	3,0637	-8,5714	-5,6181	-	1	0,00
PL_TI -					10,09	8	0
PL_TF					4		

Source: Own processing in SPSS & authors own conception

**TI - initial testing; TF - final testing; a - anterior; PM - posteromedian; PL – posterolateral*

Based on the estimated values for the probability of the null hypothesis, for the 13 tests we can say, considering a risk of 5%, that the null hypothesis is rejected for the 13 pairs of indicators. Hence, there are high differences between their average values for the two tests (TI and TF). As mentioned above, among all the parameters presented, we consider the Matorin Test to be a significant indicator for this category of parameters in relation to our research and therefore we choose to statistically interpret the results recorded and presented in the table above. Considering the results of this test and the fact that the average initial level is 387.100 and at the end of the training program is 463.150 on the dominant side and 327.600 initially and 384.210 finally on the non-dominant side, we can state that after the training the tendency of the athletes is oriented towards better overall coordination of balance and orientation in space.

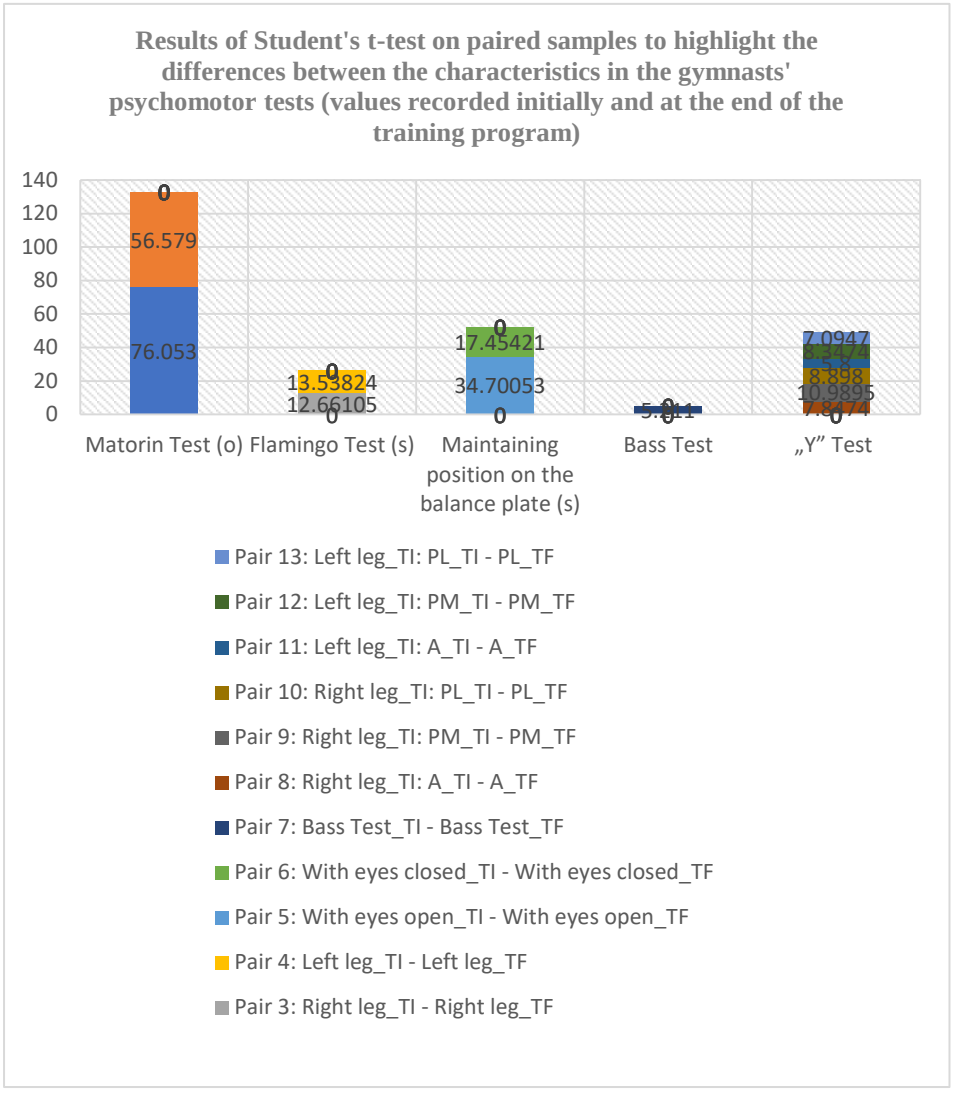

Figure 2. Results of Student's t-test on paired samples to underline the differences between the traits in the gymnasts' psychomotor tests (values obtained initially and at the end of the training program)
Source: authors own conception

Discussion

The aim of this study was identified by the effort to complement the standard sports training program with a portfolio of innovative means and methods to optimize the process of achieving performance in gymnastics competitions and to demonstrate that by applying an individualized program in the training of gymnasts, some psychomotor behaviors will be influenced.

As in any sport, as demonstrated by many specialists in the field, training is crucial for athletes to successfully navigate the rigors of the regular season, as it is for most sports. In order to help their players prepare as best they can while preventing any potential injuries, many coaches have been looking for novel approaches and innovative training methods in recent years, especially at the highest level (Abalașei, 2014). High-level athletes are currently using two techniques to optimize their physical performance: functional and plyometric training. Athletes undergoing functional training should expect a personalized regimen of workouts that target multiple joints and muscle groups simultaneously (Dimitrios et al., 2023; Ferioli et al., 2018; Holmberg, 2010; Usgu et al., 2020; Cook et al., 2014).

The findings recorded in the psychomotor tests indicate an evolution between the two tests, with significant differences regarding all 13 pairs of indicators (Matorin Test, for both dominant and non-dominant side; Flamingo Test, for the right left leg; Maintaining the stance on the balance board with eyes closed and eyes opens the "Y" Test, involving A, PM and PL), which implies a better static and dynamic balance, a better coordination among the gymnasts included in the test.

It is unanimously accepted that psychomotor skills are qualities that play a major role in achieving results in Artistic Gymnastics, both artistically and technically. These skills must be perfectly matched with that of coordination (an indispensable quality for mastering the specific technique of each apparatus).

We recommend the development of balance at this age, because as shown in many studies, subjects aged between 6 and 18 years, especially females, show better balance and dynamics than boys which emerge around the age of 6-10 years and can be optimized by innovative means used (Schedler et al., 2019; Schedler et al., 2020; Barela et al., 2003; Lenroot, & Giedd, 2006; Bair et al., 2007).

As far as coordination is concerned, as the results of our study show, this behaviour can develop, especially in girls at this age. Studies in this regard indicate that the level of coordination also increases with age and the

training methods used have a great impact on it (Davies & Rose, 2000; D'Hondt et al., 2011; Vandorpe et al., 2011).

The views of some authors highlight the fact that psychomotor skills are a factor in success in many sports, especially artistic gymnastics, as any small change affects the final result. As motor skills develop, coaches must work systematically and take into account that motor effectiveness is one of the most crucial aspects. Well-trained gymnasts from a physical standpoint are the only ones who can perform gymnastics elements and carry out technically correct exercises without injury. Compensatory body motions are vital in maintaining balance to bring centre of gravity above the support area. Unnecessary movements involving other movements of the hands, feet or torso to avoid falling off the apparatus during the exercises will be penalised by the referees (Veljković et al., 2014).

Because achieving results requires preparation before, during and after, the time spent analysing planned decisions is substantial. Experiencing motor sensations where the body incurs internal and external communication is a method to obtain a type of training focusing on individual evolution. Knowing one's own body by becoming aware of one's own thoughts, feelings, sensations means directing one's own intelligence towards the continuous development and evolution of one's own ideas (D'Hondt et al., 2011). Specialists demonstrate the importance of psychomotor training in gymnasts' training and support the idea of integrating psychomotor exercises and games that contribute to increasing the general level of psychomotor skills and various coordination qualities of athletes. They recommend psychomotor training through specific methods deriving from the development of coordination, body schema, laterality and spatiotemporal organization is used in the training of gymnasts, but time and time again, to avoid boredom, which intervenes very quickly during the early years of performing a sport (Oltean et al., 2019).

Screening talented athletes plays an important role in sport, especially in Artistic Gymnastics. To spot talented gymnasts, a way is needed to identify the best tools to work with. Advanced and very fast technology can have a major impact in discovering them. In terms of measurement and assessment, with the creation of tools that can predict an individual's achievements, it encourages us to identify and select talented athletes. On this point. In a study in Indonesia, which aimed to discover the potential sports talents possessed by SMP Negeri students in Aikmel district in 2019, 56 primary school students were tested using 10 testing methods and found among many talented children in various sports such as athletics, cricket, table tennis, archery and a number of 3 students, representing a percentage

of 5.4% of the tested sample ,who were inclined towards Gymnastics (Gable & Lockard, 2023).

In the early education of gymnasts (4 - 6 years old), they experience tremendous physical and mature development. Specialists use it as an essential tool to know and explore the physical and social setting. Understanding the need to achieve a complete development that promotes in a balanced way the physical, emotional, social and cognitive abilities of gymnasts, specialists consider that psychomotor strategies are applied in gymnastics settings to foster the improvement of physical abilities (i.e., general coordination, balance and gross motor skills) (Westerterp, 2018; Serrano et al., 2018). Specialists believe that motor training from an early age is intended to develop higher perceptual-sensory abilities as well as basic motor skills (Grigore et al. 2016, D'Hondt et al., 2011; Westerterp, 2018).

Future research directions may be directed towards identifying underlying relationships, through quantitative analyses; sometimes, linear or multiple regressions, between the variables invoked are used. Also, other psychomotor components such as spatiotemporal organisation and laterality could be taken into account, thus providing a more detailed picture of their influences on the learning process of different technical elements in Artistic Gymnastics.

5. Conclusions

Following the results obtained, we can state that psychomotor training and movement re-education shape the gymnasts' personality by linking action with the discovery of the environment for learning purposes.

The results of psychomotor tests help coaches to form an overall picture of the gymnasts from a motor perspective, because the structure of technical elements requires a proper level of balance, since the composition of the exercise for competitions includes manifestations of static and dynamic balance.

Considering the record and previously presented, we can state that, applying the training program, sports activities show improved general coordination, spatial-temporal orientation and a progress of the level of static and dynamic balance, and these can establish the degree of efficiency. of the preparation process.

We highlight and at the same time recommend the importance of the presence of physical, motor, and psychomotor elements in the evaluation process of junior gymnasts aged 10-12 and the use of a special training program developed for the achievement of psychomotor control specific to the technical elements in artistic gymnastics, which can ensure an

arrangement of execution and, implicitly, of sports performance and being a key in the training process of gymnasts.

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References

Abalaşei, B., A., Moraru, C. E., Popovici, I. M. (2018). Role of psychomotor conducts in bodily modelling. *The Impact of Sport and Physical Education Science on Today's Society*, *4*, 287 - 292.

Abalaşei, B. A. (2014). *Aplicații ale psihomotricității în fitness - curs*. Editura Universităţii „Al. I. Cuza", pp. 5, 79.

Aghase, C. D. & Bhandeo, M. (2018). Comparison of pommel horse routines among male gymnasts on the basic of their brain hemisphere dominance. *UGc Approved Journal*, *7*, 1- 4.

Akin, M. (2013). Effect of gymnastics training on dynamic balance abilities in 4 - 6 years of age children. *International Journal of Academic Research Part A*, *5*(2), 142 - 146. 10.7813/2075-4124.2013/5-2/A.22.

Bair, W. N., Kiemel, T., Jeka, J. J., Clark, J. E. (2007). Development of multisensory reweighting for posture control in children. *Experimental Brain Research, 183,* 435 - 446.

Balint, T., Diaconu, I., Moise A. (2007). *Evaluarea aparatului locomotor*. Editura Tehnopress, pp. 38, 39, 59, 109, 207.

Barela, J. A., Jeka, J. J., Clark, J. E. (2003). Postural control in children. Coupling to dynamic somatosensory information. *Experimental Brain Research*, *150*, 434–442

Bobo - Arce, M., & Méndez - Raial, B. (2013). Determinants of competitive performance in rhythmic gymnastics. A review. *Journal of Human Sport & Exercise*, *8*(3), 711 - 727. 10.4100/jhse.2013.8.Proc3.18.

Cook, G., Burton, L., Hoogenboom, B., Voight, M. (2014). Functional Movement Screening: The use of fundamental movements as an assessment of function - Part 1. *International Journal of Orthopaedic & Sports Physical Therapy*, *9*, 396–409.

Cotty, J., Lenoir M., Crombez, G. (2006). The measurement of competitive anxiety during balance beam performance in gymnasts. *Journal of Sports Science*, *24*(2), 157 - 164. 10.1080/02640410500131571.

Cottyn, J., Clercq, D., Pannier, J. L., Crombez, G., Menoir, M. (2006). The measurement of competitive anxiety during balance beam performance in gymnasts. *Journal of Sports Science - Taylor&Francis Group*, *24*(2), 157 - 164. 10.1080/02640410500131571.

Čuk, I., Atikov, A., Tabaković, M. (2009). Tkachev salto on hight bar. *Science of Gymnastics Journal*, *1*, 5 - 13.

Cuk, I., Korencic, T., Ravnik, T. T., Pecek, M., Bucar, M., Hraski, Z. (2007). Differencies in morphologic characteristics between top level gymnasts of year 1933 and 2000. *Collegium Antropologicum*, *31*(2), 613 - 619.

D'Hondt, E., Deforche, B., Vaeyens, R., Vandorpe, B., Vandendriessche, J., Pion, J., Philippaerts, R., de Bourdeaudhuij, I., Lenoir, M. (2011). Gross motor coordination in relation to weight status and age in 5- to 12-year-old boys and girls: A cross-sectional study. *International Journal of Pediatric Obesity*, *6*, e556–e564.

Dallas, G., Tsopani, D., Smirniotoy, A., Di Cango, A. (2014). Accute effect of different stretching methods on flexibility and jumping performance in

competitive artistic gymnasts. *The Journal of Sports Medicine and Physical Fitness*, *54*(6), 683 - 690.

Davies, P.L. & Rose, J.D. (2000). Motor skills of typically developing adolescents: Awkwardness or improvement? *Physical & Occipational Therapy In Pediatrics*, *20*, 19 – 42.

Dimitrios, M., Nomikos, T., Mitsopoulos, N., Kostopoulos, K. (2023). Effect of a 6-week preseason training protocol on physiological and muscle damage markers in high-level female and male basketball players. *Sports*, *11*, 229. 29. https://doi.org/ 10.3390/sports11110229

Ferioli, D., Bosio, A., Bilsborough, J.C., La Torre, A., Tornaghi, M., Rampinini, E. (2018). The preparation period in basketball: Training load and neuromuscular adaptations. *International Journal of Sports Physiology and Performance*, *13*, 991–999.

Fullam, K., Caulfield, B., Coughlan, G. F., Delahunt, E. (2014). Kinematic analysis of selected reach directions of the Star Excursion Balance Test compared with the Y-Balance Test. *Journal of sport rehabilitation*, *23*(1), 27-35. doi.org/10.1123/JSR.2012-0114.

Gable, T.F., & Lockard, M.M. (2023). Efficacy of balance training to improve balance of young female gymnasts. *Science Of Gymnastics Journal*, *15*(1), 87 - 96.

Gagea, A. (2010). *Tratat de cercetare științifică in educație fizică si sport - suport de curs*, pp. 75 - 141.

Gavojdea, A. (2016a). *Impactul programelor speciale de antrenare a aterizărilor asupra performanțelor sportive din gimnastica artistică feminină - vârsta 8 - 10 ani* (Teză de doctorat, Universitatea Națională de Educație Fizică și Sport, București), Ministerul Educației, Cercetării și Tineretului.

Gavojdea, A.M. (2016b). Study regarding balance in 9 - 10 years old gymnasts. *The European Proceedings of Social & Behavioral Science*, *10,* 218 - 225.

Grigore, V. (2001a). *Gimnastica artistică- Bazele teoretice ale antrenamentului sportiv*. București: Editura Semne, pp. 12 - 75.

Grigore, V. (2001b). *Gimnastica de bază: bazele teoretice ale pregătirii sportive.* Editura Semne, pp. 9 - 11, 47, 97.

Grigore, V. (2003). *Gimnastica. Manual pentru cursul de bază*. Editura Bren, p. 4.

Grigore, V. (2002). *Pregătirea artistică în gimnastica de Performanță*. Editura ANEFS, pp. 10 - 12.

Grigore, V., Stănescu, M., Păunescu, M. (2016). An experimental study regarding the influences of sport disciplines on the psychomotricity of the students from the University of Bucharest. *5th INnternational Congress on physical education, sport and kinetotherapy, 11*, 348 - 356.

Heller, B., Senior, T., Wheat, J. (2014). The Smartfloor: A large area force-measuring floor for investigating dynamic balance and motivating exercise. *Procedia Engineering*, *72*, 226 - 231.

Herman, A., Daniyantara, D., Dinata, K., Mahfuz, (2020). Identification of sports talent (using sport search) in students of State Middle School. *Social Science, Education and Human Research*, *563*, 178 - 182.

Holmberg, P. (2010). Preseason preparatory training for a Division III Women's College Basketball team. *Strength & Conditioning Journal*, *32*, 42–54.

Hrysomallis, C. (2011). Balance and ability and athletic performance. *Sport Med*, *41*(3), 221 - 232. 10.2165/11538560-000000000-00000.

Jaba, E. (2002). *Statistica*, Editura Economică. p. 382.

Lenroot, R.K. & Giedd, J.N. (2006). Brain development in children and adolescents: Insights from anatomical magnetic resonance imaging. *Neuroscoence & Biobehavioral Reviews*, *30*, 718 - 729.

Merida-Serrano, R., Olivares-Garcia, M.D., Gonzalez-Alfaya, M.E. (2018). Discovering the world through the body in the childhood. The importance of materials in the child psychomotricity. *Retos-Nuevas tendencias en education fisica deporte y recreation, 34*, 329 - 336.

Oltean, A., Damian, M., Teodor, D. (2019). Approaching psychomotricity in rhythnic gymnastics training. *Future Academy*, *52*, 413 - 422.

Oltean, A., Dobrescu, T., Popescu, R. (2018). Improving artistic jump at beam, *Series Physical Education and Sport/Science, Movement and Health*, *10*, 138 - 145.

Pajek, M.B., Hedbávný, P., Kalichová, M., Čuk, I. (2018). The asymmetry oflower limb load in balancebeam routines. *Science of Gymnastics Journal*, *8*(1), 5 - 13.

Pescari, T. A. & Popescu, T. L. (2012). The importance of preschool education of psychomotricity component to prevent the instrumental disorders. *Academica Science Journal, Psychologica Series*, *1*, 25.

Schedler, S., Kiss, R., Muehlbauer, T. (2019). Age and sex differences in human balance performance from 6-18 years of age: A systematic review and meta-analysis. *PLoS ONE*, *14*, e0214434.

Schedler, S., Tenelsen, F., Wich, L., Muehlbauer, T. (2020). Effects of balance training on balance performance in youth: Role of training difficulty. *BMC Sports Science, Medicine and Rehabilitation*, *12*, 71.

Serrano, M. S., Garcia, O. M., Gonzalez, M. E. (2018). Discovering the world through the body in the childhood. The importance of materials in the child psychomotricity. *Retos-Nuevas tendencias en educacio fisica deporte y recreacion, 34*, 329 - 336.

Sloanhoffer, H. L., Harrison, K. D., McCrory, J. L. (2018). Dynamic stability in gymnasts, non-balance athletes, and active controls. I*n: International Journal of Exercise Science*, *11*, 1 - 12.

Tudor, V. (2013). *Măsurare şi evaluare în sport*. Editura Discobolul. p. 161

Usgu, S., Yakut, Y., Kudas, S. (2020). Effects of functional training on performance in professional basketball players. *Turkish Journal of Sports Medicine*, *55*, 321–331.

Vandorpe, B., Vandendriessche, J., Lefevre, J., Pion, J., Vaeyens, R., Matthys, S., Philippaerts, R., Lenoir, M. (2011). The Körperkoordinations Test für Kinder: Reference values and suitability for 6-12-year-old children in Flanders. *Scandinavian Journal of Medicine & Science in Sports*, *21*, 378-388.

Veljkovic, A.A., & Markovic, L.M. (2019). The relationship between chosen kinematic parameters of the aerial cartwheel on the balance beam during skill learning. *Baltic Journal of Health and Physical Activity*, *11*(1), 18 - 23.

Veljković, A.A., Madić, D., Veličković, S., Herodek, K., Popović, B. (2014). Balance in young gymnast: age-group. *In: Physical Education and Sport*, *12*, 289 - 296.

Westerterp, K.R. (2018). Exercise, energy balance and body composition. *European Journal of Clinical Nutrition*, *72*, 1246 - 1250. 10.1038/s41430-018-0180-4

Xiao, X., Hao, W., Li., X., Wan, B., Shan, G. (2017). The influence of landing mat composition on ankle injury risk during a gymnastic landing: A biomechanical quantification. *Baztech*, *19*, 105 - 113.