



ORIGINAL SCIENTIFIC ARTICLE

CHANGES IN INDICATORS OF SPECIAL PHYSICAL PREPAREDNESS IN BADMINTON PLAYERS AGED 10–11 UNDER THE INFLUENCE OF SPECIALLY SELECTED EXERCISES

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Accepted for Publication: April 3, 2023

Published: April 28, 2023

DOI: [10.17309/tmfv.2023.2.13](https://doi.org/10.17309/tmfv.2023.2.13)

Abstract

Study purpose. The study purpose was to determine changes in indicators of special physical preparedness and speed of attacking strokes in badminton players aged 10–11 under the influence of specially selected exercises.

Materials and methods. The study participants were young badminton players aged 10–11 (12 boys), whose sports experience was 2–3 years. The study lasted 3 months and included: testing of special physical preparedness and assessment and analysis of the speed of attacking strokes of young badminton players.

Results. Analysis of the results of the study showed positive changes in the results of special physical preparedness, accuracy and speed of attacking strokes. The complex development of the speed-strength abilities of young badminton players was determined by the exercises of throwing a ball weighing 1 kg, triple long jump and jumping rope. This was manifested in the execution of attacking strokes from the place and in jumping and moving, but there was a significant increase in results in the triple jump and jumping rope. The development of speed endurance determined the 4-point center-to-center movement exercise, but the results did not change significantly over the course of the study. Accuracy indicators of attacking strokes significantly increased by an average of 2,58%. The results of the speed of attacking strokes also had a significant increase by an average of 29.41%. The use of complexes for training the accuracy of attacking strokes along with targets with a gradual complication of exercises increased the results of test exercises for accuracy and speed of execution. The indicators of the speed of attacking strokes on the left and on the right correlate with each other. The accuracy results of the right hand strokes along the line significantly correlate with right hand strokes along the diagonal and the triple long jump from a place. This indicates the connection of speed-strength abilities with the performance of attacking strokes by young badminton players. Indicators of a triple long jump from a place, jumping rope for 1 min. and throwing a ball weighing 1 kg are significantly correlated with each other, which indicates the complex development of the speed-strength abilities of young badminton players.

Conclusions. The presented complexes of special preparatory exercises had a positive effect on changes in the indicators of special physical preparedness, accuracy and speed of the attacking strokes, which makes it possible to recommend them to 10–11-year-old badminton players in the training process.

Keywords: young badminton players, attacking strokes, performance, accuracy.

Introduction

The competitive activity of badminton players requires effective and stable attacking strokes, which require well-developed physical qualities, perfect mastery of the accuracy

of body movements and the accuracy of strokes to the court. As competitive practice shows, the matches of athletes are held with greater speed and duration, with a large number of attacking strokes from different positions (Abdullah, 2014; Abián et al., 2014; Cabello-Manrique et al., 2003).

The effectiveness, speed, accuracy of attacking strokes in badminton is influenced by a large number of factors that have been studied by a number of specialists. Experts point out the need to constantly keep the shuttlecock in sight, timely and

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correctly approach it and direct the strokes to the appropriate point on the site (Luo et al., 2020). An analysis of technical and tactical actions shows that for an opponent, the closer to the net and sidelines of the court an attacking stroke is performed, the more difficult it is to receive it, and that the most important thing is to get a positive result in the game (Karatnyk et al., 2015). At the same time, highly qualified athletes showed positive relationships between the effectiveness of technical skills with speed-strength abilities and flexibility (Mahulkar, 2016; Okun et al., 2020; Rovniy et al., 2018).

A number of authors proposed a technique for assessing the trajectory of strokes on the target of a short serve (Vial et al., 2019) and determined that the time of day and temperature affect the accuracy of serving in badminton (Preeti et al., 2019).

In the works of other authors, it is emphasized that with the appropriate angle of the flight path and the force of impact, the speed of the shuttlecock increases (Vial et al., 2019), the ability to track the trajectory of impact on the shuttlecock to correlate the movement of the racket to the target due to computer technology (Chi et al., 2021). The use of video technology made it possible to carry out a kinematic analysis of the movements of the shoulders, elbows and wrists when performing an attacking stroke in badminton (Rusdiana et al., 2021).

Many authors have been involved in the selection of special exercises for training badminton players (Sturgess et al., 2008; Guven et al., 2017; Ozmen et al., 2017; Shevchenko et al., 2021), which indicates a rational approach in our research. Also Zhang, 2023 determined that the explosive power of the upper limbs and the flexible and fast lower limbs are one of the important factors for the success of athletes in competitions.

Thus, the available results confirm the relevance of studying new ways to improve attacking hits in the training of badminton players in basic training groups. Based on the above, the purpose of this study is to determine the changes in indicators of special physical preparedness and the speed of attacking hits in badminton players aged 10-11 under the influence of specially selected exercises.

Material and methods

Participants

The study involved 12 boys (age = $10,4 \pm 0,53$ y, body mass = $40,5 \pm 1,55$ kg, and height = $148,8 \pm 1,67$ cm), who practiced badminton for 2-3 years. Young athletes belonged to the same sports club and trained with the same coach. Classes were held 8 hours a week. In the training process of young badminton players, special preparatory exercises were used for 3 months. Testing was carried out twice: at the beginning and at the end of the introduction of a complex of special preparatory exercises. Permission was obtained from all parents for the participation of young athletes in the study, as well as in the supplementary exercise program in accordance with the Declaration of Helsinki.

Procedure

To determine the current level of special physical preparedness of the participants, tests were selected that

characterize the level of special qualities of badminton players. Selected test exercises: triple long jump with two legs push (m); jumping rope for 1 min. (number of times); throwing a ball weighing 1 kg with a hand that performs an attacking stroke (m); moving from the center to 4 points with the transfer of shuttlecocks, 4 series (min).

When determining the speed of the attacking strokes, targets of the area size (100×75 cm) were used. This smash accuracy assessment system allows a badminton player to score points from 1 to 5 from 40 attacking strokes from different points and directions for each stroke on the target, misses were not evaluated. To assess the speed of the attacking strokes, computer analysis was used using the American multi-sensor movements "Zepp tennis 2" (km/h). The testing with the sensor took place simultaneously with the test for the accuracy of attacking strokes. The sensor was put on the end of the racket and, using a Bluetooth wireless communication system, was combined with an iPad Air6 (2019) tablet computer. The test session was held during two days of training sessions after a day of rest.

Complexes of special running exercises for training speed-strength abilities and agility, development of coordination abilities and improvement of footwork technique, movement and imitation of attacking hits were used at the end of the special preparatory and at the beginning of the main part of the lesson. Complexes for the development and improvement of accuracy in the main part of the training with a gradual complication of tasks. Accuracy training ended with playing exercises or playing on the score.

A set of special running exercises.

Method of execution: in a circle. Dosage: perform each exercise 8-10 m 2 times.

1. Fast running sideways and backwards with a quick change of direction;
2. Running with a side step;
3. Running with a cross step;
4. Performing jerks forward, sideways, backward from the starting position of the badminton player.
5. Acceleration from a low start and a half-squat on a visual signal.

A set of exercises for training speed-strength abilities and agility:

1. Jumping rope on one leg. Dosage: 3×20 s on one and then 20 s on the other leg for 20 s (rest 15 s after the end of the cycle for both legs).
2. Spring squats followed by jumping up and changing the position of the legs in the jump. Dosage: 3×20 s. Guidelines: maintaining balance.
3. Jumping with both feet with 360° rotation. Dosage: perform 10 times in different directions.
4. Jumping on the spot with the maximum turn of the feet in both directions, from the "strip" position, jump up with a change in the position of the legs in the air and land in the starting position. Dosage: 3×20 s. Guidelines: maintaining balance.
5. A variety of jumps: up, side-long, side-up, up-back, from a place, from a fast and slow run. Dosage: 10 times each kind of jump. Guidelines: Maintain balance.
6. Throwing a medicine ball 1 kg with the movement of an attacking strike from the left and right. Dosage: 2×10 times each hand. Methodical instructions: to control the correct movement of the blow.

A set of exercises for the development of coordination abilities:

1. Catching a tennis ball in different ways (one or two hands, left, right, overhead, etc.). Performing against the wall or with a trainer. Dosage: 3×20 s. Methodical instructions: monitor the error-free performance.

2. Shuttle throws by the movement of the attacking blow according to the indication of the flight range. Dosage: 5 times in each distance of 3-6-9 m.

3. Juggle a shuttlecock and a tennis ball. Dosage: 3×20 s. When performing exercises, the control over the safety of the structure of the competitive movement of the athlete was carried out. Emphasis was placed on the impulse during an attacking hits, followed by complete relaxation for the coordination of the badminton player's movements.

A set of exercises to improve the technique of footwork, movement and imitation of attacking hits.

Way of execution: repeated. Dosage: 3 times. Rest between repetitions 1 min. Guidelines: at the base point, you always need to take the position of the game stand, all the rest must be stepped on with your right foot. Movement at maximum speed with the execution of imitation of attacking hits.

It is proposed to use the complex by points:

point №1 – base. The center of the circle is 1 m from the front service line in the center of the court;

point №2 – located at a distance of 1 m from the front service line and 1 m from the right side line (front zone);

point №3 – at a distance of 1 m from the front service line and 1 m from the left side line (front zone);

point №4 – at a distance of 1 m from the front serve and from the right touchline (middle zone);

point №5 – at a distance of 1 m from the front service line and 1 m from the leading side line (middle zone);

point №6 – located at a distance of 50 cm from the back service line and 50 cm from the right side line (rear zone);

point №7 – is located 50 cm from the back service line and 50 cm from the left side line (rear zone).

Accuracy training took place during the implementation of the above-mentioned complexes, taking into account various conditions and the use of targets: alternating hits from one, from different points of the site, according to the accuracy of the hit; the accuracy of the flight path of the shuttlecock; the sharpness and variety of the plating of the shuttlecock; hits from a place or in motion.

Complexes of development and improvement of the accuracy of attacking hits of badminton players

Way of execution: repeated. Dosage: 10 hits at each point.

Complex №1 (performing hits on the spot).

1. From point №1 to point №2.

2. From point №1 to point №3.

3. From point №1 to point №4.

4. From point №1 to point №5.

5. From point №1 to point №6.

6. From point №1 to point №7.

Complex №2 (performing hits in different directions)

1. From point №1 to point №2 and point №6 in turn.

2. From point №1 to point №3 and point №7 in turn.

3. From point №1 to point №2 and point №7 in turn.

4. From point №1 to point №3 and point №6 in turn.

The same, the execution of strikes from points №4 and №5 in the directions indicated in the complex №2.

Complex №3 (performing hits in motion and in a jump)

1. From point №1 move to point №4, hit to point №6.

2. From point №1, move to point №5, hit to point №7.

3. From point №1, move to point №4, hit to point №7.

4. From point №1, move to point №5, hit to point №6.

5. From point №1, move to point №4, hit to point №2.

6. From point №1, move to point №4, hit to point №3.

7. From point №1, move to point №5, hit to point №2.

8. From point №1, move to point №5, hit to point №3.

9. From point №1, move to point №6, hit to point №6.

10. From point №1, move to point №7, hit to point №7.

11. From point №1, move to point №6, hit to point №7.

From point №1, move to point №7, hit to point №6.

Statistical analysis

Statistical processing of the obtained data was carried out using the MS Excel licensed program. Characteristics of descriptive statistics were determined: arithmetic mean ($\bar{X}$), standard deviation (σ) and representativeness error of the arithmetic mean (m). The significance of differences was assessed using the t-test (Student's t-test), the differences were considered significant at ($p < 0.05$), given the small size of the groups.

Results

The results of changes in indicators of special physical preparedness are presented in Table 1. Thus, under the influence of a complex of special preparatory exercises, significant changes in young badminton players were obtained in terms of triple long jump ($t=4.69$; $p < 0.001$) and jumping rope ($t=4.03$; $p < 0.01$).

The development of speed endurance was determined by the exercise of moving from the center to 4 points, but the results did not change significantly during the study.

Table 1. Changes in indicators of special physical preparedness of young badminton players before and after the study (n=12)

Indicators	before	after	Reliability assessment	
	$\bar{X} \pm m$	$\bar{X} \pm m$	t	p
Triple long jump with push of two legs (m)	4.24±0.23	5.70±0.21	4.69	<0.001
Jumping rope for 1 min. (number of times)	99.20±3.47	116.40±2.49	4.03	<0.01
Throwing a ball with a mass of 1 kg with the hand that is used for the attacking strokes (m)	5.29±0.29	5.79±0.19	1.53	>0.05
Moving from the center to 4 points with the transfer of shuttlecocks, 4 series (min)	1.19±0.03	1.07±0.05	2.06	>0.05

Table 2. Changes in the indicators of the accuracy of the attacking strokes of young badminton players before and after the study (n=12)

Indicators	before	after	Reliability assessment	
	X±m	X±m	t	p
Backhand strokes speed down the line (points)	8.8±0.55	12.7±0.65	4.58	<0.001
Diagonal left strokes speed (points)	8.8±0.47	11.6±0.60	3.67	<0.01
Forehand strokes speed down the line (points)	8.9±0.46	13.9±0.72	5.85	<0.001

Table 3. Changes in the indicators of the speed of the attacking strokes of young badminton players before and after the study (n=12)

Indicators	before	after	Reliability assessment	
	X±m	X±m	t	p
Backhand stroke down the line (km/h)	53.9±2.19	115.6±6.61	8.86	<0.001
Diagonal left stroke (km/h)	55.6±1.66	119.0±5.42	11.19	<0.001
Forehand strokes down the line (km/h)	56.2±1.95	118.8±5.55	10.64	<0.001

Table 4. Correlation analysis of indicators of accuracy, speed of attacking strokes and special physical preparedness in badminton players 10-11 years old after a pedagogical experiment, n=12

Indicators	1	2	3	4	5	6	7	8	9	10	11	12
1	1											
2	0.33	1										
3	0.56	-0.04	1									
4	0.27	0.97	0.08	1								
5	0.48	0.26	0.63	0.33	1							
6	0.32	0.99	0.03	0.99	0.29	1						
7	0.29	-0.01	0.69	0.12	0.78	0.04	1					
8	0.34	0.98	0.09	0.99	0.31	0.99	0.07	1				
9	0.14	0.42	0.41	0.48	0.66	0.45	0.27	0.47	1			
10	-0.06	0.11	0.38	0.18	0.54	0.14	0.24	0.16	0.93	1		
11	-0.14	0.17	0.21	0.15	0.19	0.15	-0.14	0.18	0.73	0.59	1	
12	-0.43	-0.12	-0.48	-0.14	-0.29	-0.14	-0.02	-0.17	-0.62	-0.64	-0.45	1

1 – backhand stroke down the line, points; 2 – backhand strokes speed down the line, km/h; 3 – diagonal left hand stroke, points; 4 – diagonal left hand stroke speed, km/h; 5 – forehand strokes down the line, points; 6 – forehand strokes speed down the line, km/h; 7 – diagonal right hand stroke, points; 8 – diagonal right hand stroke speed, km/h; 9 – triple long jump, m; 10 – jumping rope for 1 minute, times; 11 – throwing a ball weighing 1 kg, m; 12 – movement from the center in 4 directions, 4 series, s.

Changes in the indicators of accuracy and speed of execution of attacking strokes by badminton players are shown in tables 2, 3. Thus, the accuracy indicators of attacking strokes increased by an average of 2.58%, and the results of the speed of attacking strokes – by 29.41%, which is confirmed by a significant difference ($p < 0.01-0.001$) between initial and final results.

The use of complexes for training the accuracy of attacking strokes along with targets with a gradual complication of exercises increased the results of test exercises for accuracy and speed of execution. Table 4 presents the results of the correlation analysis after the pedagogical experiment.

The indicators of the speed of attacking stroke on the left and on the right significantly correlate with each other ($r = 0.97-0.99$). The accuracy results of right-hand stroke along the line significantly correlate with right hand stroke

along the diagonal ($r = 0.78$) and with the triple long jump from the spot ($r = 0.66$). This indicates the connection of speed-strength abilities with the performance of attacking stroke by young badminton players. Indicators of a triple long jump from a place, jumping rope for 1 min. ($r = 0.99$) and throwing a ball weighing 1 kg ($r = 0.73$) are significantly correlated with each other, which indicates the complex development of speed-strength abilities of young badminton players.

Discussion

This study aims to determine the effect of specially selected exercises on changes in indicators of special physical preparedness and speed of attacking hits in badminton players 10-11 years old. Our results show that the presented

complexes of special preparatory exercises, which were used 8 hours a week for 3 months, are effective for improving the indicators of special physical preparedness, accuracy and speed of the attacking hits of 10-11 year old badminton players.

Our study is confirmed by the works of scientists on the predominant development of speed and speed-strength abilities of badminton players (Jaworski et al., 2015). Correlations of interrelations between indicators of agility, coordination, speed-strength abilities were determined in the works (Ahmed et al., 2022; Tiwari et al., 2011). The expediency of using computer technologies in the training of badminton players, which allows the coach to have instant adaptive feedback in the training process, is confirmed in scientific papers (Lin et al., 2021; Chernykh et al., 2022).

Our studies confirmed the data of scientists on the effect of specially selected exercises on improvement: technique techniques with a characteristic tension for playing badminton, coordination, tempo and rhythm of movement (Sobko et al., 2020), lower limb strength, dynamic balance and coordination abilities (Preeti et al., 2019; Zhang, 2023), speed and speed-strength abilities and agility of young badminton players (Güven et al., 2017; Özmen et al., 2017), flexibility (Yadav, 2017).

To assess the influence of specially selected exercises on changes in the indicators of special physical preparedness and the speed of attacking hits among young badminton players, different tests were used. To determine the level of special physical preparedness of the participants, both specific and non-specific tests for this sport were selected. Similar tests were used in studies by Kwan et al. (2010); Nasruddin et al. (2016); Sturges et al. (2008). The use of selected tests made it possible to obtain a comprehensive assessment of the level of special qualities of young badminton players.

When determining the speed of the attacking hits, computer analysis was used using the American Zepp tennis 2 multi-motion sensor. The Zepp Tennis 2 device was used by Giménez-Egido et al. (2020) and is the only smart sensor that can be used with all types of rackets, including juniors.

Correlation analysis is widely used in sports science. Comparison of the accuracy, speed of attacking hits and special physical preparedness of young badminton players allows us to assess the relationship between physical qualities and technical preparedness, which is formed in the process of sports training.

The correlation between lower body power and physical ability in young badminton players was investigated by Santos et al. (2022). The main practical implication of this study is that phase angle has a modest relationship with lower limb strength and physical ability in young badminton players. Thus, phase angle may play an important role in training load control as it can be used to assess aerobic and anaerobic capacity in young badminton players.

In our study, it was found that the indicators of the speed of attacking hits from the left and right correctly correlated with each other. Line accuracy forehand results are significantly correlated with diagonal righthand and triple long jump. This indicates the connection of speed-strength abilities with the performance of attacking hits by young badminton players.

Given the above, it can be argued that the use of a set of specially selected exercises had a positive effect on the

special physical preparedness and speed of attacking hits in badminton players 10-11 years old. The use of the proposed complex can also be used in the training of young tennis players.

Conclusions

The presented complexes of specially selected exercises had a positive impact on changes in the indicators of special physical preparedness, accuracy and speed of the attacking hits, which allows us to recommend badminton players 10-11 years old in the training process. Thus, under the influence of a complex of special preparatory exercises, significant changes in young badminton players were obtained in terms of triple long jump ($p < 0.001$) and jumping rope ($p < 0.01$). Indicators of accuracy and speed of execution of attacking hits by young badminton players are also positive changes under the influence of specially selected exercises.

Acknowledgement

We would like to express our gratitude to the Kharkiv State Academy of Physical Culture for providing support for the implementation of this research.

Conflicts of interest

Authors have no conflict of interest to disclose

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ЗМІНИ ПОКАЗНИКІВ СПЕЦІАЛЬНОЇ ФІЗИЧНОЇ ПІДГОТОВЛЕНOSTІ БАДМІНТОНІСТІВ 10-11 РОКІВ ПІД ВПЛИВОМ СПЕЦІАЛЬНО ПІДБРАНИХ ВПРАВ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 7 с., 4 табл., 28 джерел.

Мета. Визначити зміни показників спеціальної фізичної підготовленості та швидкості нападаючих ударів у бадмінтоністів 10-11 років під впливом спеціально-підібраних вправ.

Матеріали і методи. Учасники – юні бадмінтоністи 10-11 років (12 хлопців), спортивний стаж яких 2-3 роки. Дослідження тривало 3 місяці і включало: тестування спеціальної фізичної підготовленості, оцінку та аналіз швидкості атакуючих ударів юних бадмінтоністів.

Результати. Аналіз отриманих результатів дослідження виявив позитивні зміни результатів спеціальної фізичної підготовленості, точності та швидкості нападаючих ударів. Комплексний розвиток швидкісно-силових здібностей юних бадмінтоністів визначали вправи метання м'яча масою 1 кг, потрійний стрибок у довжину та в стрибки на скакалці. Це проявлялося у виконанні нападаючих ударів з міста та у стрибку та переміщеннях, але достовірно підвищення результатів мали у потрійному стрибку та стрибках на скакалці. Розвиток швидкісної витривалості визначала вправа переміщення з центру в 4 точки, але результати суттєво не змінилися протягом дослідження. Показники точності нападаючих ударів достовірно збільшилися в середньому на 2,58%. Результати швидкості нападаючих ударів також мали достовірно підвищення в середньому на 29,41%. Використання комплексів для тренування точності нападаючих ударів разом з мішенями з поступовим ускладненням вправ підвищило результати тестових вправ на точність та швидкість виконання. Показники швидкості нападаючих ударів зліва та справа достовірно корелюють між собою. Результати точності удару справа по лінії достовірно корелюють з ударами справа по діагоналі та з потрійним стрибком у довжину з міста. Це вказує на зв'язок швидкісно-силових здібностей з виконанням нападаючих ударів юними бадмінтоністами. Показники потрійного стрибка у довжину з міста, стрибки на скакалці за 1 хв. та метання м'яча масою 1 кг достовірно корелюють між собою, що вказує на комплексний розвиток швидкісно-силових здібностей юних бадмінтоністів.

Висновки. Представлені комплекси спеціально-підготовчих вправ позитивно вплинули на зміни показників спеціальної фізичної підготовленості, точності та швидкості нападаючого удару, що дозволяє рекомендувати в тренувальному процесі бадмінтоністів 10-11 років.

Ключові слова: юні бадмінтоністи, нападаючий удар, показники, точність.

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Cite this article as: Shevchenko, O., Mulyk, K., Paievskiy, V., Skaliy, A., Guba, A., Skaliy, T., & Anosova, O. (2023). Changes in Indicators of Special Physical Preparedness in Badminton Players Aged 10–11 under the Influence of Specially Selected Exercises. *Physical Education Theory and Methodology*, 23(2), 246–252. <https://doi.org/10.17309/tmf.2023.2.13>

Received: 12.02.2023. Accepted: 03.04.2023. Published: 28.04.2023

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