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ORIGINAL ARTICLE

The Effects of a Short-Term Training Programme on the Technical Performance of Female Shuttlecock Athletes Aged 14-15-Year-Old

[1]Van Hoa Nguyen, [1]Tri Huu Nguyen, [2]Vinh Quang Nguyen*, [3]Truong Ngoc Duong, [4]Thanh Viet Pham, [5]Du Trung Tran, [6]Minh Ngoc Nguyen

[1]Department of Physical Education, Can Tho University, Can Tho, Vietnam. [2]Vice Principal Ho Chi Minh City, University of Physical Education and Sport, Ho Chi Minh, Vietnam. [3]Faculty of National Defense - Security Education & Physical Education, Saigon University, Ho Chi Minh, Vietnam. [4]Faculty of Physical Education, Dong Thap University, Dong Thap, Vietnam. [5]Department of Physical Education, Tay Do University, Can Tho, Vietnam. [6] Vice Director of Center for Physical Education and Sports, Ha Noi Vietnam National University, Hanoi, Vietnam.

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ABSTRACT

Background. The shuttlecock game has received more attention in Vietnam in recent years as it is easy to play, and the high achievements of the national shuttlecock team in various international tournaments have also attracted Vietnamese people. As this kind of game requires the players to have more technical skills, there should be a highly demanding training program for better success. **Objectives.** This study evaluated the effects of a 12-week training program on the attacking skills of shuttlecock female athletes aged 14-15 from two teams in Ho Chi Minh City, Vietnam. **Methods.** Due to the limited number of shuttlecock players in each team (03 players), only twelve female adolescent shuttlecock athletes (14 to 15 years) were conveniently and randomly chosen for the experimental group (EG) (n=6) and the control group (CG) (n=6). The experimental group was given twenty-six exercises to practice and improve their attacking skills. The training program included 6 sessions per week, with 30-35 minutes of practicing the striking shuttlecock techniques, one of the attacking skills in the shuttlecock game. At the same time, the control group was given a permanent training program with a focus on comprehensive skills designed earlier. **Results.** After the treatment, the mean values of the experimental group were higher than those of the control group. Concurrently, the percent change of the experimental group was also better than that of the control group. **Conclusion.** A 12-week training program with 13 supplementary technical exercises could improve the technical performance of young female shuttlecock athletes.

KEYWORDS: ***Training Program, Attacking Skills, Technical Performance, Shuttlecock Athletes.***

INTRODUCTION

Shuttlecock, or kicking Shuttlecock, has a long history of over two thousand years. It originated as a game in China in the 5th century BC (1). During Chinese history, this game was played for relaxation and exercise. Then, it spread throughout Asia with different names. However, Shuttlecock has been widely recognized since it was included as a sport in the 2003 Southeastern Games.

In Vietnam, Shuttlecock entered the country very early in the 11th century and was played as a folk game. Since 1985, this game received more

*. Corresponding Author:
Vinh Quang Nguyen, Ph.D.
E-mail: vinhqn@upes.edu.vn

recognition and has been played as a kind of sport nationwide. To play Shuttlecock, a feather ball (Shuttlecock) is required, and the player will kick the Shuttlecock in the air and prevent it from touching the floor by using any body part but not their hands (2-5). The rules for this game are similar to those for volleyball, which allows the players to use their hands, unlike the Shuttlecock, which does not. The technical difficulty of playing Shuttlecock is medium, the exercise intensity is low, and the requirements for gender, age, location, and equipment status are low, making this kind of sport nationwide practiced (6).

The high achievements of the Vietnam national shuttlecock team in many recent Shuttlecock World Championships also made this kind of sport gain more popularity and receive more investment from sports management (2, 7).

Like many other sports, Shuttlecock involves various factors such as physical fitness, tactics, and psychology. However, technical skills are proven to considerably impact athletes' performances in shuttlecock competitions (8, 9). It is widely believed that no matter how superior their physical strength is, the athletes cannot play effectively without well-trained techniques. Athletes, therefore, are required not only to have good physical conditioning and stable psychology but also to have a solid foundation of technical skills.

Also, it should be noted that the athletes need to move the Shuttlecock with skill (8). They have continuous movements on a field court, using the skillfulness of their feet to control the Shuttlecock as desired. To control the Shuttlecock effectively and execute tactical intentions, athletes must practice the movement techniques and transform them into impressive maneuvers (5, 10). Because the sport is characterized by its complicated movements, swift turns, speed, foot agility, and unexpected situations during matches, the players must be well-prepared with sufficient techniques to perform effectively (5). In addition, proficiency in techniques also helps athletes avoid dangerous injuries.

According to Dang (2007) (11) and Chau (2016) (4), shuttlecock techniques are divided into four clusters with separate purposes, including moving, serving, defending, and attacking. Among them, the cluster of attacking techniques is considered the most crucial for dual or team games, as it helps the players end one round of attacking. This cluster includes two groups of skills: the ones using the instep and those using the footbridge. It will depend on the critical moments in which the athlete employs the appropriate techniques to attack.

The current study aims to improve attacking techniques by using the foot's bridge to kick the Shuttlecock over the opponent's net. These techniques are believed to be essential for scoring and are frequently employed during the game. To achieve them, the athletes must be trained carefully as they require more skills such as observing, moving, benching, and kicking.

MATERIALS AND METHODS

Participants. This study was conducted to enhance the achievement of the Shuttlecock 14-15 female athletes playing in Ho Chi Minh City, Vietnam. In a shuttlecock tournament, each team can register a maximum of 06 athletes to compete in singles, doubles, and triples, so the number of athletes in each team for training is usually six and fewer than in other sports. Thus, the number decided for the current study was twelve. All of them were trained and played for two shuttlecock teams in Ho Chi Minh City. To be more specific, they were chosen based on their similar recent achievements in several city shuttlecock tournaments and similar demographic backgrounds. In other words, the participants were purposefully or judgmentally chosen to meet the coaching criteria for the current study.

The decision on which team was the experimental group (EG) and the control group was random. All of them were females aged from 14 to 15 years old. They had a similar physical state, and all had been trained for the national shuttlecock competition. At the time of the intervention, the participants from both groups had no health problems and had been receiving the same training program. Before starting the experiment, the twelve shuttlecock athletes were asked to sign the consent form delivered to each member of the two teams, and the selection of participants met the ethical criteria set by the national research committee, as well as the 1964 Helsinki Statement and its subsequent revisions, or other similar ethical standards.

Data collection. To evaluate the effectiveness of the treatment – the training program- the research employed 07 skill tests to assess the technical skills that assist in attacking the athletes' skills. The tests were selected according to the studies by different

scholars such as Chau et al. (2016) (4), Duong et al. (1995) (10), Nguyen (2004) (11), Dang (2007) (12), Dang (2009) (13), Dang (2010) (14), Nguyen (2011) (15), Nguyen (2011) (16), Hoang (2012) (17), Nguyen et al. (2017) (18), Pham T et al. (2017) (19), Nguyen (2016) (20), Le (2017) (21), Nguyen et al. (2022) (22), Du (2023) (23), and the recommendations from the two coaches.

The study used the test-retest method to check the reliability of these technical tests. The results showed that the reliability coefficients of the tests are all very high, r >0.90, Sig <0.01. The validity coefficient value of the test is beneficial with r >0.55 and sig <0.05. This suggested that the seven tests have enough reliability and validity to evaluate the technical performance of the participants. The description of the tests is presented in Table 1 below.

The tests were evaluated in two sessions of the day to ensure the athletes were in a good physical state. Tests 1 to 5 were carried out in the first session, and tests 6 and 7 were conducted in the second.

Table 1. Description of the tests to evaluate technical performance

Test items	How to score
Test 1: Spiking the Shuttlecock into the 2-meter limited line (points)	The athlete stands in the kicking posture by the net and must spike three rounds with 10 ten times for each round. The score is counted based on the results of the falling of the Shuttlecock into the 2-meter limited line. If the Shuttlecock falls into the 2-meter limited line in a particular area as required in the opposite court, the athlete scores 2 points. If the Shuttlecock falls out of the required area, she will be recorded 1 point. In case the Shuttlecock is out of the court or not passing over the net, no score is counted. The highest result among the three rounds will be recorded.
Test 2: Spiking the Shuttlecock behind the 2-meter line over the net (points)	The athlete stands in the kicking posture by the net and moves quickly to catch the Shuttlecock, which is thrown from one assistant standing behind the 2-meter line and spikes freely over the net. For this test, the athlete must also perform three rounds with 10 ten times for each round. The score is counted based on the results of the falling into the opposite side. If the Shuttlecock falls into the other side of the court, the athlete scores 2 points. If the Shuttlecock falls out of the area of the opposite court, she will be recorded 1 point. In case the Shuttlecock is not over the opposite court, no score is recorded. The highest result among the three rounds will be recorded.
Test 3: Spiking the Shuttlecock vertically (points)	The athlete with a kicking posture stands by the net. When receiving a pass from the assistant standing in front of the 2-meter line, she conducts low serving and strikes it into the right corner of the opposite court in a straight line. The score is recorded similarly to the second test.
Test 4: Spiking the Shuttlecock diagonally (points)	The athlete with a kicking posture stands by the net. When receiving a pass from the assistant, she conducts a serving and strikes it diagonally into the left corner of the opposite court. The score is also recorded similarly to the second test.
Test 5: catching the Shuttlecock inside the net and then spiking it (points)	The athlete with a kicking posture stands by the net. When receiving a toss against the net from the assistant, she spikes freely the Shuttlecock into the opposite side of the court. The score is also recorded similarly to the second test.
Test 6: Spiking the Shuttlecock continuously (points)	The athlete with a kicking posture stands by the net. When receiving a pass from the assistant standing before the athlete on the same side, she continuously spikes the Shuttlecock into the opposite court. The player is requested to conduct three rounds; for each round, she must spike continuously until she fails. Each correct spike is counted for one point, and the score is recorded with the highest points among the three rounds.
Test 7: Slamming the Shuttlecock into one of the four squares (points)	The player with a kicking posture stands by the net. When receiving a pass from the assistant standing in front of the athlete on the same side, she continuously spikes the Shuttlecock ten times into each of the four 0.5-meter squares of the opposite court, which is numbered. If the Shuttlecock falls into the numbered square, she will score 2 points. If the Shuttlecock falls out of the numbered square, she will be recorded 1 point. In case the Shuttlecock is out of the square, no score is counted. The score is recorded by calculating the points from the four times.

Procedures. The first week before the experiment, all participants were informed in detail about the research program and trained to be familiar with the seven tests. The second week before the experiment, the pretest using the seven tests mentioned in Table 1 was conducted. By the

end of the sixth week of the twelfth-week training program, a midtest was conducted using the same seven tests mentioned above. One week after the experiment, the post-test was given to the participants, and two out of the six researchers carried out all the assessing procedures.

The training program for the female 14-15-year-old shuttlecock athletes lasted twelve weeks, with six sessions a week. Two experienced coaches instructed the athletes. Both groups were given a 180-minute training program, which was a 120-minute comprehensive training that included warm-up activities, technical and tactical skills, and physical strength, and 60 minutes for activities to recover and relax. In other words, only 30 to 35 minutes were spent training the attacking skills of both groups. The schedule for training the attacking skills for the two groups is presented in Appendix 1 and 3.

To be brief, the study's research design is presented in Figure 1 below.

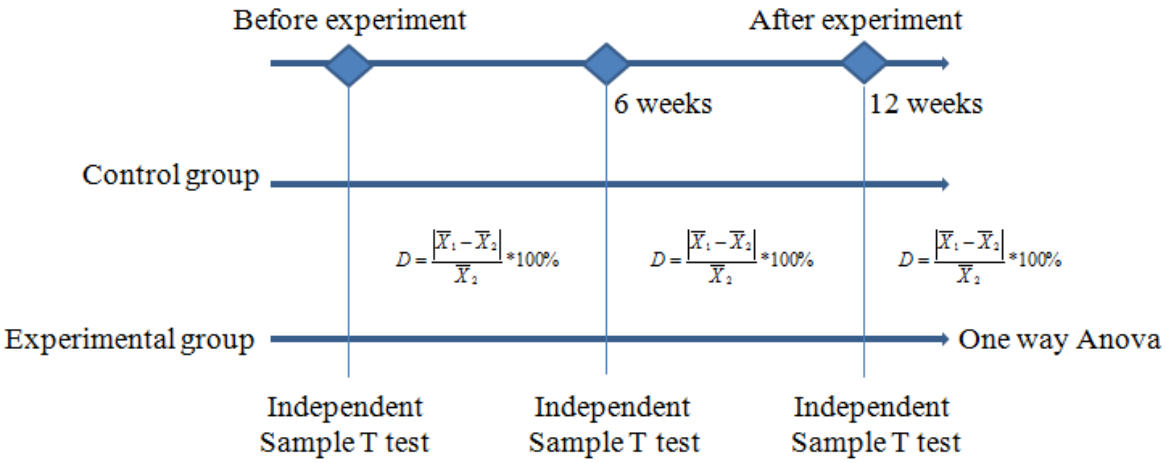

Figure 1. The Research Design of the Study.

Regarding the exercises, the experimental group was given twenty-six exercises, of which thirteen were adapted and proposed by the researchers aiming to enhance the attacking skills of the athletes (Ex3, Ex4, Ex7, Ex8, Ex9, Ex12, Ex14, Ex18, Ex19, Ex22, Ex23, Ex24, and EX26 see detailed description in Table 2 below). The intervention exercises for the treatment were carefully chosen from different references, including Chau et al. (2016) (4), Nguyen (2022) (8), Duong et al. (1995) (10), Nguyen (2004) (11), Dang (2007) (12), Dang (2009) (13), Dang (2010) (14), Hoang (2012) (17), Department of Physical Education (2010) (20), Le (2017) (21), Nguyen et al. (2022) (22), Du (2023) (23), Department of Mass Sport (2001) (24), Department of Mass Sport (2009) (25) and other related studies. The study's researchers were also consulted by some coaches and other experts in the field to gain the best performance for the athletes. At the same time, the control group practiced twenty-six exercises in the training program developed earlier (see Appendix 2 for further detailed description).

Data analysis. The data from the study was collected at three points. The first point was one week before the experiment began, the second one was by the end of the sixth week, and the last one was one week after the experiment. All data were presented as mean and standard deviation values (mean±SD). All data were analyzed with the assistance of SPSS for Windows version 22.0. The Independent T-test was used to determine the differences in mean scores of technical skill tests between the two groups at each stage, including before the experiment, after 6 weeks, and after 12 weeks of the treatment. The ANOVA was employed to examine the differences in development (%) of the experimental group's performance after 6 weeks and after 12 weeks of the experiment. The development (%) of achievement was calculated with the formula: $D=\frac{|\overline{X}_1-\overline{X}_2|}{\overline{X}_2}*100\%$ while $\bar{x}_1$: Pre-experimental

test mean; $\bar{x}_2$: Post-experimental test mean value. A p-value of less than 0.05 was determined to be a significant difference. Values were presented in mean ± standard deviation.

Table 2. Description of technical exercises given to the shuttlecock athletes in the experimental group

Purposes	Exercises
Enhancing the ability to spike the Shuttlecock into the 2-meter limited line	Exercise 1 (Ex1): The athlete performs stationary jump spikes with the Shuttlecock fixed above the net by 30-40 cm into the 2-meter line.
	Exercise 2 (Ex2): The athlete moves and jumps spikes with the Shuttlecock fixed above the net by 30-40 cm into the 2-meter line.
	Exercise 3 (Ex3): The shuttlecock athlete drops the Shuttlecock, kicks it above the net, and then moves and jumps spikes into the 2-meter line.
	Exercise 4 (Ex4): The shuttlecock athlete stands near the net and tosses the Shuttlecock vertically before spiking.
Developing the ability to spike the Shuttlecock out of the 2-meter line	Exercise 5 (Ex5): The shuttlecock athlete stands with their back against the net, receives a serve, and tosses the Shuttlecock higher than the net by 10-20 cm before spiking.
	Exercise 6 (Ex6): The shuttlecock player stands with their back against the net, then jumps spike with a shuttlecock fixed above it.
	Exercise 7 (Ex7): The shuttlecock athlete stands outside the 2-meter line, back facing the net. An assistant tosses the Shuttlecock, and the athlete tosses it and then spikes it near the net.
	Exercise 8 (Ex8): The athlete quickly catches a shuttlecock thrown from 15 meters away before spiking.
Improving the capability to spike the Shuttlecock vertically	Exercise 9 (Ex9): The athlete drops and kicks the Shuttlecock above the net, then jumps spike in a straight line.
	Exercise 10 (Ex10): The athlete continuously kicks a fixed shuttlecock 40-50 cm above the net to the opponent's right side.
	Exercise 11 (EX11): An assistant holds the Shuttlecock 40-50 cm above the net while the athlete practices continuous side kicks
Increasing the skill to spike the Shuttlecock diagonally	Exercise 12 (Ex12): The athlete drops and kicks the Shuttlecock above the net, then jumps the spike diagonally.
	Exercise 13 (Ex13): The athlete stands near the net antenna, back facing the net, and jumps diagonally diagonally with a fixed shuttlecock.
	Exercise 14 (Ex14): The athlete stands in the middle near the net, back facing the net, moves sideways, and jump spike diagonally with a fixed shuttlecock
	Exercise 15 (Ex15): The athlete raises the net to 1.7 meters and jumps spike
Training the skill to catch the Shuttlecock inside the net and then spike it	Exercise 16 (Ex16): The athlete hits the Shuttlecock against a wall and catches it on the rebound.
	Exercise 17 (Ex17): The athlete stands facing the net, tosses the Shuttlecock into the net, waits for the rebound, and then tosses it high
	Exercise 18: An assistant tosses the Shuttlecock into the net; the athlete waits for the rebound, then tosses it high and spikes
	Exercise 19 (Ex19): The athlete stands in the middle of the net, back facing the net; an assistant tosses the Shuttlecock to either side; the athlete waits for the bounce, then tosses it high
Boosting the skill to spike the Shuttlecock continuously	Exercise 20 (Ex20): The athlete maneuvers the Shuttlecock in the air using both feet, aiming for a height of 1-1.5 meters consistently.
	Exercise 21 (Ex21): An assistant tosses the Shuttlecock high over a fixed area near the net; the athlete moves and continuously jumps spikes
	Exercise 22 (Ex22): An assistant tosses the Shuttlecock high over different areas near the net; the athlete judges and moves to jump spike continuously
	Exercise 23 (Ex23): An assistant holds a fixed shuttlecock 0.5 meters above the net; the athlete stands parallel to the net and continuously jumps spike
Strengthening the mastery of controlling the Shuttlecock to spike into the drop-point	Exercise 24 (Ex24): The athlete performs controlled spikes over an opponent's block on the other side of the court, aiming for precise drop points without powerful spikes.
	Exercise 25 (Ex25): the net is raised to 1.8 meters high, and the athlete performs a drop spike into designated areas on the opponent's court
	Exercise 26 (Ex26): The athlete tosses the Shuttlecock high and performs a drop spike into the designated area.

RESULTS

Mean values between the EG and the CG before the treatment were compared using an independent sample t-test and presented in Table 3 below. As seen in Table 3, the difference in technical skills between the

experimental and control groups was insignificant before the experiment. Specifically, the difference in mean values is minimal: test 1: 0.26 (points), test 2: 0.16 (points), test 3: 0.34 (points), test 4: 0.17 (points), test 5: 0.34 (points), test 6: 0.33 (points) and test 7: 0.17 (points) and this difference is insignificant as sig >0.05. These results reveal that the two groups' attacking skills were equal and assured the conditions for the experiment.

Table 3. Independent Sample t-test comparisons for the seven technical assessment items between the control group and experimental group before the experiment

No	Test items	Before experiment			
		EG	CG	Mean difference |EG - CG|	Sig
		Mean ± SD	Mean ± SD		
1	**Test 1:** Spiking the Shuttlecock into the 2-meter limited line (points)	10.76±1.63	10.50±1.22	0.26	0.42
2	**Test 2:** Spiking the Shuttlecock out of the 2-meter line (points)	11.17±1.94	11.33±1.75	0.16	0.44
3	**Test 3:** Spiking the Shuttlecock vertically (points)	12.17±1.33	11.83±0.98	0.34	0.32
4	**Test 4:** Spiking the Shuttlecock diagonally (points)	12.50±1.38	12.33±1.21	0.17	0.41
5	**Test 5:** catching the Shuttlecock inside the net and then spiking it (points)	12.67±1.75	12.33±1.37	0.34	0.36
6	**Test 6:** Spiking the Shuttlecock continuously (points)	22.50±3.08	22.83±2.64	0.33	0.42
7	**Test 7:** Slamming the Shuttlecock into one of the four squares (points)	36.17±4.79	36.00±3.46	0.17	0.47

EG: Experimental group; CG: Control group.

ANOVA was used to compare the mean values of the experimental group before the treatment, after 6 weeks, and after 12 weeks of the treatment, and the results are presented in Table 4 below.

The data in Table 4 shows that after 6 weeks of the experiment, the mean values of the seven technical assessment tests of the experimental group were significant. Still, the difference was not statistically significant (sig >0.05). After the 12 weeks of the experiment, the difference was statistically significant (sig <0.05). It can be said that the performance in technical skills of the female athletes in the experimental group was better than before the experiment.

Table 4. ANOVA comparison of the experimental group's mean values before, after 6 weeks, and after 12 weeks of the experiment

Tests	Before experiment	After 6 weeks	After experiment	F	Sig.	Post - hoc (Bonferroni)
	Mean ± SD	Mean ± SD	Mean ± SD			
Test 1	10.76±1.63	12.50±1.64	14.83±1.60	9/895	0.002	$\mu1 \approx \mu2; \mu2 \approx \mu3, \mu1 < \mu3$
Test 2	11.17±1.94	13.33±1.86	14.67±1.67	5.673	0.015	
Test 3	12.17±1.33	13.83±1.17	15.33±1.37	9.033	0.003	
Test 4	12.50±1.38	14.17±0.98	15.67±1.21	10.423	0.001	
Test 5	12.67±1.75	14.17±1.33	15.33±1.21	5.106	0.020	
Test 6	22.50±3.08	26.50±2.74	29.33±2.80	5.532	0.003	
Test 7	36.17±4.79	44.83±3.66	50.67±4.13	17.943	0.000	$\mu2 \approx \mu3, \mu1 < \mu2, \mu3$

μ1: Before experiment; μ2: After 6 weeks; μ3: After experiment.

An independent sample t-test was employed to compare the mean values between the experimental and control groups, and the results are presented in Table 5 below.

The data in Table 5 reveals that after 6 weeks of the experiment. However, the mean values of the six tests in the experimental group were higher than those of the control group (test 1: 0.67 (points), test 2: 0.83 (points), test 3: 0.83 (points),

test 4: 1.00 (points), test 5: 0.84 (points), test 6: 2.00 (points), they were insignificant as sig >0.05. Only the results of test 7 were found to be significant as sig <0.05 (EG = 44.83, CG = 41.17). The data revealed that the training exercises were practical and unnecessary to be adjusted.

However, after 12 weeks of the treatment, the EG's performance was much better than the CG's (sig <0.05). To be specific, the mean differences in tests were 2.16 (points),1.67 (points), 1.66 (points), 1.67 (points), 1.5 (points), 3.66 (points) and 6.67 (points) respectively.

Table 5. Independent Sample t-test comparisons for the seven technical assessment items between the control group and experimental group after 6 weeks and after the experiment

No	Test items	after 6 weeks				after experiment			
		EG	CG	Mean difference |EG - CG|	Sig	EG	CG	Mean difference |EG - CG|	Sig
		Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
1	Test 1	12.50±1.64	11.83±1.47	0.67	0.24	14.83±1.60	12.67±1.51	2.16	0.02
2	Test 2	13.33±1.86	12.50±1.64	0.83	0.22	14.67±1.67	13.00±1.26	1.67	0.04
3	Test 3	13.83±1.17	13.00±0.63	0.83	0.08	15.33±1.37	13.67±1.03	1.66	0.02
4	Test 4	14.17±0.98	13.17±1.17	1.00	0.07	15.67±1.21	14.00±1.26	1.67	0.02
5	Test 5	14.17±1.33	13.33±1.63	0.84	0.11	15.33±1.21	13.83±1.33	1.5	0.03
6	Test 6	26.50±2.74	24.50±2.35	2.00	0.10	29.33±2.80	25.67±2.58	3.66	0.02
7	Test 7	44.83±3.66	41.17±2.93	3.66	0.04	50.67±4.13	44.0±2.68	6.67	0.00

EG: Experimental group; CG: Control group.

To further examine the effectiveness of the treatment, an independent Sample t-test was applied to determine the difference in percent change (%) in the technical performance of the experimental and control groups after 6 weeks and 12 weeks of training. The results of the comparison are shown in Table 6.

Table 6 shows that after six weeks of the treatment, the percent change of the experimental group was higher than that of the control group. Still, only the results of 04 tests (test 2, test 4. Test 6, test 7) of the experimental group were significant with sig <0.05. After 122 weeks of treatment, the percent change of the experimental group was much better and significant with sig <0.05. To sum up, the results indicate that the 26 exercises positively impacted the attacking skills of the experimental group after 12 weeks of training.

Table 6. Comparison of percent change (%) in the technical performance of the experimental and control groups

No	Test items	% change after 6 weeks				% change after the experiment			
		EG	CG	Mean difference |EG - CG|	Sig	EG	CG	Mean difference |EG - CG|	Sig
		Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
1	Test 1	14.68±6.06	11.14±3.52	3.54	0.12	27.97±8.55	16.90±5.25	11.07	0.01
2	Test 2	16.52±3.83	9.50±3.65	7.03	0.01	24.25±5.33	13.09±6.70	11.15	0.01
3	Test 3	12.08±5.68	9.10±3.72	2.98	0.15	20.68±4.62	13.42±3.02	7.25	0.01
4	Test 4	11.95±4.17	6.23±5.75	5.73	0.04	20.36±3.42	11.81±5.56	8.55	0.01
5	Test 5	10.79±6.55	7.35±4.10	3.43	0.15	17.65±6.30	10.91±4.14	6.74	0.03
6	Test 6	15.33±3.41	6.91±3.57	8.42	0.01	23.53±3.91	11.12±3.18	12.41	0.01
7	Test 7	19.60±4.11	12.67±2.45	6.93	0.01	28.82±4.39	18.31±3.22	10.50	0.01

EG: Experimental group; CG: Control group.

DISCUSSION

The study aimed to examine how twenty-six chosen exercises could improve the attacking skills by using the bridge of the foot of the female 14-15-year-old shuttlecock athletes. After the training program, the findings indicated that the twenty-six exercises selected could boost the experimental group's attacking skills by using their bridge of the foot. The results collected from the seven tests before and after the treatment showed the development of the experimental group in terms of different techniques supporting the shuttlecock athletes in attacking. Specifically, the attacking skills by using the foot's bridge were evaluated via assisting skills such as spiking the Shuttlecock into the 2-meter limited line, spiking the Shuttlecock

out of the 2-meter line, spiking the Shuttlecock vertically, spiking the Shuttlecock diagonally, catching the Shuttlecock inside the net and then spiking it, spiking the Shuttlecock continuously and slamming the Shuttlecock into one of the four squares. This study has showcased the positive impact on the attacking skills of the participants, who were female shuttlecock professional players between the ages of 14 and 15. The results from this study have revealed significance from other related studies. The current study is a deep emphasis on the development of one of the two attacking skills, i.e., striking the Shuttlecock by using the bridge's foot for the shuttlecock players; meanwhile, the studies of Dang (2010) (14), Hoang (2012) (17), and Nguyen et al. (2022) (22) mainly build on the technical skills for the athletes.

Furthermore, although various studies in the field investigated the impact of different exercises on the attacking techniques, each has distinctive objectives and different groups with varied backgrounds. For instance, Le (2017) (21) selected 30 exercises to develop all clusters of attacking techniques for female shuttlecock athletes who were 15-17 years old; meanwhile, Du (2023) (23) chose 36 exercises to increase the overall ability to attack for male athletes or Nguyen (2022) (8) employed 61 exercises to develop all techniques for male athletes. These three studies manipulated exercises to develop attacking techniques for athletes, such as sweeping the Shuttlecock, kicking the Shuttlecock, striking the Shuttlecock, and supplemented physical exercises to support the athletes in attacking. However, these exercises did not focus on attacking techniques, such as using the foot's bridge, which is a difficult skill in attacking but is effective in a shuttlecock game. Some of the exercises in the current study (Ex1, Ex2, Ex5, Ex6, Ex10, Ex11, Ex13, Ex15, Ex16, Ex17, Ex20, Ex 21, and Ex25 were adapted from the studies of Nguyen (2022) (8), Nguyen (2004) (11), Dang (2009) (13), Dang (2010) (14), Hoang (2012) (17), Department of Physical Education (2010) (20), Le (2017) (21), Nguyen et al. (2022) (22), Du (2023) (23), Department of Mass Sport (2001) (24), Department of Mass Sport (2009) (25), Eduacation Bureau (2010) (26). The researchers of the current study proposed the rest of the exercises. After six weeks of treatment, all of the selected exercises in the training program were effective, as the experimental group's mean values in all tests differed. Still, only the figure of test 7 was more significant than that of the control group (3.66). It can reveal that the proposed exercises in the study (Ex 24 and Ex 26) could be more efficient for the athletes in slamming the Shuttlecock into one of the four squares despite the short training time (6 weeks). After 12 weeks of training, it was clear that all 26 exercises could support the study participants in attacking skills.

CONCLUSION

The study proposed 13 supplementary exercises to train the shuttlecock athletes' attacking skills, which could be applied to other shuttlecock athletes aiming to gain similar purposes.

To provide deeper insights into the results of the current study, further research for more extensive and diverse samples in other contexts could be conducted. More studies with different training regimes and detailed comparative analyses would provide more profound insights into the results of the current study.

Though the study has obtained its research objectives, some limitations should be discussed. The demographics of the participants may affect the results of the study. Specifically, the 14-15-year-old athletes who were not fully grown up may have difficulties performing a few exercises requiring more physical strength and high skills. Another limitation that can influence the study's results is the external conditions, such as the practice place, the weather conditions during the treatment, or the amount of time spent practicing. Our study did not investigate whether physical background influences the effectiveness of an attacking ability or whether the results will be better or worse in real competitions.

Further research could be carried out to examine various factors that may contribute to the efficacy of scoring accomplishment. Another future study can be conducted by simultaneously developing the two attacking techniques with the instep and the foot's bridge. Hence, further research should be done on more exercises to bring more success for the professional players in their competitions.

APPLICABLE REMARKS

- Attacking skills are believed to be crucial in any tournament of the shuttlecock games, and the training program, with a careful supplementing of thirteen exercises, enhanced the technical performance.
- The results of this study may be adequate training for shuttlecock athletes of the same age and gender across Vietnam.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Vinh Quang Nguyen. Acquisition of data: Truong Ngoc Duong. Analysis and interpretation of data: Van Hoa Nguyen. Drafting the manuscript: Tri Huu Nguyen. Critical revision of the manuscript for important intellectual content: Minh Ngoc Nguyen. Statistical analysis: Van Hoa Nguyen. Administrative, technical, and material support: Du Trung Tran. Study supervision: Thanh Viet Pham.

CONFLICT OF INTEREST

The authors declare that no conflicts of interest could be perceived as interfering with the publication of this study.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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ETHICAL CONSIDERATION

The paper was an experimental study on human subjects who were professional players, and all of them signed a consent form before joining the study.

ARTIFICIAL INTELLIGENCE (AI) USING

The authors did not use AI in the paper.

REFERENCES

1. Wang, W. Using Machine Learning Algorithms to Recognize Shuttlecock Movements. Wireless Communications and Mobile Computing. 2021; Article ID 9976306: 1-13. [doi:10.1155/2021/9976306] [PMid:35573891]
2. International Shuttlecock Federation accessed from https://www.shuttlecock-world.org/. September 15; 2023.
3. Vietnam Sports and Fitness Committee. Shuttlecock Law. Hanoi: Sports and Fitness Publishing House; 2017.
4. Chau H, et al. Shuttlecock Curriculum. Hochiminh: Vietnam National University Ho Chi Minh Publishing House; 2016.
5. Nguyen Huu Thai. Shuttlecock textbook. Hanoi: Sports Publishing House; 2004.
6. C. Yang and Z. Lv. Gender-based face ageing with cycle consistent adversarial networks. Image and Vision Computing. 2020; vol. 100: 103945. [doi:10.1016/j.imavis.2020.103945]
7. https://e.vnexpress.net/news/sports/vietnam-win-two-gold-medals-at-foot-shuttlecock-championship-3971851.html.
8. Nguyen Cong Truong. Exercises to improve the effectiveness of left instep kick attacks for Hanoi male shuttlecock athletes. [PhD thesis]. Hanoi: Sports Institution; 2022.
9. Pham T. Research into the factors influencing the achievements in competition of shuttcock players in Dong Thap province. [PhD thesis]. Hochiminh: Ho Chi Minh Sports University; 2018.
10. Duong T, Trinh H, Le D. Teaching and Training Shuttlecock. Ha Noi: Sports Publishing House; 1995.
11. Nguyen T. Shuttlecock Curriculum. Ha Noi: Sports Publishing House; 2004.
12. Dang Q. Shuttlecock Curriculum. Hanoi: University of Education Publishing House; 2007.
13. Dang Q. An investigation into some skills of propelling, passing and teaching methods in Shuttlecock. [PhD thesis]. Hanoi: Sports Institution; 2009.
14. Dang N. Research on suplementary exercises to improve the quality of teaching and training some basic technical skills for young shuttclecock athletes. [Project in Sports]. Hanoi: Sports Institute; 2010.
15. Nguyen Van Vung. Developing contents, assessment criteria to select athletes of male shuttlecocking players of primary school age in School of Talented Sports Players, Dong Thap. [MA thesis]. Zhang Zhou: Zhang Zhou academy of Sports; 2011.

16. Nguyen The Luong. Evaluation the level of physical and technical development of talented shuttlecock athletes aged 12 - 13 in Tan Binh district, Ho Chi Minh City after 6 months of training. [MA thesis]. Shanghai: Shanghai Sports Academy; 2011.
17. Hoang B. Selecting exercises to improve the passing skills for female shuttlecock athletes of Ha Noi team (aged 15-17). [MA thesis]. Hanoi: Ha Noi University of Education; 2012.
18. Nguyen Quang Vinh, Pham Viet Thanh. Develop standards for technical level assessment of male athletes in Dong Thap shuttlecock team. International Scientific Conference; 18/12/2017 Bac Ninh Sports University, P.186-195.
19. Pham Viet Thanh, Nguyen Quang Vinh, Le Nguyet Nga. Developing technical evaluation standards of female shuttlecock athletes in Dong Thap province. Journal of Science and Training, Ho Chi Minh Sports University. 2017; (5): 12-18.
20. Nguyen Xuan Thanh. A study on assessing the training level of female athletes of sepak takraw of Dong Nai young team of 13-15 after 2 years of training. [PhD thesis]. Hanoi: Sports Institution; 2016.
21. Le S. Research into some exercises improving technical skills for female 16-17- year-old shuttlecock athletes in Dong Thap province. [MA thesis]. Hochiminh: Ho Chi Minh University of Physical Education and Sports; 2017.
22. Van Hoa Nguyen, Quang Vinh Nguyen, Xuan Dung Phung, Quang Son Nguyen and Ha Hoang. Effects of a Short-term Training Program on the Technical Performance of Shuttlecock Athletes Aged 10-11. The Open Sports Sciences Journal. 2022; Volume 15: 1-11. [doi:10.2174/1875399X-v15-e2204280]
23. Du Que Loc. Exercises to improve the effectiveness of the left attack technique for male athletes of Ho Chi Minh City shuttlecock team". [MA thesis]. Hochiminh: Ho Chi Minh University of Physical Education and Sports; 2023.
24. Department of Mass Sport. Shuttlecock teaching and training. Hanoi: Sports Publishing House; 2001.
25. Department of Mass Sport. Methods of Shuttlecock Teaching and Training. Ha Noi: Sports Publishing House; 2009.
26. Physical Education Section. Teacher's Handbook for Shuttlecock Activities. Hong Kong: Taoist Association; 2010.