Innovative technique of combined use of tennis balls, rubber bands and jumping exercises in the training process of badminton players aged 14-15

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Abstract

Background and purpose

The use of effective sports equipment helps players to improve their game, provides comfort and safety during the game, and also contributes to the improvement of badminton players’ sports skills.

Purpose: to develop and experimentally justify the use of sets of exercises using tennis balls, rubber bands, jumping exercises through jars with feather frills in the educational and training process of young badminton players.

Material and methods

20 badminton players of the Youth Sports School «DOR» of Dnipro aged 14 to 15 took part in the study. Control group (10 people), experimental group (10 people). All participants and their parents agreed to participate in the experiment. The experiment was conducted from February to July 2023. Research methods: analysis of scientific and methodological sources, testing of physical qualities (long jump from a place with the right and left side, plank with a weighting, push-up, 30 s, jumps with a rope for 1 min, jumps with rotation of a rope forward, raising of a trunk in a saddle for 1 min), technical capabilities (test «Speedy movement», test «Transfer of flounces diagonally», test «Reaction», test «Smash with finishing», test «The maximum number of strokes in a draw»), methods of mathematical statistics

Results

The experimental group used a combination of exercises using tennis balls, rubber bands and jumps to develop physical qualities and technical capabilities. The control group used exercises without equipment. The results of the experiment confirmed that the control group showed significant improvement in two physical fitness tests: «Jumping rope in 1 min» and «Throwing a stuffed ball 1 kg» (p<0.05; p<0.01). The experimental group also showed significant improvement in two physical fitness tests: «Jumping rope for 1 min» and «Raising the body in a sit-up for 1 min», as well as in three tests of technical fitness: «High-speed movement», «Diagonal transfer of flounces» and «Smash with finishing» (p<0.05; p<0.01). Analysing the obtained results, significant differences between the control and experimental groups were revealed. In particular, in the experimental group there were significantly higher values in the tests «Mix with finishing» and «Maximum number of blows» in comparison with sportswomen of the control group (p < 0.05)

Conclusions

The complexes of exercises which include the use of sports equipment are developed and included into the training programme of badminton players of 14-15 years old. It is recommended to use exercises with tennis balls, rubber tape, jumping exercises for improvement of physical and technical fitness of young badminton players.

Keywords

badminton players, sports equipment, rubber bands, tennis balls, jumping exercises

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### Анотація

Владислав Стерін. Інноваційна методика поєднаного застосування тенісних м’ячів, гумових стрічок та стрибкових вправ в тренувальному процесі бадмінтоністів 14-15 років

| Обґрунтування і мета | Використання ефективного спортивного інвентарю допомагає гравцям покращити свою гру, забезпечує комфорт і безпеку під час гри, а також сприяє вдосконаленню спортивних навичок бадмінтоністів.

Мета: розробити та експериментально обґрунтувати використання комплексів вправ із використанням тенісних м’ячів, гумових стрічок, стрибкових вправ через баночки з пір’яними воланами у навчально-тренувальному процесі юних бадмінтоністів.


| Результати | Експериментальна група використовувала поєднання комплексів вправ із застосуванням тенісних м’ячів, гумових стрічок та стрибків для розвитку фізичних якостей та технічних можливостей. Контрольна група використовувала вправи без інвентарю. Результати експерименту підтвердили, що в контрольній групі спостерігалося значне покращення у двох тестах фізичної підготовленості: «Стрибки зі скакалкою за 1 хв» та «Метання набивного м’яча 1 кг» (р<0,05; р<0,01).

У експериментальній групі також було значне покращення у двох тестах фізичної підготовленості: «Стрибки зі скакалкою за 1 хв» та «Піднімання тулуба в сід за 1 хв», а також у трьох тестах технічної підготовленості: «Швидкісне пересування», «Перенесення воланів по діагоналі» та «Смеш з добиванням» (р<0,05; р<0,01). Аналізуючи отримані результати, були виявлені значні різниці між контрольною та експериментальною групами. Зокрема, в експериментальній групі спостерігалося значно вищі значення у тестах «Смеш з добиванням» та «Максимальна кількість ударів» порівняно зі спортсменками контрольної групи (р<0,05).

| Висновки | Розроблено та включено до тренувальної програми бадмінтоністів 14-15 років комплексів вправ, які включають в себе використання спортивного обладнання. Рекомендовано застосування вправ з тенісними м’ячами, гумовою стрічкою, стрибкових вправ для поліпшення рівня фізичної та технічної підготовленості юних бадмінтоністів.

| Ключові слова | бадмінтоністи, спортивний інвентар, гумова стрічка, тенісні м’ячі, стрибкові вправи
Introduction

Modern sports equipment and facilities play an important role in the game of badminton and have a great impact on the quality of the game and the results of the players. The use of efficient sports equipment helps players improve their game, ensures comfort and safety during the game, and contributes to the improvement of badminton players’ sportsmanship. Different players can choose the equipment according to their individual needs and playing style, because badminton has seen great changes in technical equipment, cost-effectiveness of technical and tactical training in recent decades. Reducing the weight of the racket, improving the quality of the shuttlecock and racket, and changing the rules of sports competitions have led to a noticeable increase in the speed of the entire game, a decrease in the time of shuttlecock processing, and as a result, an increase in the intensity of training and competition load. And, naturally, this has changed both the technique of performing the stroke movement and the technique of moving around the court [1,2]. In modern badminton technical fitness is connected with physical, tactical, mental capabilities of the athlete and external conditions of performance of sports actions. The better the athlete’s technical skills, the better prepared he or she is to solve more complex tactical tasks. It can also be noted that changes in the variety of sports tactics, rules of the game, time or number of points in games, improvement of sports equipment, etc., in turn, affect the content of technical fitness [3,4].

The analysis of literature data shows that one of the main elements in the training of badminton players is technical training. Technical fitness means a set of motor skills necessary or actually acquired in the process of training, and even the degree of their mastery. The main task of technical training is to form such skills of performing actions in competitions that would allow a badminton player to use his/her capabilities in competitions with the greatest efficiency and to ensure the steady improvement of technical skills in the process of long-term sports activities [4]. The difficulty of performing most technical elements in badminton is explained by the fact that the athlete has to solve several tasks at once: to monitor the accuracy of the movement pattern, to keep the flying shuttlecock in sight, and, finally, to approach it in a timely and correct manner. According to the literature, it has been established that the use of means to improve physical and technical fitness in badminton in recent years has been studied by such scientists as Dai; Sobko, et. all; Liuwei et. all [4,5,6]. The main theses are the importance of all qualities of physical training in badminton and an integrated approach to improving each of them. After analyzing the main physical qualities necessary for successful badminton, distinctive physical abilities that are worth paying attention to are identified, and one can see the difference with other sports [7,8]. Badminton is a rather difficult, but at the same time, interesting sport. To master it, it is necessary to select the right sets of exercises that will contribute to the development of certain physical abilities. Regular implementation of composed complexes of exercises for the development of necessary physical qualities allows athletes to increase their potential in this sport and improve their playing skills faster [9,10]. In order to play the way the strongest badminton players in the world do, it is necessary to use not only the right exercises, but also to use modern sports equipment.

Purpose: to develop and experimentally justify the methodology of training basketball teams of humanitarian higher educational institutions, taking into account the psychophysiological capabilities of the players.

Material and Methods

Participants

20 badminton players of the Youth Sports School «DOR» of Dnipro aged 14 to 15 took part in the study. Control group (10 people), experimental group (10 people). All participants and their parents agreed to participate in the experiment. The experiment was conducted from February to July 2023.

Before and after the experiment, the athletes of the control and experimental groups were tested for physical and technical fitness. Training sessions were held 12 times a week in each group (from Monday to Saturday, 2 times a day). The experimental group performed
complexes of exercises during morning trainings 4 days a week: 1 day - 1 complex. During the training sessions of the control group the following exercises were used for the development of physical qualities, but without the use of special equipment.

**Method of analysis of literary sources**

A number of authors indicate the presence of specific features in the processes of higher Theoretical analysis and generalization of the scientific and methodical literature showed the reflection of the use of means and methods of physical training of badminton players in modern literature. 25 literature sources were analyzed.

**Methods of determining the level of physical and technical readiness**

Methods of physical fitness testing:
1. Long jump from a place with the right and left side, (cm).
2. Plank with a weighting, (s)
3. Push-up, 30 s
4. Jumps with a rope for 1 min, (number of times). Jumps with rotation of a rope forward. The number of jumps for 1 min was fixed.
5. Raising of a trunk in a saddle for 1 min (number of times).

Technique testing methods:
1. Test "Speedy movement" (s). There are 7 zones on the court with chalk, in the central zone there are 6 shuttlecocks, the badminton player stands in the center. At the signal, he moves with the first shuttlecock to the first zone and leaves it in the circle, then returns to the starting point and takes the next shuttlecock, which he carries to the second zone, etc. After each shuttlecock has taken its position in each zone, the athlete must return the objects to the starting point in the same sequence. The total time of the exercise is measured and evaluated [11].
2. Test "Transfer of flounces diagonally", (s).

On a court 4 zones are drawn with chalk, in two of which there are 6 shuttlecocks (in the right and left rear corners), a badminton player stands in the center. On a signal, he starts moving behind the first shuttlecock to the first zone, picks it up and moves to the opposite diagonal corner (near the net) and puts it in a circle. After that, the athlete moves to another zone on the back line of the court and takes the next shuttlecock, which makes a transfer to the zone on the net opposite to this one, and so on. The result is recorded when all the shuttlecocks have been transferred from the back to the front of the court[11].

3. Test "Reaction" (number of times).

The coach stands in front of the player at a distance of 1.5 meters and holds 20 shuttlecocks in his hand. The sportsman is in a state of readiness. On the signal, the coach begins to throw the shuttlecocks to the athlete at maximum speed to perform blows from below (defensive blows). The task of the athlete is to react in time and interrupt the greatest number of shuttlecocks out of 20 through the net (without making a mistake). There are 2 attempts, the best result is recorded[11].

4. Smash with finishing, (number of times).

The coach throws to the athlete from the right back corner for a smash. After the hit, he throws to the right front corner to finish on the net, and then sends the shuttlecock back diagonally from the previous hit. Accordingly, after performing a smash in the left back corner, the athlete goes out and makes a finish on the net along the line to the left. The number of strokes is taken into account. The result is recorded by the last successfully executed stroke before the onset of the error [11].

5. Test “The maximum number of strokes in a draw” (number of times).

All sportmen are divided into pairs. Each pair performs the test in turn, the total number of strokes for both players is counted. With the help of a serve, the shuttlecock is brought into play and the task for the athletes is to keep the shuttlecock in play as long as possible using arbitrary, technically correct strokes. The result of the last successful stroke before the error is recorded.

**Intervention technology**

Based on the results of the factor analysis of the structure of the readiness of basketball students of humanitarian universities and the generalization of literature data [9, 10, 13, 14], a training methodology for athletes, players of
the humanitarian university basketball team was developed, which formed the basis of a formative pedagogical experiment.

The developed methodology assumes that the educational and training process in the basketball teams of humanitarian universities is based on the awareness of the players. This awareness, as a rule, is activated through the artistic thinking of humanities university students, which is confirmed by literary sources and the results of the analysis of the structure of readiness. This opinion is based on the theory of I.P. Pavlov [9, 10] about the existence of different types of thinking in people and on the data of modern scientists, who showed that artistic thinking is more common among students of humanitarian specialties.

In addition to literary data, the basis of the development methodology is data on the factor structure of thinking of basketball students of humanitarian universities. Elements of interpretation, in particular the concept of attention, occupy an important place in the revealed structure of readiness. On the basis of these provisions, methods were developed to activate imaginative and artistic thinking when teaching basketball techniques and tactics, as well as when conducting spontaneous and ideomotor training.

In addition to indicators characterizing attention, key indicators of players' speed and strength capabilities, as well as a high level of fatigue, were found in the structure of the readiness of basketball players of the humanitarian university [1–4, 9, 10]. These provisions determined the main provisions of the developed methodology for training basketball teams of humanitarian universities.

Thus, on the basis of literary data and data obtained as a result of our own research, we determined the methodological features of the training of humanities university students in basketball. These features are expressed in the following key provisions in educational and training sessions:

- When structuring the educational and training process - based on the data of the factor analysis, rely on the main qualities in the general structure of preparedness and the individual structure of preparedness of the players. This approach involves the performance of individual tasks that require activation of the athlete's consciousness;

- when adjusting the load - use of a subjectively recognized scale of load intensity;

- Visual guides, educational cartoons, and video tapes with various technical techniques recorded by professional basketball players were widely used when teaching technical and tactical techniques. Visual aids were issued to each student and could be studied in detail for an unlimited period of time. Educational animations were played on computers and mobile phones;

- To develop the feeling of the ball and the so-called "softness of the hands", exercises for juggling the ball and exercises for "virtuoso possession" were performed, as well as homework for manipulating the ball or a soft bag with sand. When performing these tasks, attention was focused on observing the necessary effort and biomechanical details of the exercises;

- Exercises aimed at developing and improving the sense of time, for example, hitting a ball for 30 seconds. In addition, some methods are aimed at developing specific sensations that develop in basketball players who are already at a fairly high technical level, that is, the feeling of the ball, court, opponent, etc.

Visual guides, educational cartoons, and video tapes with various technical techniques recorded by professional basketball players were widely used when teaching technical and tactical techniques. Visual guides were published every student and could be studied in detail for an unlimited period of time. Educational animations were played on computers and mobile phones;

To create printed manuals, the method of video recording of qualified basketball players demonstrating technical techniques was used, with further processing of the obtained data on a computer. The video material was shot by a video camera and transferred to a computer using a TV tuner. The video material was divided into frames using the Adobe Premier program. Adobe Photoshop was then used to select the desired frames and remove the background. The background has been removed to ensure contrast and visual recognition of technical elements. The video game created in this way was printed and distributed to each student for independent study. Below are examples of videograms and...
drawings created in this way (Fig. 1-4).

The use of sports equipment allows you to perform general developmental exercises aimed at developing specific abilities, taking into account the specifics of this sport, as well as special exercises that contribute to the development of physical qualities necessary for the effective execution of strokes and serves, which are the main technical movements of athletes in badminton. The coaches use different types of equipment in their practical training.

Every day from Monday to Thursday, one of the training complexes was used to develop the physical qualities and technical techniques of the athletes. The lesson began with a general warm-up (running and jumping exercises and warm-ups on the spot), imitations of blows, and movements. After that, the coach would give one of the complexes.

A set of exercises with a tennis ball:
1. Repulsion of a tennis ball from a floor with the right/left hand (10 times).
2. Repulsion from a floor at a level of a belt. Hit the ball from the floor with the right hand, catch it with the left. The same with change of hands (10 times)
3. Tossing a tennis ball from the right hand to the left, hands are taken to the sides (10 times).
4. Throwing a ball from behind with the right hand, catch with the left. The same with the other hand (15 times)
5. To throw a ball up, to catch a ball under a foot with the left hand. The same with the other hand (15 times)
6. To hit the ball from the floor with the right hand, to catch it under the foot with the left hand. The same with the left hand (15 times)
7. Hit the ball from the floor with the right hand, turn 360 to the right, catch the ball with the right hand. Do the same with a turn to the left, catch the ball with the left hand (15 times)
8. Throw the ball up, turn 360 to the right, catch it with the right hand. Do the same with a turn to the left, catch the ball with the left hand (15 times)
9. S.p. - player 1 stands straight, arms half bent, put in front of him. The ball is in the right hand. Legs are half bent, stand parallel. Player 2 stands at a distance of 2.5 steps facing player 1, legs half bent, parallel; arms in front of him, half bent; ready stance. On a signal, player 1 throws a ball to the side from himself to the right or to the left, the task of the player 2 is to execute correctly technically an exit to a ball, imitating a game situation in badminton (front zone of a game), and to catch a ball before it gets on a floor. Then player 2 returns the ball (2x10 times)
10. S.p. - player 1 stands straight, arms half bent, put in front of him. The ball is in the right hand. Legs are half bent, stand parallel. Player 2 stands at a distance of 1.5 steps facing player 1, legs half bent, parallel; arms in front of him, half bent; ready stance. On a signal, player 1 throws the ball to the side of player 2 to the right or left, whose task is to correctly execute the technical exit to the ball, imitating the game situation in badminton (middle zone of the game), and catch the ball before it hits the floor. Then player 2 returns the ball (2x10 times).
11. S.p. - player 1 stands straight, arms half bent, put in front of him. In the right hand there is a ball. Legs are half bent, stand parallel. Player 2 stands at a distance of 1 step facing player 1, legs half-bent, parallel; arms in front of him, half-bent; ready stance. On the signal, player 1 throws the ball back behind player 2 to the right or left, whose task is to correctly execute the technical approach to the ball, imitating the game situation in badminton (back court), and catch the ball before it hits the floor. Then player 2 returns the ball (2x10 times).
12. S.p. - player 1 stands straight, arms straight, put in front of him. There is a ball in each hand. The player 2 stands at a distance of 1 step facing to the player 1, legs half-bent, parallel; arms in front of him, half-bent; a stand of readiness. From the beginning of the exercise, player 1 drops one of the balls at any time. The task of player 2 is to react to the ball and catch it before it hits the floor, after which he returns the ball (10 times).
13. S.p. - player 1 stands straight, arms straight, put in front of him. There is a ball in each hand. Player 2 stands at a distance of 0,25 steps with a back to player 1, legs half-bent stand parallel; arms in front of him, half-bent; a stand of readiness. From the beginning of the exercise player 1 drops one of the balls at any time. The task of player 2 is to react to the ball and catch it after it bounces off the floor, then returns the ball back. At any time, player 1 can send the ball forward between the legs of player
A set of exercises with a rubber band:

1. S.p. - Rubber tape is wound around the hips of player 1, player 2 stands behind the back of player 1 and takes the rubber by the edge and pulls it so that it does not sag. On the signal, player 1 performs the drill: as quickly as possible and with the correct technique, he makes an exit to the right front corner with an imitation of finishing on the net. Then he returns to the center at a moderate pace. There, he takes the starting position and repeats the same in the left front corner (2 sets x 12 times).

2. The rubber band is wrapped around the hips of player 1. Player 2 stands facing player 1 (back to the net) and takes the rubber band by the edge and pulls it so that it does not sag. On the signal, player 1 performs the exercise: as quickly and sharply as possible, he makes a downward lunge to the right and touches the sideline of the singles court with the racket handle. Then, without straightening up, returns to the center (2 sets x 10 times).

3. A rubber band is wrapped around the hips of player 1. Player 2 stands to the left of player 1 (facing the net) and takes the rubber band by the edge and pulls it so that it does not sag. On the signal, player 1 performs the exercise: as quickly as possible and sharply, he makes a downward lunge to the right and touches the sideline of the singles court with the racket handle. Then, without straightening up, returns to the center (2 sets x 10 times).

4. S.P. - A rubber band is wrapped around the thigh of player 1. Player 2 stands behind player 1 and takes the rubber band by the edge and pulls it so that it does not sag. On the signal, player 1 starts moving at maximum speed with a minimum amplitude, lifting the right and then the left legs alternately, always in motion. At the signal at maximum speed, you need to jump out in front of you and perform an imitation of finishing, and then return to the starting position (2 sets x 10 times).

5. A rubber band is wrapped around the hips of player 1. Player 2 stands behind player 1 and takes the rubber band by the edge and pulls it so that it does not sag. Player 3 picks up 20 flounces and stands on the opposite side of the court (behind the net). On the signal, player 3 starts throwing on the stand. Player 1, with the correct technique, takes 2 steps to the right front corner and hits the shuttlecock. Then he returns to the center and prepares for the next shot. After completing the approach, the players change places in a circle. When everyone has completed 2 sets, a new circle begins in the left front corner (2 sets x 20 times).

6. The rubber band is wrapped around the hips of player 1. Player 2 stands behind player 1 and takes the rubber band by the edge and pulls it so that it does not sag. Player 3 picks up 20 flounces and stands on the opposite side of the court (behind the net) in the center on the service line. On the signal, player 3 throws on the net alternately to the right and left corners. Player 1 technically correctly performs the exercise "front triangle with a flounce" by going to each corner in turn and performing a high backhand. At the end of the approach, the players change with each other in a circle (2 approaches x 20 times).

7. The rubber band is wrapped around the hip of player 1. Player 2 faces player 1 (back to the net) and takes the rubber band by the edge and pulls it so that it does not sag. Player 3 picks up 20 flounces and stands on the opposite side of the court (behind the net) in the center of the court. On the signal, player 3 throws to player 1 in the right back corner to perform a mix, and the latter with the correct backward step, 2 steps, makes a shot and returns to the center. After completing the approach, the players change places in the circle. When everyone has completed 2 series, a new circle begins in the left rear corner 2 sets x 16 times.

8. The rubber band is wrapped around the hip of player 1. Player 2 stands to the left of player 1 (facing the net) and takes the rubber band by the edge and pulls it so that it does not sag. Player 3 is on the same side and holds 12 flounces in his hand. On the signal, player 3 begins to throw a blocking kick: player 1 quickly and sharply takes a quick and sharp step, followed by a jump to the right and performs a blocking kick from the top down, then lands and returns to the center. After completing the approach, the players change in a circle. When everyone has completed 2 sets, a new circle begins in the left rear corner 2 sets x 12 times.

9. The rubber tape is fixed behind the court on the left side, so that when player...
Player 1 stands in the center it almost does not sag. Player 2 stands on the other side of the court and holds 16 shuttlecocks in his hand. On a signal, player 2 throws it first backwards for a short diagonal shot and then to the front of the court for a long volley. After 3 sets, the players change 16 times x 3 sets).

10. There are 3 players on the court. Player 1 has a rubber band attached to the left side of the court so that when he stands in the center it does not sag. He stands in the left half of the court. Player 2 works without a rubber and stands in the right half of the court. Player 3 is on the opposite side, his rubber.

A set of jumping exercises. They were performed one by one in a circle (3 circles) by jumping over the banks.

1. Jumping over jars with feather flounces (height of a jar is 40 cm). 10 cans are placed along the line at a distance of 40-60 cm from each other. On the signal the athlete starts to jump over the cans. As soon as he has jumped over the last jar he turns around and continues the exercise in the opposite direction, it is performed for 40 seconds.

2. Exercise "Slide". A lid from a jar, a jar with plastic flounces (height - 24 cm), jars with feather flounces (height - 40 cm) are placed along a line at a distance of 40 cm from each other. On the signal, the athlete starts jumping. As soon as he jumped over the last can, he turns around and continues the exercise in the opposite direction. 1 circle - the exercise is performed facing forward, 2 circle - the exercise starts from the right side, 3 circle - the exercise starts from the left side, 40 s.

3. Jumping over a jar (height 24 cm) with the right and left side, is performed 40 s
4. Single jumps with a rope without stopping for speed, is performed 40 s.
5. Double jumps with a rope without stopping is performed 40 s.
6. Exercise "Jumping on a platform". The platform is 50 cm high. The task of the sportsman to jump on it from two feet, and then calmly to descend in a s.p. is executed 15 times.
7. Jumping over the side corridor of the side platform. The athlete stands outside the court and on a signal begins to jump over the corridor, gradually moving forward. When the player passes along the whole length of the court, he turns around and jumps in the opposite direction, performed 40 s.

8. Exercise "Inside - outside". The athlete stands outside the court and on a signal jumps into the middle of the corridor and then jumps out on the other side, gradually moving forward. When the player passes the entire length of the court, he turns around and jumps in the opposite direction, 40 seconds.

Statistical analysis

Traditional methods of mathematical statistics were used to process digital material, while Microsoft Excel and SPSS programs were used. For each indicator, the analysis was carried out using the Student's t-test with the appropriate level of significance (p). The following parameters were determined during the analysis: mean (arithmetic mean), standard deviation (S), error of representativeness (m) and estimated probability of differences between the initial and final results. The sample was tested for normality of distribution using the one-sample Kolmogorov-Smirnov test.

Results

At the beginning of the experiment, the control and experimental groups did not significantly differ from each other in all test scores. After the experiment, the control group significantly improved in 2 tests: "Jumping with a rope for 1 min, number of times", "Raising a trunk in a saddle for 1 min, number of times", (p < 0.05; p < 0.01) (Table 5). It can be substantiated by the fact that sportsmen of the control group, in connection with work on the general physical preparation, increased the level of development of explosive force (strengthened muscles of legs and a stomach), developed high-speed endurance. Improvement of these qualities will allow athletes to feel more confident on the court due to fast movement on the court and strong strokes in the back zone due to the press (Table 1).
Indicators of physical and technical fitness of badminton players of the control group before and after the experiment (n = 10)

<table>
<thead>
<tr>
<th>№</th>
<th>Name of the test</th>
<th>Group</th>
<th>M</th>
<th>S</th>
<th>m</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Long jump from a place with the right and left side, (cm).</td>
<td>C1</td>
<td>119.00</td>
<td>16.71</td>
<td>5.28</td>
<td>-0.42</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>121.70</td>
<td>11.93</td>
<td>3.77</td>
<td>0.68</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>Jumps with a rope for 1 min, (number of times).</td>
<td>C1</td>
<td>157.40</td>
<td>695</td>
<td>2.20</td>
<td>-3.42</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>167.20</td>
<td>5.83</td>
<td>1.84</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>3</td>
<td>Push-up, 30 s, (number of times)</td>
<td>C1</td>
<td>23.43</td>
<td>2.85</td>
<td>2.17</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>23.60</td>
<td>2.42</td>
<td>2.03</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>4</td>
<td>Raising of a trunk in a saddle for 1 min (number of times)</td>
<td>C1</td>
<td>49.30</td>
<td>4.60</td>
<td>1.45</td>
<td>-2.17</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>53.80</td>
<td>4.66</td>
<td>1.47</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>5</td>
<td>Test “Speedy movement” (s)</td>
<td>C1</td>
<td>33.81</td>
<td>2.67</td>
<td>0.84</td>
<td>1.05</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>32.71</td>
<td>1.94</td>
<td>0.61</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>6</td>
<td>Test “Transfer of flounces diagonally” (s)</td>
<td>C1</td>
<td>58.94</td>
<td>0.95</td>
<td>0.30</td>
<td>0.75</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>58.64</td>
<td>0.83</td>
<td>0.26</td>
<td>0.46</td>
<td>0.46</td>
</tr>
<tr>
<td>7</td>
<td>Test “Reaction” (number of times).</td>
<td>C1</td>
<td>13.50</td>
<td>2.80</td>
<td>0.89</td>
<td>0.83</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>14.40</td>
<td>2.01</td>
<td>0.64</td>
<td>0.42</td>
<td>0.42</td>
</tr>
<tr>
<td>8</td>
<td>Smash with finishing, (number of times)</td>
<td>C1</td>
<td>67.20</td>
<td>10.75</td>
<td>3.40</td>
<td>0.99</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>72.00</td>
<td>7.92</td>
<td>3.45</td>
<td>0.34</td>
<td>0.34</td>
</tr>
<tr>
<td>9</td>
<td>Test “The maximum number of strokes in a draw” (number of times)</td>
<td>C1</td>
<td>93.60</td>
<td>22.72</td>
<td>7.18</td>
<td>0.18</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>91.60</td>
<td>19.54</td>
<td>8.71</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>10</td>
<td>Plank with a weighting, (min)</td>
<td>C1</td>
<td>2.62</td>
<td>0.73</td>
<td>0.23</td>
<td>0.66</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>2.88</td>
<td>0.96</td>
<td>0.30</td>
<td>0.52</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Notes: *C1 – the control group before the experiment; C2 – the control group after the experiment

The analysis of the results of the experimental group showed that the performance of 5 tests improved significantly: "Jumping with a rope for 1 min, number of times", "Raising a trunk in a saddle for 1 min, number of times", test "Speed movement, s", test "Transferring of flounces on a diagonal, s", "Smash with a finish, number of times" (p<0.05; p<0.01) (tab. 2). On the basis of the obtained indicators it is possible to conclude that during the performance of exercises with a rubber band for a long time, a complicated situation during movements or work with a shuttlecock brought as a result such an effect as "supercompensation". The tests on moving with the shuttlecock were improved many times over by increasing the level of explosive power, high-speed endurance and agility. During the second test, it was easier for the athletes to cope with the task, and the results we received are proof of this. Also, looking at the results of other tests, we can see that the experimental group has improved their overall physical fitness. The test "Smash and grab, number of times" analyzes the quality and strength of punches, the level of general endurance, and the level of coordination. Since the players passed this test better after the implementation of our proposed program in the training process, we can confidently say that the above qualities were improved.

Summarizing the results of the experiment, significant differences between the control and experimental groups were found. According to the results of tests “Mix with finishing, number of times”, “Maximum number of blows, number of times”, in the experimental group these indicators are significantly higher in comparison with sportswomen of the control group (p< 0.05) (tab. 3). The additional load during the performance of standard exercises created a complicated situation for sportsmen, which as a result made the organism work more effectively. The presence in the training process of exercises with a sports rubber band helped to improve the strength of arms and legs, which, based on the results of the study, increased the speed on the court and improved the maneuverability of players. Thanks to the exercises aimed at improving strokes in different directions, muscles developed and technique improved. It can also be seen that exercises with a sports rubber band improved coordination and balance. The athletes of the experimental group during the “Maximum number of strokes” test...
looked more confident on the court and it was easier for them to keep the shuttlecock in play for a long time.

Increasing the level of complexity of training exercises has definitely become a key to the development of athletes’ endurance and improvement of physical fitness. Tasks that require more effort help to increase the players’ aerobic and anaerobic endurance levels. The development of endurance is a very important aspect of physical training in badminton, as the game requires high intensity, fast movements and partial changes of direction on the court. This results in players experiencing significant physical exertion during matches and training sessions.

**Table 2**

Indicators of testing physical and technical fitness of badminton players of the experimental group before and after the experiment (n = 10)

<table>
<thead>
<tr>
<th>No</th>
<th>Name of the test</th>
<th>Group</th>
<th>M</th>
<th>S</th>
<th>m</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Long jump from a place with the right and left side,</td>
<td>Е₁</td>
<td>123.10</td>
<td>13.49</td>
<td>4.26</td>
<td>-1.38</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>(cm)</td>
<td>Е₂</td>
<td>131.20</td>
<td>12.73</td>
<td>4.02</td>
<td>-1.38</td>
<td>0.18</td>
</tr>
<tr>
<td>2</td>
<td>Jumps with a rope for 1 min, (number of times).</td>
<td>Е₁</td>
<td>156.20</td>
<td>8.28</td>
<td>2.62</td>
<td>-3.30</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>166.20</td>
<td>4.80</td>
<td>1.52</td>
<td>-3.30</td>
<td>0.01</td>
</tr>
<tr>
<td>3</td>
<td>Push-up, 30 s, (number of times)</td>
<td>Е₁</td>
<td>24.50</td>
<td>2.19</td>
<td>3.54</td>
<td>0.20</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>24.60</td>
<td>2.34</td>
<td>2.95</td>
<td>0.20</td>
<td>0.85</td>
</tr>
<tr>
<td>4</td>
<td>Raising of a trunk in a saddle for 1 min (number of</td>
<td>Е₁</td>
<td>51.30</td>
<td>5.64</td>
<td>1.78</td>
<td>-2.34</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>times)</td>
<td>Е₂</td>
<td>56.10</td>
<td>3.21</td>
<td>1.02</td>
<td>-2.34</td>
<td>0.03</td>
</tr>
<tr>
<td>5</td>
<td>Test “Speedy movement” (s)</td>
<td>Е₁</td>
<td>33.85</td>
<td>1.82</td>
<td>0.58</td>
<td>2.42</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>32.27</td>
<td>0.97</td>
<td>0.31</td>
<td>2.42</td>
<td>0.03</td>
</tr>
<tr>
<td>6</td>
<td>Test “Transfer of flounces diagonally” (s)</td>
<td>Е₁</td>
<td>59.56</td>
<td>0.46</td>
<td>0.15</td>
<td>4.53</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>58.65</td>
<td>0.44</td>
<td>0.14</td>
<td>4.53</td>
<td>0.01</td>
</tr>
<tr>
<td>7</td>
<td>Test “Reaction” (number of times).</td>
<td>Е₁</td>
<td>13.80</td>
<td>2.78</td>
<td>0.88</td>
<td>-0.46</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>14.30</td>
<td>2.06</td>
<td>0.65</td>
<td>-0.46</td>
<td>0.65</td>
</tr>
<tr>
<td>8</td>
<td>Smash with finishing, (number of times)</td>
<td>Е₁</td>
<td>68.70</td>
<td>10.59</td>
<td>3.35</td>
<td>-2.37</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>78.10</td>
<td>5.76</td>
<td>2.14</td>
<td>-2.37</td>
<td>0.03</td>
</tr>
<tr>
<td>9</td>
<td>Test “The maximum number of strokes in a draw” (number of times).</td>
<td>Е₁</td>
<td>104.70</td>
<td>29.12</td>
<td>9.21</td>
<td>-0.61</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>112.10</td>
<td>20.82</td>
<td>7.85</td>
<td>-0.61</td>
<td>0.55</td>
</tr>
<tr>
<td>10</td>
<td>Plank with a weighting, (min)</td>
<td>Е₁</td>
<td>2.36</td>
<td>0.57</td>
<td>0.18</td>
<td>-0.97</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Е₂</td>
<td>2.64</td>
<td>0.73</td>
<td>0.23</td>
<td>-0.97</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Note: *E1 – the experimental group before the experiment; E2– the experimental group after the experiment*
Table 3
Indicators of testing of physical and technical fitness of badminton players of the control (n = 10) and experimental groups after the experiment (n = 10)

<table>
<thead>
<tr>
<th>№</th>
<th>Name of the test</th>
<th>Group</th>
<th>M</th>
<th>S</th>
<th>m</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Long jump from a place with the right and left side, (cm).</td>
<td>Е₂</td>
<td>131.20</td>
<td>12.73</td>
<td>4.02</td>
<td>0.60</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>121.70</td>
<td>11.93</td>
<td>3.77</td>
<td>-0.35</td>
<td>0.73</td>
</tr>
<tr>
<td>2</td>
<td>Jumps with a rope for 1 min, (number of times).</td>
<td>Е₂</td>
<td>166.20</td>
<td>4.80</td>
<td>1.52</td>
<td>-0.35</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>167.20</td>
<td>5.83</td>
<td>1.84</td>
<td>0.87</td>
<td>0.40</td>
</tr>
<tr>
<td>3</td>
<td>Push-up, 30 s, (number of times)</td>
<td>Е₂</td>
<td>27.60</td>
<td>9.34</td>
<td>2.95</td>
<td>1.16</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>23.60</td>
<td>6.42</td>
<td>2.03</td>
<td>1.16</td>
<td>0.27</td>
</tr>
<tr>
<td>4</td>
<td>Raising of a trunk in a saddle for 1 min (number of times)</td>
<td>Е₂</td>
<td>56.10</td>
<td>3.21</td>
<td>1.02</td>
<td>0.87</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>53.80</td>
<td>4.66</td>
<td>1.47</td>
<td>0.87</td>
<td>0.40</td>
</tr>
<tr>
<td>5</td>
<td>Test “Speedy movement” (s)</td>
<td>Е₂</td>
<td>32.27</td>
<td>0.97</td>
<td>0.31</td>
<td>0.04</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>32.71</td>
<td>1.94</td>
<td>0.61</td>
<td>1.85</td>
<td>0.09</td>
</tr>
<tr>
<td>6</td>
<td>Test “Transfer of flounces diagonally” (s)</td>
<td>Е₂</td>
<td>58.65</td>
<td>0.44</td>
<td>0.14</td>
<td>0.24</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>58.64</td>
<td>0.83</td>
<td>0.26</td>
<td>0.24</td>
<td>0.81</td>
</tr>
<tr>
<td>7</td>
<td>Test “Reaction” (number of times).</td>
<td>Е₂</td>
<td>14.30</td>
<td>2.06</td>
<td>0.65</td>
<td>2.45</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>14.40</td>
<td>2.01</td>
<td>0.64</td>
<td>2.45</td>
<td>0.04</td>
</tr>
<tr>
<td>8</td>
<td>Smash with finishing, (number of times)</td>
<td>Е₂</td>
<td>78.10</td>
<td>5.76</td>
<td>2.14</td>
<td>2.27</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>71.00</td>
<td>7.09</td>
<td>2.88</td>
<td>2.27</td>
<td>0.05</td>
</tr>
<tr>
<td>9</td>
<td>Test “The maximum number of strokes in a draw” (number of times).</td>
<td>Е₂</td>
<td>112.10</td>
<td>20.82</td>
<td>7.85</td>
<td>2.27</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>91.60</td>
<td>19.54</td>
<td>8.71</td>
<td>2.27</td>
<td>0.05</td>
</tr>
<tr>
<td>10</td>
<td>Plank with a weighting, (min)</td>
<td>Е₂</td>
<td>2.36</td>
<td>0.57</td>
<td>0.18</td>
<td>-0.92</td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>С₂</td>
<td>2.88</td>
<td>0.96</td>
<td>0.30</td>
<td>-0.92</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Note: * C – the control group after the experiment; E–the experimental groups after the experiment (n = 10)

Discussion
The study confirmed the hypothesis that the use of exercises with modern sports equipment will improve the physical and technical fitness of badminton players aged 13-14. The results are in line with the research of Kozina, Sobko, Ulaeva, Safronov, Boichuk, Polianskyi, Polishchuk, Polishchuk, that to achieve high results, the necessary qualities for any athlete are strength, speed, endurance, well-developed joint mobility, which contributes to the acquisition of a wide range of motor skills that develop volitional qualities[12,13]. Regular training is also important for developing coordination, flexibility, agility, and promoting the development of the nervous and cardiorespiratory systems [14,15,16].

Liuwei, Karatnyk, and Pitin emphasize that in almost every game of the game, the athlete's body must withstand heavy loads during long draws, accompanied by rapid movements and sudden changes in direction. And still an important factor is long-term loads, with the help of which the overall endurance rises, and a great psychological impact on the volitional qualities of the badminton player is manifested[6,17]. The use of sports equipment, including special equipment and props, can contribute to the development of badminton players' endurance, providing them with comfortable conditions for training and playing, as well as supporting their physical and technical development [18,19].

Experts found that during the training
of high-speed endurance, athletes are recommended to use short-distance running, swimming, sports and outdoor games. It can be noted that jumping over poles or banks gives a positive result: the higher the pace of jumping, the faster the development of this quality. The use of double and triple jumping rope increases the load several times [7].

Modern badminton specialists emphasize that speed is one of the most important qualities in badminton, because it is a component of the game itself [20,21,22]. Speed is the ability to perform movements in the shortest possible time for a given condition [20]. The maximum flight speed of a shuttlecock in the game has already reached 493 km per hour. The athlete's task is to react to the shuttlecock, run to it in time, correctly determine where to respond, and complete the situation in his or her favor - all in a matter of seconds. The methodology of training speed abilities is, first of all, the implementation of already well-mastered tasks or combinations of strokes at maximum speeds, which allows the badminton player to focus all efforts on speed, not on the method of execution [23,24].

An important ability in badminton is flexibility, which characterizes the ability to perform a variety of movements with a large amplitude. According to the authors, the lack of mobility in the joints limits movement [25]. Without it, it is impossible to master the correct technique. Technical elements in badminton require good development of the spine, shoulder, elbow, wrist, knees, and ankles. During the jump, the athlete needs to twist the spine significantly. When going to the net, the player sometimes has to literally sit on the twine, and then push back and return to the starting position. When building flexibility, it is important to use all types of stretching exercises that require warming up the muscles. The most effective result can be obtained by performing exercises in several sets of 10 repetitions each. It is important to work on flexibility regularly, several times a day.

Scientists describe agility as a non-standard quality, and in badminton agility is motor skills, highly developed muscle feeling, and plasticity of nervous processes. The more developed a badminton player's sense of their own movements and the accuracy of their execution, the faster they master new exercises. Previous motor experience plays an important role here, as athletes with many motor skills can master new movements much more easily. To develop this quality, various game situations are used in which it is necessary to quickly assess the situation and make the right decision [16].

According to the authors Sobko, Zharkova, Vitsko, special physical training in badminton is inextricably linked to general physical training, contributing to the mastery of technical techniques of the game, increasing tactical skills, achieving form, as well as improving psychological readiness. Its main goal is to maximize the development of strength, speed, agility, endurance, and flexibility. To solve these problems, special preparatory exercises with a characteristic game tension are recommended. For this purpose, exercises of a technical and tactical nature, various outdoor games, exercises from other sports and, of course, the game of badminton itself are suitable. Special physical training should be carried out on the basis of specific conditions, exercises and complexes concerning the peculiarities of the game, the flight of the shuttlecock and the peculiarities of moving on the court [4].

Thus, jumping exercises with cans help strengthen leg muscles, improve coordination, and increase overall endurance, as badminton requires fast and energetic movements. A balancing hemisphere, also known as a balance platform or balance board, helps develop body awareness and improve coordination. In badminton, good balance is an important factor for efficient movements, quick reactions, and accurate strokes. The rubber band is used to train arm strength and flexibility, as well as to improve stroke power.

**Conclusions**

Developed and included in the training program of badminton players of 14-15 years old complexes of exercises that include the use of sports equipment. It is recommended to use exercises with tennis balls, rubber tape, jumping exercises for improvement of physical and technical fitness of young badminton players.

**Conflict of interest**

The author declares no conflict of interest.
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