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Optimizing speed and agility in a volleyball game – Junior players

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Abstract

The present study aims to identify if and how motor skills such as speed and agility can be improved by using training activities corresponding to performance in volleyball. The experiment included a total of 16 male athletes (17–18 years old), divided into two groups (control and experimental group). The tests applied in the research were the Illinois test and the Hexagon test, since speed, agility and quickness are essential to high performance in volleyball. After the initial tests, the experimental group became part of a 6-week training programme, designed to learn and master speed and agility drills. The results obtained at the final control tests demonstrated that the indicators of motor skills registered a real progress. This confirmed our working hypothesis stating that physical exercises, motor games and other means, specific to the game of volleyball, can influence the development of motor skills.

Keywords: Agility, speed, performance sport, Illinois test, Hexagon test, volleyball training.

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1. Introduction

It is common knowledge that, over the span of decades, ball games have been highly popular among both children and adults, mostly because of their centre point – the ball. Given the fact that volleyball is, at the same time, mostly dynamic and highly spectacular, we want to analyse how and if motor skills (speed and agility) are developed through this game, especially in the case of junior athletes. Modern performance volleyball competitions require from the athletes qualities like agility, coordination, speed, strength and balance (Gonzalez-Rave et al., 2011), and not just the classical skills like passing and spiking.

These motor qualities can be influenced by the body mass index (BMI) of athletes, as highlighted in a 2016 study (Neculaes & Lucaci, 2016), which states that although the average weight of BMI in tested subjects is normal, at the individual level, there have been situations in which they exceed the BMI within the normal value, which could also influence sports performance.

Volleyball game usually involves many types of speeds; most common is the speed of reaction (Castagna et al., 2009), with many dynamic combinations, both active and passive, that requires great intensity effort alternated with less intensity in other phases (Borras et al., 2001).

Sports are rarely performed straight ahead, but rather require changes of direction in which lateral movements are used in several planes of movement simultaneously. Agility skill has multiple definitions like: 'the quick movement of the body in response to a stimulus' (Chelladurai, 1976) or 'the ability to rapidly change the movement direction' or 'the ability to start and stop quickly' (Little and Williams, 2005). Agility is also defined as the ability to decelerate, accelerate and change direction quickly while maintaining good body control without decreasing speed (Costello & Kreis, 1993). Motor skills that affect the agility are balance, coordination, explosive strength and flexibility (Young & Farrow, 2006). When speaking about agility in volleyball, we mention not only the cognitive components that are involved in different tasks (like the start in sprinting and running in zigzag) that are more different than the more complex and unpredictable tasks in sport games (like blocking an attack in volleyball or reacting in receiving a spike in volleyball) (Sheppard & Young, 2006).

Agility is always linked to decision-making and anticipation in all processes in sport games (Horicka et al. 2014). Speed and agility involve moving the body very quickly, as fast as possible, but in agility skill we add the attribute of changing direction that is very important in sport games (Verkhoshansky, 1996).

In our current paper, we intended to highlight the importance of developing these two basic motor skills: speed and agility, both essential for performance in volleyball. We must bear in mind that a multitude of motor actions undertaken by the individual during daily routines or sports activities are performed with different degrees of accuracy, in relation to the degree of development of his/her motor skills.

In order to demonstrate our hypothesis, we had to:

- Identify the research sample;
- Enrol in field observation and data recording;
- Apply the Illinois and Hexagon practical tests in order to measure the speed and agility of the volleyball players participating to our study;
- Systematically apply the volleyball training exercises specific to the development of speed and agility;
- Analyse resulting data and assess the level of development of motor skills.

In order to reach a conclusion, we started from the hypothesis that, by using physical exercises, motor games and other means specific to the game of volleyball, we can develop motor skills, while optimally combined methods and means of action could lead to obtaining stable acquisitions.

2. Materials and methods used

The experiment we refer to in our present paper took place in September–October 2019 and included a total of 16 male athletes, divided into two groups (control group and experimental group). The athletes aged 17–18 years old were part of the Romanian volleyball team CSS Bacau, junior level.

During the trial run, the subjects received initial and final tests measuring the level of development of motor skills like speed and agility. In order to be able to highlight the degree of efficiency of the means and working methods used, we chose a series of tests that can show the progress of the motor qualities considered: the Hexagon test and the Illinois test.

3. The Hexagon test

This test aims to assess speed and agility, and also the ability of the athlete to start, stop and balance, in a series of very fast movements over short distances, with departure and return in all directions. The Hexagon is made of six sides of 61 cm with an angle of 120° between them. The athlete must jump outside each side of the Hexagon and return immediately, each time, to the starting point, as shown in Figure 1. Any touch of the drawn lines is penalised with 0.5 seconds. Each athlete was required to complete two full revolutions (trials) in both clockwise and anticlockwise direction. A stopwatch was used to record the time of each revolution. Data were not recorded if the participant failed to completely jump over each line demarcating the Hexagon, and he was required to repeat the trial. The average completion times of the two trials in both the clockwise and anticlockwise directions were used for analysis. A shorter completion time indicated superior agility (Beekhuizen et al., 2009).

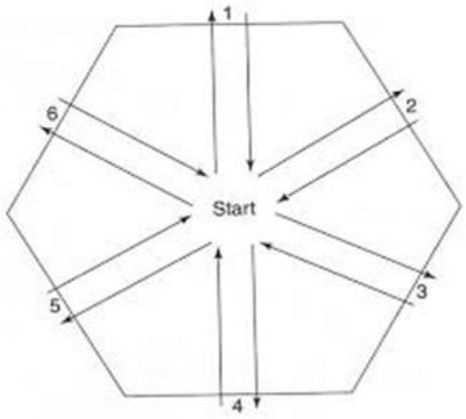

Figure 1. Hexagon test

4. The Illinois test

To measure agility, we have used the Illinois test. The length of the route is 10 m and the width (distance between the start and finish lines) is 5 m. Four milestones are used to mark the beginning, the end and the two turning points. Another four milestones are placed in the centre, at an equal distance from each other (3.33 m). The subjects are seated in front, with their head towards the starting line and their hands on their shoulders. At the coach's command, the timer starts and the athlete gets up as quickly as possible and runs the route in the indicated directions without lowering the milestones to the finish line, when the timer stops (Mackenzie, 2005) (Figure 2).

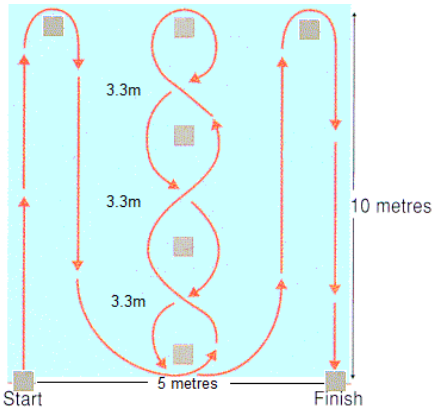

Figure 2. Illinois test

After applying the initial tests, the experimental group has received an intense 6-week training containing special drills designed to improve speed, agility and quickness. The programme's goals were: 1. Defence – increased vertical jump for blocks; improve reaction and level changes for digs; and improve lateral quickness for digs. 2. Offense – improve vertical jump and core for spiking.

In order to work on developing speed, the following details are extremely important:

- All speed workouts must be performed when the body is fully recovered from previous workouts. A tired or over-trained athlete cannot improve speed capabilities in a fatigued state. Fatigue can also lead to injuries.
- Proper sprinting technique must be taught and mastered by the athletes. To master skills, they have to be performed correctly through many repetitions to reinforce the skill acquisition.
- All sets and repetitions of a speed workout must be followed by adequate rest.
- Speed workouts should be varied between light, medium and heavy days.
- Unfortunately, many people consider that the speed is born, not made so it is a waste of time to pursue a speed development programme. Our opinion is different.
- When taking into consideration agility development, we need to understand that agility training includes the following:
- Increased power, balance, speed and contraction;
- Increased intramuscular coordination;
- Increased explosiveness of the major muscle groups;
- Increased quickness;
- Increased ability to repeat high-intensity work;
- Increased coordination of skills.

Fortunately, once developed, agility declines less quickly than does speed, strength or endurance. Agility training leaves a more lasting mark upon muscle memory.

Table 1 describes the weekly training and a few drills used during the programme. Please note that these exercises did not replace the regular volleyball training session; they were an addition to this.

Table 1. Weekly training programme for improving speed and agility

Needs	Week 1 drill name	#	Week 2 drill name	#	Week 3 drill name	#
Speed	Standing Stationary Arm Swings	1	Weighted Arm Swings (v)	1	Contrast-Resisted Arm Swings (v)	1
	Hexagon Drill	4	Multidirectional Skipping	9	Backpedal	9

Agility	Forward Roll	98	Crossover Skipping	99	T-Drill	20
	Zigzag	55	Figure Eights	20	Side-to-Side With Volley (v)	89
Quickness	Hip-Twist Ankle Jumps	171	In Place Tuck Jumps	174	Pike Jumps (v)	174
	MB Wall Chest Passes	141	Tap Drills	125	One-Handed Tap Drills With Partner	126
Needs	Week 4 drill name	#	Week 5 drill name	#	Week 6 drill name	#
Speed, agility and quickness	Foot-Tapping Frequency to Bounce and Catch	147–135	Side Shuffle to Bounce and Catch	115–135	Side Shuffle to Sprawl and Stand Up	115–97
	Stand Up From Four Points	94	Stand Up From a Sitting Position	95	Stand Up From a Lying Position (v)	96
Speed and quickness	MB Overhead Throw to Sprint	145–179	MB Overhead Throw to Vertical Jump	145–175	MB Overhead Throw to Sprint	145–179
	Repeated Vertical Jumps (v)	175	Side Shuffle to Quick Hands Tass	115–133	Side Shuffle to Ball Drops	115–132
Agility and quickness	Backward Roll to Vertical Jump	99–175	Forward Roll to Vertical Jump	98–175	Sprawl and Stand Up to Vertical Jump	97–175
	Side Shuffle to Quick Hands Tass	115–133	Lateral Skaters to Bounce and Catch	173–135	Lateral Skaters to Quick Hands	173–133

Examples of drills used for training speed

1. Standing Stationary Arm Swings

Purpose – Improve running mechanics and speed by providing teaching cues to the upper body while in a stationary position.

Procedure

- Stand with feet together and swing arms in a sprinting motion.
- Each arm should move as one piece with the elbow bent at about 90°.
- Keep hands relaxed.
- Hands should come up to about shoulder level in the front and should pass the gluteus in the back.
- The arm action should be forward and back without crossing the main line of the body.

Variations

- Seated arm swings – The athlete is seated on the floor with the legs straight out in front. Be careful not to bounce off the floor as the drill become more vigorous. This drill will help train the correct position of the arms as the hands pass the lowest point of the swing by avoiding contact with the ground.
- Weighted arm swings – Use light dumbbells in the hands to work on shoulder strength. Use enough resistance to provide a good training stimulus but not enough to alter good arm mechanics.
- Contrast-resisted arm swings – Perform arm swings with 1–2 pound weights for 10–20 arm swings, then drop the weights and perform 10–20 arm swings without resistance.

2. Backpedal

Purpose – Improve speed and flexibility in the hip flexors.

Procedure

- In an athletic stance maintain your centre of gravity over your base of support and run backwards.
- Increase stride length with good form.

Complex variation

- On command, use an open step and sprint to a designed cone.

3. Multidirectional Skipping

Purpose – Improve quickness and coordination in locomotive mechanics.

Procedure

- While skipping respond to commands or cues to change your direction, using forward, backward and side skipping.
- Stay facing a target in front of you.

Complex variation

- Increase amplitude of skip and lower the number of reps.
- Concentrate on the first skip after the command to change direction.
- Add a sprint or skill on command.

4. Hexagon Drill

Purpose – Improve speed

Procedure

- Each side of the Hexagon is about two feet long, although this can vary.
- Using a hexagon pattern, have the athlete begin in the middle, facing a determined direction.
- Always facing that direction, the athlete jumps with two feet outside each side of the hexagon sides.
- This should be done in a clockwise and anticlockwise direction while being timed.

Complex variation

- Use single leg hop.
- Vary the size of the hexagon (Brown et al., 2000).

Examples of drills used for training agility

1. Crossover Skipping

Purpose

- Develop explosive crossover mechanics for direction changes.
- Develop explosive contra lateral hip flexion and extension.

Procedure

- Start in a two-point stance.
- Begin skipping laterally to your left crossing the right leg over the left.
- Emphasise left hip extension and right left hip flexion.
- Rotate the hips to the left as the right leg goes over and in front of the left.
- Keep shoulder square to the front.

2. T-Drill

Purpose – Development of agility, conditioning, flexibility in abductors and adductors, and transition between the three major skills (run, shuffle and backpedal).

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Procedure

- Start in a two-point stance.
- Sprint forward 10 yards to a marked spot on the ground.
- Side shuffle to the right and touch a line five yards away with your right hand.
- Shuffle back to the left for 10 yards and touch the far line with your left hand.
- Shuffle back to the right for five yards to the marked spot.
- Touch the marked spot with either foot and backpedal 10 yards through the start line to the finish.

Complex variation

- Make the cones any distance that mimics the 'sport distance' you are working on.
- Vary the bio-motor skill during each leg of the drill.

3. Figure Eights

Purpose – Change of direction and reaction development.

Procedure

- Position two flat cones 5–10 yards apart.
- Start in a two-point stance.
- Run a figure eight between the cones, placing your inside hand on the cone while you make the turn.

Complex variation

- Change the distance between cones.
- Change the radius of the turns.
- Start drill from various positions (e.g., lying, sitting, four-point stance etc.)

4. Zigzag

Purpose – Footwork and change of direction skills.

Procedure

- Start in a two-point stance.
- Stand facing a row of 10 cones, each cone one yard apart.
- Step forward quickly and diagonally with the right foot to the right of the first cone, and then slide the right foot to the left foot.
- Zigzag through all the cones quickly and explosively.

Complex variation

- Start from different positions (e.g. lying, four-point stance etc.)
- Change distance of cones to appropriate distance for sport and energy system.
- Change skills of each leg to meet specific needs.
- Cut with inside or outside leg.
- Cut on the outside of the cone or circle around the cones.
- Put inside hand on the ground during turns (Brown et al., 2000).

5. Results

Table 2. Results obtained in the initial test by the athletes of the control group

Subjects	Hexagon test	Illinois test
S4	11.5″	16.4″
S6	11.8″	16.2″
S1	12.0″	17.2″
S8	10.8″	16.0″
S3	11.6″	16.2″
S5	11.6″	16.5″
S2	10.7″	15.8″
S7	10.2″	14.8″

Table 3. The results obtained in the initial testing by the athletes of the experimental group

Subjects	Hexagon test	Illinois test
S2	11.7″	16.1″
S7	11.0″	15.9″
S8	10.8″	15.6″
S3	12.0″	17.1″
S1	11.4″	16.1″
S5	10.5″	16.0″
S6	11.2″	16.1″
S4	9.8″	14.1″

Table 4. Mathematical indicators obtained in the initial testing by the control group and the experimental group

Testing group	Mathematical indicators	Hexagon test	Illinois test
1	Average	10.61	15.22
2	Median	10.5	15.1
3	The module	11.6	16.2
4	Standard deviation	0.89	1.17
5	Coefficient of variation	8.38%	7.69%
Experimental group			
1	Average	10.42	15.1
2	Median	10.5	15
3	The module	9.6	16.1
4	Standard deviation	0.96	1.11
5	Coefficient of variation	9.27%	7.35%

Table 5. Results obtained in the final test by the athletes of the control group

Subjects	Hexagon test	Illinois test
S4	11.3″	16″
S6	11″	15.6″
S1	11.4″	16.6″
S8	9.7″	15.1″
S3	11.2″	15.1″
S5	10.8″	15.3″
S2	9.9″	14.9″
S7	9.8″	14.2″

Table 6. Results obtained in the final test by the athletes of the experimental group

Subjects	Hexagon test	Illinois test
S2	11.1″	15.8″
S7	10.2″	15″
S8	10″	14.8″
S3	11.3″	16.3″
S1	10.5″	15.3″
S5	9.9″	15.2″
S6	10.4″	15.1″
S4	9.2″	13.5″

Table 7. Mathematical indicators obtained in the final test by the control group and the experimental group

Nr. crt.	Mathematical indicators	Hexagon test	Illinois test
1	Average	10.03	14.5
2	Median	9.8	14.5
3	The module	9.1	15.1
4	Standard deviation	0.88	1.14
5	Coefficient of variability	8.79%	7.89%
1	Average	9.73	14.26
2	Median	9.4	14.2
3	The module	9.4	13.5
4	Standard deviation	0.83	1.18
5	Coefficient of variability	8.61%	8.27%

6. Control test no. 1 – for speed measurement

We used the Hexagon test as control test no. 1. This test was aimed at measuring speed and agility, but also the ability of athletes to start, stop and balance, through a series of fast movements over short distances, with departure and return in all directions. The group of athletes in the control group (base players within the team) included in the study made a progress of 0.58 seconds in the final test, compared to the initial one. The group of athletes from the experimental group (reserve players) made a 0.69 seconds progress in the final test, compared to the initial one.

7. Control test no. 2 – to measure agility

The participating volleyball players' agility was verified by using the Illinois test. The group of athletes from the control group included in the study made a progress of 0.72 seconds in the final test compared to the initial one. At the beginning of the research, the arithmetic average for this control test was 15.22 seconds, while at the end of the research it improved to 14.5 seconds. In the experiment group, the athletes made a progress of 0.84 seconds. At the initial tests they had an average of 15.1 seconds, and at the final ones the average was 14.26 seconds. Improving the results of this control test by 59 hundredths of a second represents a considerable progress made by the subjects of this research. Through the coefficient of variability, we showed the degree of homogeneity of the groups of athletes, for each test. In both the initial test and the final test, the degree of homogeneity for each control sample was good. Each time it verified below the 10% threshold, which showed us two groups with a high degree of homogeneity.

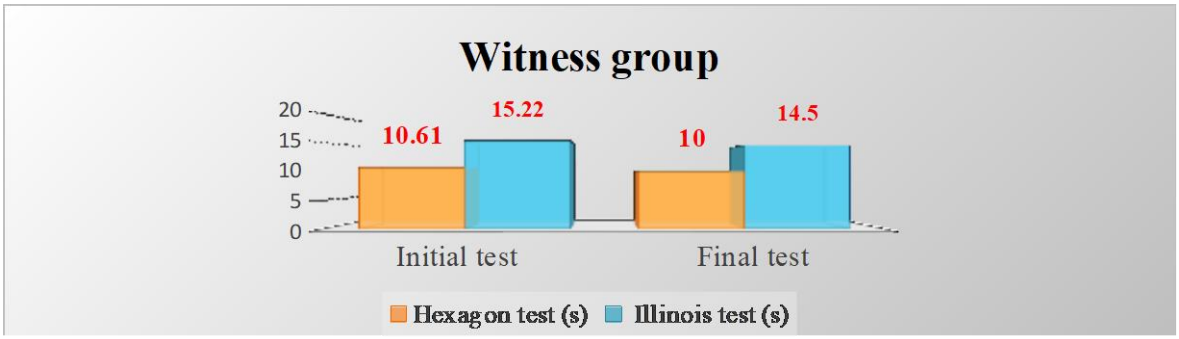

Figure 3. Comparison of the arithmetic mean of the control and experimental groups in the initial tests

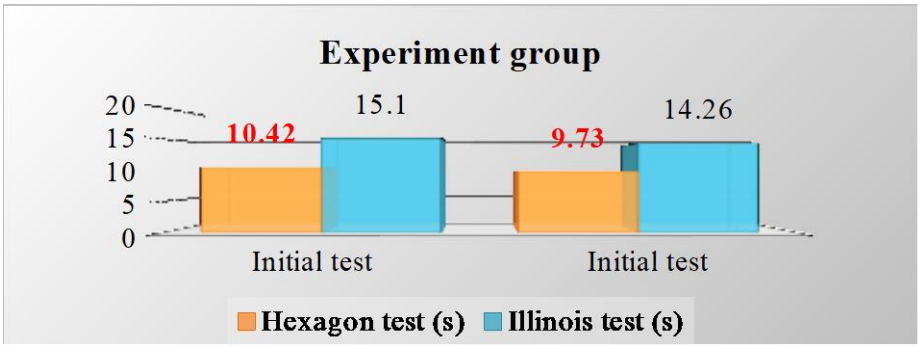

Figure 4. Comparison of the arithmetic mean of the samples at the initial and final test in the experimental group

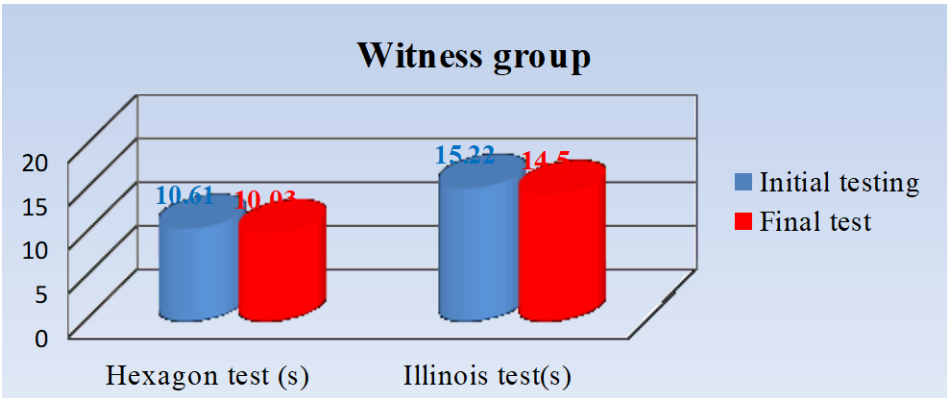

Figure 5. Comparison of the arithmetic means of the initial and final tests to the tests carried out – control group

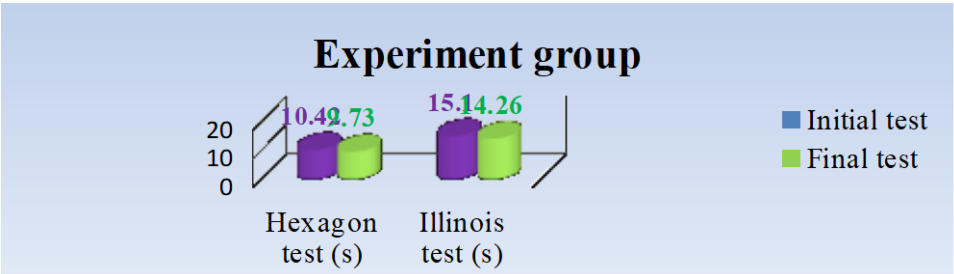

Figure 6. Comparison of the arithmetic mean of the initial and final tests – experimental group

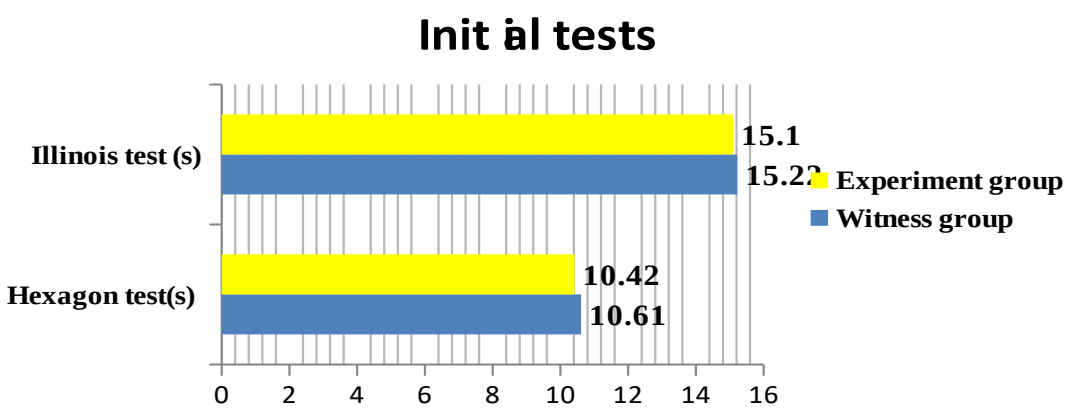

Figure 7. Comparison of the arithmetic mean of the control and experimental groups in the initial tests

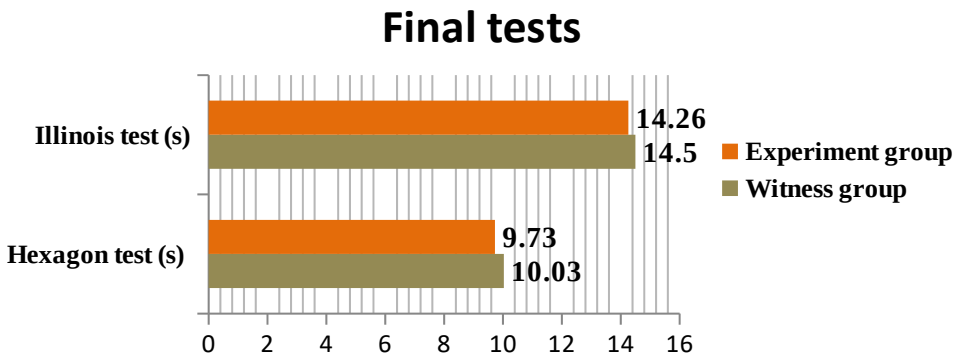

Figure 8. Comparison of the arithmetic mean of the control and experimental groups in the initial tests

8. Conclusion

Performance in volleyball game is described as perfection in all motor qualities; learning and mastering the main volleyball skills, like passing and spiking, is not enough. An athlete should also have speed, coordination, balance, strength, quickness and good agility skill too. In our study, we wanted to see if by using specific training, skills like agility and speed will be improved.

The experiment confirmed the working hypothesis according to which physical exercises, motor games and other drills specific to volleyball can act on the development of motor qualities, obtaining stable skill acquisitions. The control tests focused on the manifestations of motor skills proved that the athletes who were part of the experimental group made more progress in the final test compared to the results obtained in the initial test.

Certainly, there were other uncontrolled variables (e.g., the process of growth and development, nutrition, rest, injuries, sickness, BMI etc.) that influenced the education of speed and agility; these variables were not quantified and verified.

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