



## BUILDING UP THE 12-WORK-OUTS TO IMPROVE THE MUSCULAR ENDURANCE FOR MALE BADMINTON TEAM

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### Abstract:

The purpose of this study was to find out the work-outs to improve the muscular endurance of the male badminton team at Saigon University. Eleven healthy male students in the badminton team at Saigon University were chosen to participate in the 15-week pre-season training program. Four evaluation tests were selected to identify the muscular endurance for male badminton, such as the handgrip strength test, standing high jump test, loaded heavy racket in 30 seconds test, and B endurance test. Twelve work-outs were chosen and applied to the training program. The results indicated that there were significant differences between before and after the experiment (after the application of 12 work-outs) in all evaluation tests. In short, 12 work-outs were highly effective to improve muscular endurance for the male badminton team at Saigon University. Future studies should be applied 12 work-outs in the next pre-season badminton training as well as for female badminton athletes at Saigon University.

**Keywords:** muscular strength, male badminton athletes, 12 work-outs, 15-week pre-season training program

### 1. Introduction

Badminton is a competitive sport whose achievements are reflected in the individual ability of each athlete to use their own technique, tactics, physical strength and psychological stability (Abian-Vicen, et al., 2012). Competing badminton not only requires athletes to be technically proficient, and creatively in terms of tactics, but also to fully promote the physical qualities that require high physical strength, flexibility to deal

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with each specific situation in competition and muscular endurance to smash, save, and return the shuttle (Bin, 2015). Badminton demands on-court agility that includes both physical and perceptual quickness and predicts the shot from the opponent (Abernethy et al., 2012). The feature of badminton competition is that athletes always have to move continuously at high speed within their court area by moving, running or jumping, along with a combination of hitting movements.

Muscular endurance refers to how long muscles can sustain exercise. Therefore, the muscular endurance ability in badminton is often expressed in any training program to help athletes win the Game. Greater muscular endurance allows a person to complete more repetitions of an exercise, for example, run from the preparation position to the hitting positions, jump for smash, return the shuttle with high precision, etc. The movement of hitting the shuttlecock requires maximum force with many repetitions and must be able to maintain throughout the time of the competition (Pathmanathan et al., 2015). Therefore, the construction of the muscular endurance work-outs for badminton athletes is very necessary for the practitioner to assess the development of professional fitness as well as to select a team for competition.

## **2. Materials and Methods**

### **2.1 Participants**

11 volunteer healthy male athletes in the badminton team at Saigon University were chosen (such as in good condition, no using any drugs or any injuries treatment, no smoking, etc.). All of the subjects attended the 15-week pre-season training program, which had two training sessions per week (from 15h30 to 17h00 on Tuesday and Thursday each week). They were informed of the test procedures before providing written consent.

### **2.2 Procedures**

Two weeks before the training program began, participants reported to the head coach for their participation. They checked for health problems, and existing injuries, and explained the order of research as well as explaining the evaluation tests performed in the study. The next week, all participants were tested on the status of their muscular endurance through the 04 evaluation tests, such as the handgrip strength test, standing high jump test, loaded heavy racket in 30 seconds test, and B endurance test. After 15 weeks, participants of the study were re-examined four tests for the first time. Therefore, this study took two times for testing: (1) before training (pre-test) and (2) after 15-week training (post-test) from the first week of January to April (shown in Table 1). The study period was for the academic year 2020-2021, the duration of each lesson was 100 minutes (Son, et al. 2018).

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

Months		January			February				March				April					
Weeks		Pre	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Post
<b>Physical fitness</b>	Strength	Pre-test	General				Specialization											Post-test
	Endurance		Anaerobic endurance															
	Speed		General fitness	General				Speed endurance										
	Mix			Basic		Mix-training												
<b>Others training</b>	Skills		Basic			Advance				Specialization								
	Tactics		Singles				Doubles											
	Mentality		Singles															
	Laws		Combined with tactical and physical training															

### 2.3 Muscular endurance tests

Based on the literature, former studies (Khoi, 2012; Golds, 2016; Kim, 2017; Dong et al., 2018; etc.) and nature in badminton, we selected four tests to evaluate the agility in badminton, which suited for male students, facilities available and training level of participants (Son et al., 2018) at Saigon University. They were handgrip strength test (kg), standing high jump test (cm), loaded heavy racket in 30 seconds test (times), and B endurance test (s). B endurance test is also called a badminton-specific endurance test (Madsen et al., 2016). It was a repeated sequence of badminton-specific actions toward the 4 corners of the court.

### 2.4 Statistical analysis

All data are expressed as mean and standard deviation values (mean±SD). Statistical analysis was performed using SPSS version 20 for Windows. The parried sample t-test used showed the difference between before and after the test in each group. The growth algorithm (G%) was used to evaluate the improvement after testing (Brody, 1927). The level of statistical significance was set at p<.05.

## 3. Results and Discussions

### 3.1 Participants characteristics

No participants dropped out through the study. The average age, height and weight of the male group were 20.81±0.33 years, 172.63±1.09 cm and 60.09±2.34 kg, respectively, which was shown in Table 2.

**Table 2:** Characteristics of participants

Age (years)	Height (cm)	Weight (kg)
20.81±0.33	172.63±1.09	60.09±2.34

### 3.2 The selection of the work-outs to improve muscular endurance for the male badminton team at Saigon University

Based on the literature and many former studies such as Vinh & Thanh (1998), Thanh (2002), Thuy (2001), Le & Khanh (1997), Son (2006), Khoi (2012), Gunalan (2001), etc. Based on the characteristics of participants, features of badminton, the requirements of the pre-season training program, and the assessment of muscular endurance in badminton for male athletes, the authors gave 20 work-outs to improve the muscular endurance for the male badminton team at Saigon University (more details in Table 3)

**Table 3:** Results of expert interviews (n=20)

No.	Work-outs	Evaluation		
		Agree	Not sure	Disagree
1	Loaded heavy badminton racket in 30s	18 (90%)	2 (10%)	0 (0%)
2	Throw the ball away	19 (95%)	1 (5%)	0 (0%)
3	Move across the court swinging the racket in 30s	14 (70%)	3 (15%)	3 (15%)
4	Back and forth hitting the shuttlecock and block in 30s	17 (85%)	3 (15%)	0 (0%)
5	5x move the 4 corners of court	19 (95%)	1 (5%)	0 (0%)
6	Jumping with one foot 10 steps	19 (95%)	1 (5%)	0 (0%)
7	Jump and smash the bridge 40 times	18 (90%)	2 (10%)	0 (0%)
8	Frog jump 20m	14 (70%)	3 (15%)	3 (15%)
9	Turn on the podium in place in 1 minute	17 (85%)	1 (5%)	2 (10%)
10	Hopscotch 20m	11 (55%)	3 (15%)	6 (30%)
11	Lift weights straight to the sides (70-80% RM)	7 (35%)	12 (60%)	1 (5%)
12	Lift squats	19 (95%)	1 (5%)	0 (0%)
13	Push-ups 30s	18 (90%)	2 (10%)	0 (0%)
14	Pull the rubber band straight out	11 (55%)	7 (35%)	2 (10%)
15	Jump on 5m stairs	14 (85%)	3 (15%)	3 (15%)
16	5 x high jump with the spot	17 (85%)	1 (5%)	2 (10%)
17	Throw a 3 kg solid ball with both hands	12 (60%)	5 (25%)	3 (15%)
18	Alternately right and left, crossing your head 10 times	8 (40%)	10 (50%)	2 (10%)
19	Move the tire to the square in 1 minute	18 (90%)	2 (10%)	0 (0%)
20	Move 4 corners to hit a fixed point in 1 minute	19 (95%)	1 (5%)	0 (0%)

From the results of Table 3, the authors selected the work-outs with more than 80% in expert interview results. Therefore, 12 work-outs to improve muscular endurance for the male badminton team were applied to the 15-week pre-season training at Saigon University. The structure of the 12-work-outs were (1) Loaded heavy badminton racket in 30 seconds (times) performed 5 times x 4 groups, resting for 30 seconds; (2) Throw the ball away (meters) 10 balls/time x 4 nests, rest 30 seconds; (3) Move back and forth swinging the racket to simulate 30 seconds of hitting the shuttlecock to block the net (times), performed 3 times x 4 nests, resting for 1 minute; (4). Move the 4 corners of the court 5 times (seconds) perform 2 times x 4 groups rest for 2 minutes; (5). Jumping with one foot 10 steps (m) done 5 times x 4 groups rest for 1 minute; (6). Jump and smash 40 times (seconds) 3 times x 4 groups, rest for 1 minute; (7). Turn on the podium in place for 1 minute (times), perform 2 times x 4 groups, rest for 2 minutes; (8). 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; (9). Push-ups according to the count of 30 seconds, perform 3 times x 4 groups, rest for 1 minute; (10). Jump high with the spot done 5 times x 4 nests resting between 10 seconds; (11) Move the bridge tire to the square for 1 minute (times), perform 3 times x 2 groups, rest for 2 minutes; (12). Move 4 corners to hit a fixed point 1 minute, perform 3 times x 2 groups, rest for 2 minutes. The schedule to perform the 12-work-outs is described in Table 4.

**Table 4:** Schedule implementation of the selected 12-work-outs for male badminton team at Saigon University

Work-outs	January				February				March				April			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1		x			x		x				x		x		x	
2		x		x		x	x	x		x		x		x		
3		x		x		x		x		x		x		x		
4			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			
8					x					x						x
9			x				x	x				x		x		
10		x		x		x			x		x		x		x	
11			x				x	x			x		x		x	
12				x		x			x			x		x		

**Notes:** (1). Loaded heavy badminton racket in 30 seconds (times) performed 5 times x 4 groups, resting for 30 seconds; (2). Throw the ball away (meters) 10 balls/time x 4 nests, rest 30 seconds; (3) Move back and forth swinging the racket to simulate 30 seconds of hitting the shuttlecock to block the net (times), performed 3 times x 4 nests, resting for 1 minute; (4). Move the 4 corners of the court 5 times (seconds) perform 2 times x 4 groups rest for 2 minutes; (5). Jumping with one foot 10 steps (m) done 5 times x 4 groups rest for 1 minute; (6). Jump and smash 40 times (seconds) 3 times x 4 groups, rest for 1 minute; (7). Turn on the podium in place for 1 minute (times), perform 2 times x 4 groups, rest for 2 minutes; (8). 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; (9). Push-ups according to the count of 30 seconds, perform 3 times x 4 groups, rest for 1 minute; (10). Jump high with the spot done 5 times x 4 nests resting between 10 seconds; (11) Move the bridge tire to the square for 1 minute (times), perform 3 times x 2 groups, rest for 2 minutes; (12). Move 4 corners to hit a fixed point 1 minute, perform 3 times x 2 groups, rest for 2 minutes.

### 3.3 Evaluating the effectiveness after applying the 12-work-outs for the male badminton team at Saigon University

Results before and after the after applied the 12-work-outs for the male badminton team at Saigon University are presented in Table 5.

**Table 5:** Differences between before and after the applied the 12-work-outs for male badminton team

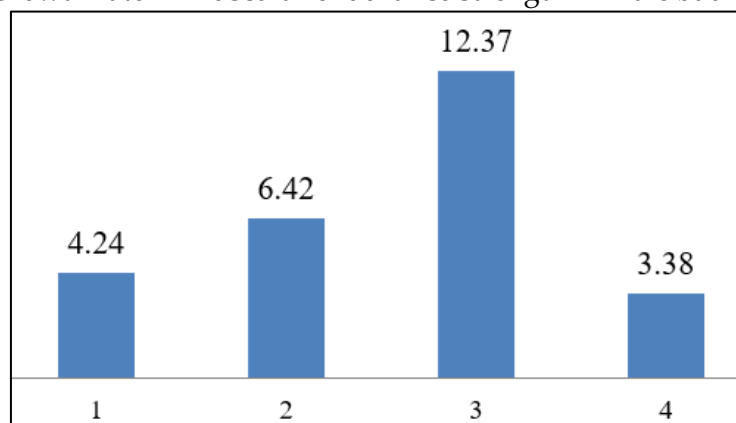
Test	Pre-test	Post-test	t	df	p	G%
1	41.75±1.38	43.56±1.27	-10.000	11	.000	4.24
2	41±0.57	43.72±0.57	-6.367	11	.001	6.42
3	28.27±0.91	32±0.61	-5.311	11	.002	12.37
4	44.14±0.86	42.67±0.69	5.615	11	.000	3.38

**Notes:** 1: handgrip strength test (kg), 2: standing high jump test (cm), 3: loaded heavy racket in 30s test (times), 4: B endurance test (s), G%: Growth rate.

Results from Table 5 indicated that there were significant differences in all 04 evaluation muscular endurance tests after the applied the 12-work-outs for the male badminton team at Saigon University. It means that 12-work-outs were suitable for applied in the pre-season badminton training program to improve muscular endurance for male athletes. Szafraniec et al. (2020) indicated that short-term core stability training might enhance balance and trunk muscle endurance in weightlifters. In our study, the 12-work-outs were a combination of exercises to improve muscular endurance, which optimized during 15-week preseason training had the advantage results for male badminton athletes. Thus, it should be used annual in badminton training to perfect the ability in muscular endurance, which might enhance performance and achievement in competition.

In addition, the growth rate index (Figure 1) showed that the loaded heavy racket in 30s test had the highest growth (12.37%), while the B endurance test had the lowest one (3.38%). The reason for the differences in growth rate may come from the specific exercises in the training program, which focused on the technique such as forehand and smash techniques combined with jumping and hitting the ball overhead. However, results also indicated that the B endurance test still has not had good growth as expected. This can be explained by the fact that the 12-work-outs were new, causing confusion in practice as well as the lack of a combination of exercises in the training program and the 12-work-outs.

**Figure 1:** Growth rate in muscular endurance strength in male badminton team



**Notes:** 1: 1: handgrip strength test (kg), 2: standing high jump test (cm), 3: loaded heavy racket in 30s test (times), 4: B endurance test (s). Figures are described as a percentage (%)

#### 4. Conclusion

In short, the study identified 12 work-outs to improve muscular endurance for the male badminton team at Saigon University. Besides, the application of the 12 work-outs in the 15-week pre-season badminton training program improved the muscular endurance of the male badminton team. Future studies should be applied to the 12 work-outs for the next training period and for female badminton athletes at Saigon University.

#### Authors' contributions

Tran Minh Tuan (main author) drafted, wrote down, and revised the manuscript while Nguyen Do Minh Son and Le Thi My Hanh took control of revising and editing the manuscript after all. All authors have approved the latest paper of this manuscript. We agreed on the order of the presentation.

#### Conflict of interest statement

The authors declare no conflicts of interest.

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