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THE APPLICATION OF FOOTWORK EXERCISES TO IMPROVE PHYSICAL FITNESS FOR FEMALE BADMINTON ATHLETES

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Abstract:
The purpose of this study was to find out the footwork exercises to improve physical fitness for female badminton athletes at Saigon University. 24 female badminton athletes volunteered and were selected who were divided randomly into two groups (12 athletes in the experimental and 12 athletes in the control group). 04 evaluation tests were selected to identify the physical fitness of female badminton athletes, such as the jump rope, back and forth repetitions, left and right across the court, and B endurance (quickly touch 4 points). The 20-footwork exercise was selected and applied to the experimental group, while the control group practiced according to a pre-determined 15-week training program. The results indicated that there were significant differences between before and after the experimental (after the application of the 20-footwork exercise) in all evaluation tests. Therefore, the application of the 20-footwork exercise had better physical development in wrist strength, sideways reaction, front-back reaction, and speed endurance in the experimental group than in the control one. In conclusion, footwork exercises for female athletes in badminton were really effective for improving physical fitness and might be added to annual training for the next training periods.

Keywords: footwork exercises, female badminton athletes, physical fitness, training program

1. Introduction

Badminton requires a comprehensive set of physical factors as well as high technical and psychological requirements, operating according to specific situations with quick movements of speed and power to move quickly around the court and return the shuttle in less than one-second decision (Bin, 2015).

Besides, the duration of the competition (average 20 minutes per "round") along with the high intensity, continuous and rapidity of each specific problem require

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badminton players to have a strong program of extreme strength and specialized endurance (Abian-Vicen et al., 2012). Therefore, the special feature of the badminton competition is that players always have to move continuously at high speed within their yard area by moving, running, or jumping, along with that work. It has been the work of cooperatively connecting the strong and fast-hitting effects to realize their tactical intentions in the competition to achieve high efficiency.

Therefore, badminton players need to coordinate technical movements in combination with high-speed footwork to both enhance the effectiveness of the technique and irritate the opponent in unexpected and passive situations. during the game.

The importance of foot movement was one of the very important techniques that should be learned first. It was necessary to practice to the point of automation (Duc et al., 2015) to understand the rules of walking, the steps will be gentle and smooth (Khanh et al., 2021).

During the training process, the female badminton athletes revealed many limitations in the ability to move their feet, thereby making the return inefficiency, reducing the predictive performance (Alder et al., 2019) causing fatigue (decreased fitness and muscle condition), and leading to an increased risk of injury (Herbaut & Delannoy, 2020). Moreover, it could be said that the ability to move your feet in badminton has a key role in judging difficult phases, moving to a favorable position, or simply making your body always in a ready state. Therefore, in order to achieve high results, coaches need to build a system of footwork exercises to assess the ability to move faster, not only contributing to improving competition performance in the competition but also gradually improving the effectiveness of physical fitness for badminton athletes.

2. Methodology

2.1 Participants

24 volunteer female athletes in the badminton club model at Sai Gon University were chosen (such as in good condition, not using any drugs or any injuries treatment, no smoking, etc.).

They were randomized and divided into 2 groups: 12 athletes in the control group (training program as usual without the 20-footwork exercise) and 12 athletes in the Experimental group (with the 20-footwork exercise).

All of the participants attended the 15-week training program, which had two training sessions per week (from 15.30 to 17.00 on Tuesday and Thursday each week). They were informed of the test procedures before providing written consent. The appropriate Review Boards (Saigon University Board and Faculty Board) approved this study for the use of human beings (female students). All participants were recommended to continue their daily dietary and physical activity training throughout the study.

2.2 Procedures

Two weeks before the training program began, participants reported to the head coach for their participation. They were under health examination (resting heart rate, blood pressure, physical checking with no injuries or painful…) and accepted all the testing throughout being trained. This study took 2 times for testing: (1) before training (pre-test) and (2) after 15-week training (post-test) from the first week of September to December 2022. For each participant, all tests were performed two times with the same conditions and methods. Besides, participants were familiar with the mentioned procedures as part of their regular training process. A pre-determined 15-week training program as shown in Table 1 was used in yearly training at Saigon University (Son, et al. 2023).

Table 1: A pre-determined 15-week training program in badminton at Saigon University

<table>
<tr><td colspan="2">Months</td><td colspan="4">September</td><td colspan="4">October</td><td colspan="4">November</td><td colspan="4">December</td></tr>
<tr><td colspan="2">Weeks</td><td>Pre-</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>Post-</td></tr>
<tr><td rowspan="4">Physical fitness</td><td>Strength</td><td rowspan="4">Test</td><td colspan="4">General</td><td colspan="8">Specialization</td><td rowspan="4">Test</td></tr>
<tr><td>Endurance</td><td colspan="4" rowspan="3">General fitness</td><td colspan="8">Anaerobic endurance</td></tr>
<tr><td>Speed</td><td colspan="4">General</td><td colspan="4">Speed endurance</td></tr>
<tr><td>Mix-trained</td><td colspan="2">Basic</td><td colspan="6">Mix-training</td></tr>
<tr><td rowspan="4">Others training</td><td>Skills</td><td rowspan="4">Test</td><td colspan="4">Basic</td><td colspan="3">Advance</td><td colspan="4">Specialization</td><td rowspan="4">Test</td></tr>
<tr><td>Tactics</td><td colspan="6">Singles</td><td colspan="6">Doubles</td></tr>
<tr><td>Mentality</td><td colspan="12">Singles</td></tr>
<tr><td>Laws</td><td colspan="12">Combined with tactical and physical training</td></tr>
</table>

2.2.1 Physical fitness tests

Based on the literature, former studies Bo.Omosegaard (1990), Brahms (2014), D.P Gunalan (2001), Vinh et al. (2004), Sang (1994), Le & Khanh (1997), Son (2006), Khoi (2012). Bo.Omosegaard (1990), etc., and nature in badminton, we selected 4 tests to identify the step badminton footwork for female athlete badminton, which suited for female athlete badminton, facilities available, and training level of participants (Son et al., 2023) at Saigon University. They were jumping rope in 30 seconds (wrist strength), 5 repetitives back and forth (sideways reaction), 5 repetitives left and right across the court (front-back reaction), and B endurance (speed endurance).

2.2.2 The 20-footwork-exercise

Based on Frederick et al. (2014), Golds (2016), Khoi (2012), Son (2006), and many former studies about the footwork in badminton (Bin, 2015; Farrow et al., 2005, Brahms (2014), etc.), the 20-footwork-exercise to improve the physical fitness for female athlete at Saigon University were selected.

These exercises were applied to the experimental group as follows:

1) Single jumping rope in 30 seconds performed 5 times x 3 groups, resting for 1 minute;

2) Move across the single court swinging the racket to simulate a fast right and left shuttlecock in 1 minute performed 2 times x 4 groups, resting for 2 minute;
3) Smash go to net kill forehand corners in 1 minute performed 2 times x 4 groups, resting for 2 minute;
4) Move the 4 corners of the court 10 times performed 2 times x 4 groups, resting for 3 minute;
5) Move 4 corners to hit a fixed point 1 minute perform 2 times x 4 groups resting for 2 minute;
6) Calf Raises in 30 seconds perform 5 times x 3 groups resting for 30 seconds;
7) Running thigh raise 30 seconds performed 5 times x 3 groups, resting for 1 minute;
8) Thigh contraction 30 seconds performed 5 times x 3 groups, resting for 1 minute;
9) Turn on 4 directions 30 seconds performed 3 times x 4 groups, resting for 2 minute;
10) Jump on 5m stairs performed 2 times x 4 groups, resting for 1 minute;
11) Jumping with one foot 10 steps performed 4 times x 4 groups, resting for 1 minute;
12) Walking Lunge step 20 meters performed 3 times x 3 groups, resting for 1 minute;
13) Shuttle Run 4x10m performed 3 times x 4 groups, resting for 2 minute;
14) Squat Jumps in 30 seconds performed 5 times x 3 groups, resting for 1 minute;
15) Left Reverse Lunge to Hop 30 seconds performed 2 times x 3 groups, resting for 1 minute;
16) Right Reverse Lunge to Hop 30 seconds performed 2 times x 3 groups, resting for 1 minute;
17) Hopscotch 20m performed 3 times x 3 groups, resting for 1 minute;
18) Change direction according to command 1 minute performed 2 times x 4 groups, resting for 3 minute;
19) Lift squats with a weight of 10-15% of body weight (backs and palms) performed 10 times x 4 groups of rest for 1 minute;
20) Resistance band leg exercises while sitting 30 seconds performed 5 times x 4 groups, resting for 1 minute. The schedule to perform the 20-exercise is described in Table 2.

2.3. Statistical analysis

All data were expressed as mean and standard deviation values (mean±SD). Statistical analysis was performed by using the SPSS version 20 for Windows. An Independent t-test was used to identify the differences between the experimental and control groups. A paired sample t-test was used the show the differences between pre- and post-test in each group. The Growth rate (G%) calculation was used to evaluate the improvement after the experimental process (Brody, 1927). The level of statistical significance was set at $p<.05$.

3. Results and Discussions

No participants dropped out of the study. The average age, height, and weight in the Experimental group were 20.42±0.45 years, 158.67±5.14 cm, and 47.91±7.86 kg,

respectively, while the average age, height, and weight of the control group were 20±0.60 years, 160±7.75 cm, and 51.08±8.94 kg, respectively (showed in Table 3).

Table 2: Schedule implementation of the selected 20-footwork-exercise.

Exercise	Test	September				October				November				December			Test
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Test	x	x	x	x		x	x	x	x	x	x		x		x	Test
2		x		x		x		x		x	x	x		x		x	
3		x		x		x		x		x	x	x		x		x	
4			x		x		x		x		x		x		x		
5		x				x				x			x		x	x	
6		x		x		x		x		x		x			x	x	
7			x		x		x		x		x		x		x		
8				x		x		x		x		x		x			
9			x		x		x		x		x		x		x		
10			x		x		x		x		x		x		x		
11		x		x		x		x		x		x		x		x	
12		x		x		x		x		x		x	x	x		x	
13			x		x		x		x		x		x		x		
14		x			x		x	x			x			x		x	
15			x	x		x		x		x		x		x			
16			x	x		x		x		x		x		x			
17			x		x	x			x			x			x		
18			x		x		x		x		x		x		x		
19		x			x		x		x				x		x	x	
20		x		x		x	x	x	x	x		x	x	x		x	

Note: (1) Single jumping rope in 30 seconds performed 5 times x 3 groups, resting for 1 minute; (2) Move across the single court swinging the racket to simulate a fast right and left shuttlecock in 1 minute performed 2 times x 4 groups, resting for 2 minute; (3) Smash go to net kill forehand corners in 1 minute performed 2 times x 4 groups, resting for 2 minute; (4) Move the 4 corners of the court 10 times performed 2 times x 4 groups, resting for 3 minute; (5) Move 4 corners to hit a fixed point 1 minute perform 2 times x 4 groups resting for 2 minute; (6) Calf Raises in 30 seconds perform 5 times x 3 groups resting for 30 seconds; (7) Running thigh raise 30 seconds performed 5 times x 3 groups, resting for 1 minute; (8) Thigh contraction 30 seconds performed 5 times x 3 groups, resting for 1 minute; (9) Turn on 4 directions 30 seconds performed 3 times x 4 groups, resting for 2 minute; (10) Jump on 5m stairs performed 2 times x 4 groups, resting for 1 minute; (11) Jumping with one foot 10 steps performed 4 times x 4 groups, resting for 1 minute; (12) Walking Lunge step 20 meters performed 3 times x 3 groups, resting for 1 minute; (13) Shuttle Run 4x10m performed 3 times x 4 groups, resting for 2 minute; (14) Squat Jumps in 30 seconds performed 5 times x 3 groups, resting for 1 minute; (15) Left Reverse Lunge to Hop 30 seconds performed 2 times x 3 groups, resting for 1 minute; (16) Right Reverse Lunge to Hop 30 seconds performed 2 times x 3 groups, resting for 1 minute; (17) Hopscotch 20m performed 3 times x 3 groups, resting for 1 minute; (18) Change direction according to command 1 minute performed 2 times x 4 groups, resting for 3 minute; (19) Lift squats with a weight of 10-15% of body weight (backs and palms) performed 10 times x 4 groups of rest for 1 minute; (20) Resistance band leg exercises while sitting 30 seconds performed 5 times x 4 groups, resting for 1 minute.

Results from Table 4 indicated that the experimental group had statistically significant differences in 4 tests, such as B endurance test, 5 repetitives left and right across the court test, 5 repetitives back and forth test, and the jumping rope in 30 seconds test, at the significance level $p<0.05$. Meanwhile, the control group did not have a statistically significant difference in all 4 tests ($p>0.05$). These results showed that the experimental group had better physical development (wrist strength, sideways reaction, front-back reaction, and speed endurance) than the control group. Moreover, the study compared the growth rate of footwork movement before and after the application of the 20-footwork exercise in female athletes of the badminton team at Saigon University (in Figure 1).

Table 3: Characteristics of participants in this study (n=24)

Contents	Groups	
	Control (n=12)	Experimental (n=12)
Age (years)	20±0.6	20.42±0.45
Height (cm)	160±7.75	158.67±5.14
Weight (kg)	51.08±8.94	47.91±7.86

Besides, the differences between before and after the application of the 20-footwork-exercise for female athletes in two groups are shown in Table 4.

Table 4: Differences between before and after the application of the 20-footwork-exercise for female badminton athletes after 15 weeks

Groups	Test	Times	Levene	Sig.	x ±SD	t	df	p	G%
Control	1	Pre-test	0.142	0.710	58.06±6.63	0.384	22	.705	0.89
		Post-test			58.58±4.37				
	2	Pre-test	0.598	0.448	22.15±1.48	0.675	22	.507	5.66
		Post-test			20.93±1.50				
	3	Pre-test	0.261	0.615	19.40±0.67	1.726	22	.098	5.78
		Post-test			18.31±0.67				
	4	Pre-test	0.148	0.704	60.92±4.36	-0.05	22	.961	1.63
		Post-test			61.92±4.06				
Experimental	1	Pre-test	0.033	0.857	57.08±5.73	2.217	22	.037	4.17
		Post-test			54.75±4.09				
	2	Pre-test	1.2	0.285	21.77±1.32	2.777	22	.011	11.67
		Post-test			19.37±1.24				
	3	Pre-test	0.625	0.438	18.96±0.57	3.534	22	.002	8.47
		Post-test			17.42±0.55				
	4	Pre-test	0.580	0.454	61±3.79	-2.334	22	.029	6.73
		Post-test			65.25±2.83				

Notes 1: B endurance test (s), 2: 5 repetitives left and right across the court test (s), 3: 5 repetitives back and forth test (s), 4: The jumping rope in 30 seconds test (times), G%: Growth rate.

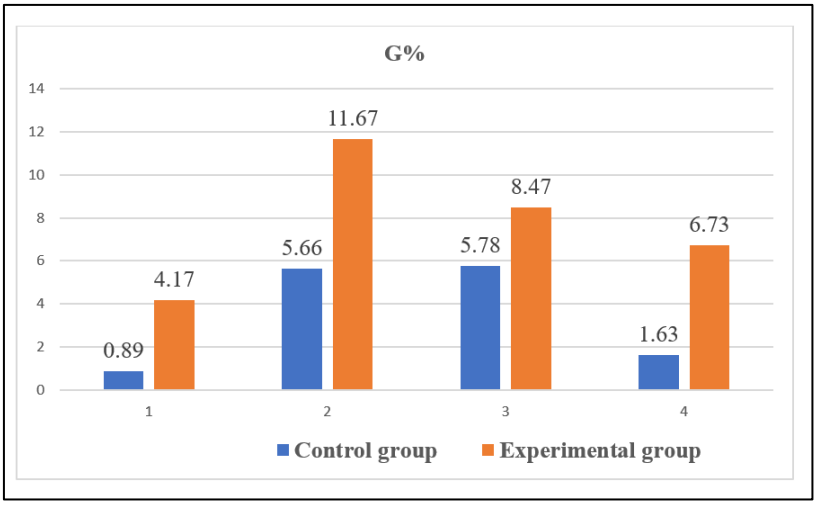
The results in Figure 1 showed that the growth rate was highest in test 5 repetitives left and right across the court test (s) (ranging from 5.66-11.67%). Meanwhile, the lowest

growth rate was shown in the test B endurance test (s) (ranging from 0.89-4.17%). The highest growth rate in the experimental group (the group that used the 20-footwork exercise to improve the efficiency of badminton footwork) was higher than the control group (without footwork exercise).

Research by Valldecabres et al. (2020) showed that movement speed in badminton might accelerate faster and more frequently in the second game onwards. They also showed that no footwork movement was a common situation in competition, however, players often used two types of footwork movements such as (1) long backward and (2) short diagonally forward to the left or right. This needs to be paid more attention during training to help improve the performance of young and less experienced athletes in matches that last longer than usual. The high frequency and intensity of play throughout the competition, together with the high maximum average heart rate indicated that badminton was a sport with a high rate of movement, and high individual anaerobic power to allow athletes to sustain this type of effort for a total of approximately 30 minutes. Therefore, coaches should base training on a large number of competitive actions of high intensity but short duration (Manrique & Gonzalez-Badillo, 2003). Besides, it was necessary to train the speed endurance and activities performed for short periods of time (15–20 seconds) and/or for very short periods of time (6–10 seconds). As a result of this research, we also focused on a number of exercises related to these two types of foot movements, which could be the reason for improving

Sideways & front-back reaction, as well as the speed endurance in female badminton athletes at Saigon University.

Figure 1: Growth rate of physical fitness after the application of the footwork exercises on female badminton athletes



Notes: B endurance test (s), 2: 5 repetitives left and right across the court test (s), 3: 5 repetitives back and forth test (s), 4: The jumping rope in 30 seconds test (times), Figures are described as a percentage (%).

According to research by Duncan et al. (2023) showed that when applying a program to change footwork movement, it needs at least 10 weeks or more of training to give optimal results. In this study, although there was no evaluation of different

application times on the impact on the exerciser's fitness, this was one of the limitations, as well as only focusing on the female group (due to the fact that the number of male athletes in the badminton club at Saigon University was quite low) and the application in one university; However, the application period in the study was 15 weeks of training, which shows why the results in this study achieved good results in terms of growth in physical fitness. Results from the study by Kuo et al. (2022) have shown that there was a need for quick reaction exercises that affect foot movements for badminton players (need to be accurately measured and quantified) to improve agility and competition performance. This study also provided exercises on quick reaction in footwork movement and the results were very positive. Therefore, after the 15-week training, the application of the 20-footwork exercise might improve the physical fitness of female athletes of the badminton team at Saigon University with very good growth, as well as contribute to improving the movement of the athletes. The growth of footwork movement was consistent with the plan and amount of movement applied during the 15 weeks of training.

4. Conclusion

In short, the 20-footwork exercise selected for female badminton athletes indeed had a high potential to improve physical fitness, which might be added to the training program for the next training periods as the annual training of the badminton club model. Further studies should evaluate the 20-footwork-exercise in applied to pre-match periods, male athletes, or other universities to be able to have a multidimensional analysis of the results achieved.

Author Contributions

Nguyen Do Minh Son (corresponding author) drafted, wrote down, and revised the manuscript. I have approved the latest paper of this manuscript and agreed with the order of the presentation.

Competing Interest Statement

I have no competing interests.

About the Author

Nguyen Do Minh Son works as an energetic and determined specialist in badminton coaching and Physical Education at Saigon University, Vietnam.

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