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TESTING AND DEVELOPING AGILITY SKILL IN VOLLEYBALL PLAYERS AGED BETWEEN 10-12 YEARS

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Abstract

Nowadays, speed and coordination parameters have developed in the volleyball game, and players are required to increase their movement and agility characteristics to keep up with the game improvements. The speed, coordination and agility skills are very well developed in the early age so we started our experiment with the idea that increasing the indices of agility would help us in getting better results at volleyball. The experiment took place in the 2016-2017 competition year, with the mini volleyball team of CSM Bucharest, composed of 20 male players with the age between 10 and 12 years. The experiment group followed a 6-months agility development program in which we aimed to increase the indices of movement in any direction, sidestep, running backward and forwards, balance, dynamic coordination, laterality, quickness. We used a battery of agility tests composed of the following tests: Illinois Agility, Agility T-test, Agility Cone, Box Drill, 505 Agility test, Arrowhead agility. Also, we did some anthropometric measurement and proportionality tests before and after the experiment. The results showed significant improvements ($p<0.05$) at the final test compared with the initial test in the agility parameters, also we found some developments in the anthropometric and proportionality indices. In conclusion, the progress achieved by the experimental group and the results obtained in the championship have shown that improving the agility indices can help us in the development of young volleyball players.

Keywords: Agility development, speed, coordination, volleyball..

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1. Introduction

Sport is a popular spectacle and a mass social movement of contemporary times (Baro & Nandi, 2016). Volleyball is a competitive sport played on many different court surfaces depending on whether it is being conducted indoors or outdoors (Gortsila, Theos, Nesic, & Maridaki, 2013).

Volleyball has become one of the most practiced sports in the world. The game of volleyball requires expertise in several physical fitness and performance areas (Szabo, 2015).

Volleyball is a sport in which 76.6% of rallies last 12 seconds or less, and the average rally time is approximately 11 seconds. The range of durations includes rallies as short as 3 seconds and as long as 40 seconds. In addition, 44% of rest periods between rallies are 12 seconds or less, with the average rest time being 14 seconds (Sheppard et al., 2007). During those rallies, volleyball players perform different activities such as: jumps, drops, multidirectional accelerations, quick changes of directions, stops and landings. Players at different positions (setter, opposite hitter, passer-hitter, middle blocker and libero player) use various movement patterns with different frequency during a competition (Marques, van den Tillaar, Gabbett, Reis, & Gonzalez-Badillo, 2009). The game of volleyball should proceed from simple to complex techniques, tactics and strategies (Szabo, 2014).

Training programs for volleyball players can accelerate their physical and physiological development (Lidor & Ziv, 2010). In addition, it was recently shown that volleyball training agility programs significantly improved the skill levels of volleyball players (Lidor, Hershko, Bilkevitz, Arnon, & Falk 2007). Reaching training goals and improving athlete's motor skills and technical-tactical abilities, including optimising performance are specific activities to any coach (Hulpus, 2014a). The game of volleyball has a wide range of actions in the game, from the simplest to the most complex. This required the players to continue training and persevering, and staging the sequence of processing the learning and teaching for coaches, which gives a touch of increased subtlety of this game (Szabo, 2015).

Volleyball is a game requiring a high aerobic capacity, jumping abilities (i.e., in blocking and spiking), power output, and agility, especially in multi-set games where maintaining a high level of performance over time is required (Khuu, Musalem, & Beach, 2015). At present, in the theory and practice of sports training, there are many approaches, extensively and intensively, of the different aspects characteristic to the training process (Stoian, 2016).

Agility skill is defined by specialists as the process which involves a rapid whole-body movement with change of speed as a feedback to a stimulus being present in all team sports (Chatzopoulos, Galazoulas, Patikas, & Kotzamanidis, 2014; Milanovic, Sporis, Trajkovic, James, & Samija, 2013). It seems to be related to athletic abilities like strength, power, speed and balance and it's a determinant of sport performance in field and court sports like volleyball, soccer and rugby (Barnes et al., 2007).

Agility has as its main characteristic the rapid change of direction, speed of movement with its own phases: acceleration, maintaining speed and deceleration (Plisk, 2008), also a fast change of running direction (Simonek, Horicka, & Hianik, 2016) being considered as a physical quality with some mixed abilities (Měkota, 2000). Some other specialists dived agility in two: real sport agility, which depends on quick and accurate responses to a stimuli specific to sport environments, and pre-planned agility of reactive agility which refer to non-played agility in sports (Scanlan, Humphries, Tucker, & Dalbo, 2014; Sheppard, Young, Doyle, Sheppard, & Newton, 2006; Young & Willey, 2010; Simonek, Horicka, & Hianik, 2016).

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A very important skill in the agility development is coordination, the level of coordination also influencing the ability to adapt to various unexpected requirements and situations. The higher the level of coordinative capacity, the better the assimilation of the technique, the process of learning the technical procedures is shortened, and the movements will be easier and more precise. (Zaharie, 2015)

By rigorously forming the fundamental movements, at an early age, we create favourable conditions for forming and consolidating the body scheme, for developing coordination, balance (static and dynamic), spatial orientation, rhythm and tempo etc. (Zaharie, Grigore, & Bugner, 2012).

Previous studies observed the importance of developing sport-specific tests in process of evaluation of reactive-agility to replicate real-sport environments (Gabbett & Benton, 2009). Technical skills like serving, spiking, setting, blocking and passing accuracy along with tactical skills seem to play a critical role in volleyball performance. Gabbett and Benton (2009) evaluated the technical skills of junior volleyball players before and after an 8-week skill-based training program.

Knowing the way laterality and other components of coordination operate represents the starting point for identifying it and using it effectively during training sessions (Băiţel & Pătru, 2017). Also, studying laterality as an increasing factor of the motor and performance capacities can expose the importance of this skill in both upper and lower body (Pătru, Băiţel, Negulescu, & Angelescu, 2015).

2. Problem Statement

Nowadays volleyball game requires a series of new skills to be developed like coordination in speed regime, balance, different types of movement (lateral, sidestep, forward and backwards and on diagonal), in one word, the agility parameters. In our coaching career in volleyball, we observed, in the beginners, a problem of movement on the volleyball court. At the mini volleyball level, we consider that developing good technical volleyball skills and increasing the movement on the court are the basic skills to be learned. So, our research started from the assumption that increasing the parameters of agility skill in a mini volleyball team, with pupils aged between 10 and 12 years, would give us the opportunity to develop the volleyball specific skills and also improve our team's results. Also, another aim of the study was to analyse if our 6 months agility development program would have results in the anthropometric and physical development of our team.

3. Research Questions

The main question that guided our research was: can agility programs develop skills like coordination, speed, quickness, balance, reaction time and different types of movement on the volleyball court at the mini volleyball stage? Can agility skills improve our volleyball performances?

4. Purpose of the Study

The main idea or purpose that guided our research was to test the agility skills of our volleyball players and to try to develop their agility skills like coordination, quickness, rapid response and reaction time of their decisions, speed and balance.

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5. Research Methods

5.1. Subjects of the research

Our research subjects group was formed by 20 young male volleyball players at the mini volleyball level (10 to 12 years old) that were in the second year of practice and were registered with the CSM Bucharest volleyball team.

The experiment took place between 2016 and 2017 at the Middle School No. 179, Sector 1, Bucharest, and consisted in two anthropometric measurements (initially in September 2016 and finally in June 2017) and two agility tests (initially in September 2016 and finally in June 2017). After the anthropometric measurements, we also calculated the proportionality index of some required parameters in volleyball. Between the two tests, we followed up an extra training program, with the aim of improving the agility skills of our players, and secondly, to develop their anthropometric parameters. The extra program for improving agility consisted of: ladder drills, exercises for improving balance and coordination, exercises for improving speed and quick movement, exercises for the reaction time and for changing direction, lateral, forward and backward running exercises and exercises for taking rapid decision. Our team had four training sessions per week, with two hours practice time that aimed to develop volleyball skills and tactics, and we also added an extra half hour for developing agility skills.

5.2. Methods of research applied in our research

Assessment through tests has as main objective the gathering of concrete information about the aspects studied in order to formulate a prognosis aimed at assessing the efficiency of the means used and the scientific direction of the instructive-educational process (Stoian, 2018).

The test is a standardised assessment method that sets very precisely the conditions of development, the content and the norms (scales) to be met (Stoian, 2016).

We used as research methods the following tests:

A. Anthropometric development tests and tests for proportionality index development.

B. Volleyball specific agility tests like: Agility T-test, Illinois Agility, Agility Cone, Box Drill, Arrowhead agility, 505 Agility test. The agility tests are assessment procedures that verify different agility skills like coordination, speed, quickness, balance etc. The test list is provided by Wood (2008).

T-test is a well-accepted standard agility test that is easy to administer, since it does not require complex equipment and long hours of preparation (Sassi et al., 2009).

505-test is also a reliable and valid test for the evaluation of agility in many sports but it requires the use of dual beam electronic timing gates (photocells) (Gabbett, 2007). They concluded that 505-test simulates the “general” movement patterns in team sports like rugby, basketball and volleyball.

5.3. Program of agility used on the team

The research aimed to develop the agility skills of the sportive, so we planned a six month program with two extra trainings of 30 min per week for developing the basic components of agility: speed, quickness, lateral movement, quick decision making – the speed of taking decision, coordination in speed combination, balance. The program used cone drills, ladder drills, jumping and speed drills, contests and also dynamic games for developing children’s abilities (Table 01).

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Table 01. The agility training program

Training weeks	**IT**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**FT**
Learning the special technique for agility and changing direction		x	x	x																		
Frontal agility movement					x	x	x															
Lateral agility movement					x	x	x															
Changing direction agility movement 90 degrees								x	x	x				x	x	x						
Changing direction agility movement more than 90 degrees								x	x	x							x	x	x			
Backward agility movement								x	x	x				x	x	x						
Other agility tasks											x	x	x									
Cone drills					x	x	x	x	x	x	x	x	x									
Ladder drills					x	x	x	x	x	x	x	x	x									
Jumping and speed drills														x	x	x	x	x	x	x	x	
Balance exercises																		x	x	x	x	
Coordination exercises														x	x	x	x					
Dynamic games		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

Legend: IT – initial test, FT – final test

6. Findings

Our study started with an initial anthropometric measurement, in September 2016, which evaluated the main physical characteristics of our research sample. We measured, as can be seen in Table 01, the following physical parameters: body height, body weight, wingspan, bust, biacromial diameter, bitrochanteric diameter, thoracic perimeter, length of lower limbs and length of upper limbs.

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Table 02. The results of the anthropometric measurements at the initial test

Item no.	Anthropometric measurements (Initial test)	Arithmetic mean	Standard deviation	Standard error	Confidence interval for mean	
					Lower bound	Upper bound
1	Age	11.42	1.412	0.256	10	12
2	Height	142.10	2.198	0.125	133	151
3	Weight	38.05	1.731	0.349	33	45
4	Wingspan	142.05	2.240	0.247	138	145
5	Bust	78.88	1.112	0.453	74	82
6	Biacromial diameter	28.65	1.591	0.221	28	29
7	Bitrochanteric diameter	30.01	1.131	0.333	28	31
8	Thoracic perimeter	74.23	2.901	0.125	70	77
9	Length of lower limbs	65.03	3.102	0.347	62	70
10	Length of upper limbs	56.03	1.433	0.121	50	61

After the period of six months of following the training program for developing agility skills, we repeated the anthropometric measurements in the final evaluation (as we can see in Table 03) following the same procedure as at the initial testing. The parameters chosen for the measurement were important in our volleyball training and also in the evaluation of agility parameters.

Table 03. The results of the anthropometric measurements at the final test

Item no.	Anthropometric measurements (Final test)	Arithmetic mean	Standard deviation	Standard error	Confidence interval for mean	
					Lower bound	Upper bound
1	Age	11.77	1.561	0.179	11	12
2	Height	145.51	1.916	0.212	136	155
3	Weight	39.21	1.552	0.171	35	46
4	Wingspan	145.15	1.351	0.215	139	147
5	Bust	80.04	2.017	0.223	75	83
6	Biacromial diameter	29.15	2.295	0.174	28	30
7	Bitrochanteric diameter	30.71	1.268	0.218	29	32
8	Thoracic perimeter	75.13	1.241	0.276	72	78
9	Length of lower limbs	66.73	2.267	0.211	64	71
10	Length of upper limbs	57.13	1.235	0.189	50	62

As we can see in Figure 01, the results of the anthropometric measurements show significant improvement between the initial evaluation and the final evaluation as follows:

At the body height parameter, we can see an improvement of 3.41 cm, with a growing rate of 2.40%, from the initial evaluation (142.10 cm) to the final evaluation (145.51 cm).

Regarding the body weight of our subjects, it can be observed an improvement of 1.16 kg, with a growing rate of 3.04%, from the initial measurement (38.05 kg) to the final measurement (39.21 kg).

Observing the wingspan parameter, we can see an improvement of 3.1 cm, with a development rate of 2.18%, from the initial assessment (142.05 cm) to the final assessment (145.15 cm).

Analysing the results of measurements at the bust parameter, we can see an improvement of 1.16 cm, with a development rate of 1.47%, from the initial evaluation (78.88 cm) to the final evaluation (80.04 cm).

At the biacromial diameter, we can observe an improvement of 0.5 cm, with an increasing rate of 1.74%, from the initial measurement (28.65 cm) to the final measurement (29.15 cm).

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Regarding the bitrochanteric diameter, we can see an improvement of 0.70 cm, with an increasing rate of 2.33%, from the initial measurement (30.01 cm) to the final measurement (30.71 cm).

At the thoracic perimeter assessment, we observed an increase of 0.9 cm, with a progress rate of 1.21%, from the initial measurement (74.23 cm) compared with the final measurement (75.13 cm).

Observing the length of the lower limb measurement, we can see an increase of 1.7 cm, with a progress rate of 2.61%, from the initial measurement (65.03 cm) to final measurement (66.73 cm).

At the last parameter, the length of the upper limbs, we can observe an increase of 1.1 cm, with a progress rate of 1.96%, from the initial measurement (56.03 cm) to the final measurement (57.13 cm).

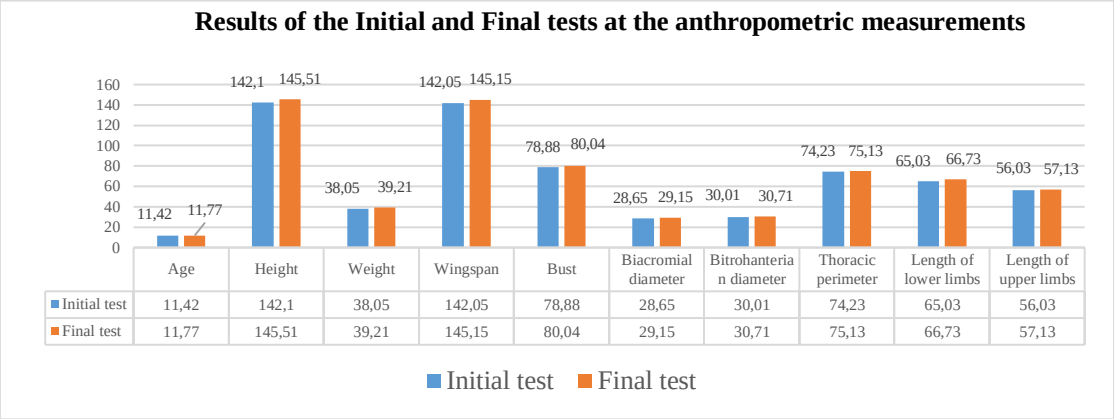

Figure 01. Results of the initial and final tests at the anthropometric measurements

Table 04. Results of the proportionality index calculation at the initial test

Item no.	Proportionality indices (Initial test)	Arithmetic mean	Standard deviation	Standard error	Confidence interval for mean	
					Lower bound	Upper bound
1	Body mass index	18.8	1.121	0.110	18.3	19.2
2	Wingspan-height relation	99.96	2.101	0.151	95.10	101.31
3	Biacromial diameter-height relation	20.16	1.102	0.215	19.21	22.01
4	Bitrochanteric diameter-height relation	21.12	2.011	0.215	20.05	22.87
5	Thoracic perimeter-height relation	52.24	2.343	0.191	50.02	54.33

Table 05. Results of the proportionality index calculation at the final test

Item no.	Proportionality indices (Finial test)	Arithmetic mean	Standard deviation	Standard error	Confidence interval for mean	
					Lower bound	Upper bound
1	Body mass index	18.5	1.547	0.216	18.3	18.8
2	Wingspan-height relation	100.25	2.592	0.347	97.20	103.31
3	Biacromial diameter-height relation	20.03	1.289	0.145	19.15	21.83
4	Bitrochanteric diameter-height relation	21.11	2.265	0.168	20.24	22.91
5	Thoracic perimeter-height relation	51.63	2.213	0.126	50.24	55.63

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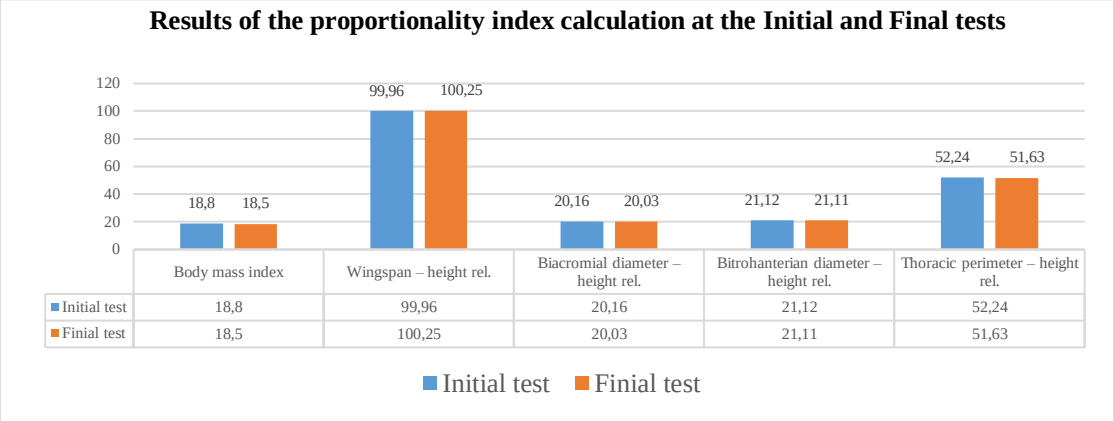

Figure 02. Results of the proportionality index calculation at the initial and final tests

The next step in our research investigation was to calculate some proportionality indices based on the initial anthropometric assessment (Table 01) and the final anthropometric assessment (Table 02). We decided to apply the following proportionality indices: body mass index, the relationship between wingspan and body height, the relationship between biacromial diameter and body height, the relationship between bitrochanteric diameter and body height and the relationship between thoracic perimeter and body height.

The results were calculated for the initial evaluation in Table 03, and for the final evaluation, in Table 04. Also, graphical representations of the results can be analysed in Figure 02 as follows:

At the proportionality indices of body mass index, we can observe a decrease of 0.3 points, representing a decreasing rate of 1.62%, from the initial evaluation (18.8 points) to the final evaluation (18.5 points).

Regarding the relationship between wingspan and body height, we observed an increase of 0.29 points, representing a growing rate of 0.29%, from the initial assessment (99.96 points) to the final evaluation (100.25 points).

Analysing the relationship between biacromial diameter and body height, we can observe a decrease of 0.13 points from the initial evaluation (20.16 points) to the final evaluation (20.03 points).

Regarding the relationship between bitrochanteric diameter and body height, we can observe a decrease of 0.01 points from the initial evaluation (21.12 points) to the final evaluation (21.11 points).

At the last indices evaluated, the relationship between thoracic perimeter and the body height, we can see a decrease of 0.61 points from the initial evaluation (52.24 points) to the final evaluation (51.63).

Table 06. Results of the initial agility test

Item no.	Agility tests (Initial test)	Arithmetic mean	Standard deviation	Standard error	Confidence interval for mean	
					Lower bound	Upper bound
1	Agility T-test	16.78	1.157	0.145	16.02	17.53
2	Illinois Agility	22.05	2.445	0.291	20.16	25.32
3	Agility Cone	9.21	1.155	0.151	9.11	10.04
4	Box Drill	11.20	1.569	0.191	10.55	12.89
5	Arrowhead agility	15.33	2.224	0.211	13.88	17.02
6	505 Agility test	4.51	1.102	0.120	4.30	5.02

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Table 07. The results of the agility final test

Item no.	Agility tests (Finial test)	Arithmetic mean	Standard deviation	Standard error	Confidence interval for mean	
					Lower bound	Upper bound
1	Agility T-test	15.22	1.361	0.217	15.05	16.23
2	Illinois Agility	20.88	1.993	0.145	19.88	23.22
3	Agility Cone	9.04	2.258	0.256	8.91	9.33
4	Box Drill	10.55	2.121	0.231	10.02	11.94
5	Arrowhead agility	14.23	1.191	0.122	12.78	15.87
6	505 Agility test	3.98	2.287	0.218	3.80	4.55

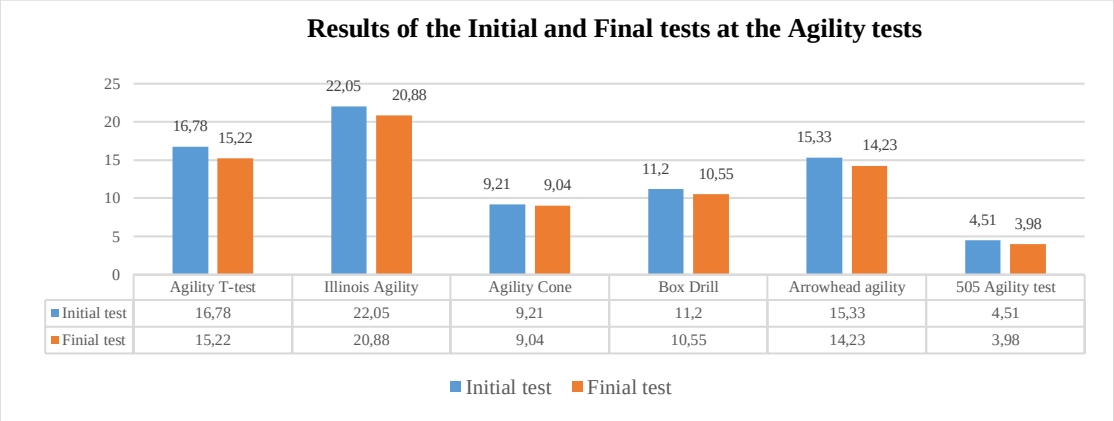

Figure 03. Results of the initial and final test at the agility tests

At the last step of our investigation, we will analyse the results of the agility test and compare the initial test results (Table 05) with the final test results (Table 06). As can be seen, we used a battery of six agility tests: Agility T-test, Illinois agility test, Agility cone, Box drill agility, Arrowhead agility and 505 agility test.

The results were then compared between the initial and final tests (Figure 03) and were as follows:

At the agility t-test, we can observe a decrease of time of 1.56 sec. between the initial test (16.78 sec) and the final test (15.22 sec), with a decreasing rate of 9.30%.

Regarding the Illinois agility test, we can observe a decrease of time of 1.17 sec. between the initial test (22.05 sec) and the final test (20.88 sec), with a decreasing rate of 5.31%.

At the agility cone test, we can observe a decrease of time of 0.17 sec. between the initial test (9.21 sec) and the final test (9.04 sec), with a decreasing rate of 1.85%.

Following the results at the box drill agility test we can observe a decrease of time of 0.65 sec. between the initial test (11.20 sec) and the final test (10.55 sec), with a decreasing rate of 5.80%.

Regarding the results of the Arrowhead agility test, it can be observed a time decrease of 1.1 sec. between the initial test (15.33 sec) and the final test (14.23 sec), with a decreasing rate of 7.18%.

At the last agility test, the 505 agility test, it can be observed a time decrease of 0.53 sec. between the initial test (4.51 sec) and the final test (3.98 sec), with a decreasing rate of 11.75%.

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7. Conclusion

Agility skill is very important in the modern game of volleyball, compared with other sports where resistance and force are the main skills, in volleyball game the components of agility are very important, skills like speed, quickness, balance, coordination, rapid change of direction and laterality are fundamental abilities that every good volleyball player need.

In an experimental study comparing volleyball players and badminton players, the authors concluded that agility and speed are very important skills in both games but found significant differences between those two sports, volleyball players are better at leg strength compared with badminton players that are more agile and fast (Baro & Nandi, 2016).

The conclusion of our study showed that our six month agility training program had good influence on the development of our volleyball players both on the agility skill components (coordination, speed, balance, laterality, quick change of direction etc.) and also on anthropometric parameters and proportionality indices. The agility tests applied on our sample showed that our volleyball players developed their skills regarding agility and obtained better results at the assessment.

Calculating the statistical significance between tests:

The results of the anthropometric measurements were compared and we calculate the statistical significance between the initial results and final results using T-student test. The results of the t-test showed that the p value was 0.0021 and the differences are considered to be very statistically significant. Regarding the confidence interval the mean of the initial test compared with the final test is -1.4100 with 95% confidence interval of the difference from -2.1586 to -0.6614. Other intermediate values used in calculations were: t = 4.2605, df = 9, standard error of difference = 0.331.

Regarding the proportionality indices we compared the results and calculated the statistical significance using the t-test. The results showed that the p value was 0.3671 with a difference considered to be statistically significant, with a 95% confidence interval, and the mean difference between the two tests was 0.1520, and an interval between -0.2634 to 0.5674. The intermediate values used in calculation were t = 1.0160, df = 4, and the standard error of difference = 0.150.

At the agility tests measurements we also compared the results of the two tests (initial and final ones) using the statistical significance t-test. The results showed us that the value of p was 0.8082 with a difference between the results of the two tests being considered to be statistically significant. The confidence interval of difference was 95% between -6.8540 to 8.5806 and the difference between their means equalled 0.8633. The intermediate values used in calculations were: t = 0.2493, df = 10, and standard error difference = 3.464. Other findings compared agility and reactive agility comparing the results of the Illinois Agility Test and Fitro Agility Check. The results showed that in Illinois Agility Test the content of the test is well known and the agility parameters are evasive compared with the Fitro Agility Check that is more spontaneous and require the sportive to decision making in short period of time (Simonek, Horicka, & Hianik, 2016). Those findings are also supported by another opinion that decision-making process in sport games is extremely important and they determine on the speed of realisation of the motor task to a great measure (Spasic, Krolo, Zenic, Delextrat, & Sekulic, 2015). A big role in the process of developing agility is a good training timeline and efficient program of exercises. Concretely, the coach, by virtue of his role as manager and specialist, and his skill and experience, has the role of adapting the working methods

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and the intensity of the training according to the athletes' reaction to the planned effort, without departing from the proposed goals (Hulpus, 2014b).

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