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Effects of 15 weeks of Jianzi training on the physical fitness and physiological functions of university female students

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ABSTRACT

The current study investigated how the traditional sport of Jianzi (also called shuttlecock) affects physical fitness and body functions. The experimental group (EG) conducted a 15-week experiment with the Shuttlecock Model Club (SMC), while the control group (CG) participated in the physical education (PE) program at An Giang University (AGU) as usual. Both groups comprised 60 normal healthy female students. To evaluate fitness, this study included five tests: the 30-second sit-up test, the 30-meter sprint test, the shuttle run test (4 x 10 meters), the long jump test, and the 5-minute running test to measure maximal aerobic rate (MAS). We used 10 tests to evaluate physiological functions of the body such as BMI; Body fat %; Chest skinfold (mm); Waist skinfold (mm); Thigh skinfold (mm); Diastolic pressure; Flexion angle of the hip joint; Resting heart rate; Systolic pressure; VO2max. Except for explosiveness and core strength of the legs, this study demonstrated that EG improved more than CG in speed, agility, and maximal aerobic speed after completing 15 weeks. The EG group exhibited the most significant improvement in fitness tests, with MAS increasing by 23.60% and speed by 1.03%. The control group improved at a low level with an increased rate of 0.99% in speed and 6.87% in MAS. For functional body tests, the EG group also showed significant improvement compared to the CG. The highest improvement (18.39%) was in the variable waist skinfold (mm) in the EG.

KEYWORDS

Shuttlecock; Physical Fitness; College Students

1. INTRODUCTION

The game of shuttlecock, often called kicking shuttlecock, is well-known and has a lengthy history. Regular shuttlecock practice may improve a player (Zeng, 2022). The sport of shuttlecock, which originated in China, has a remarkable and significant place in traditional Vietnamese gymnasiums. People now like to play shuttlecock. After being liberated, Shuttlecock was formally renamed from its previous moniker of "Net Shuttlecock," which it had been known by since its Chinese origins in Guangzhou. It has been developed for many years in China. The shuttlecock tournament was staged for the first time in December 1928 in Shanghai during the "China Domestic Products Exhibition," which aided in the project's advancement (Zeng, 2022).

Humans can organically adapt to and adjust their daily routines, study, work, and production habits. Chronic bone and joint conditions including sciatica, lumbar disc herniation, shoulder and neck disorders, and cervical spondylosis can all be helped with the shuttlecock. It benefits the training of the human body in all facets. The technical difficulty of badminton ranges from straightforward to challenging. It not only integrates the physical and psychological aspects of growth and development issues with the regularity of human motor abilities, but it also supports adolescent growth and development and enhances their entire physical well-being.

During the training process, Shuttlecock will be able to regulate the degree and intensity of training, which will assist participants to train their aerobic endurance and enhance their metabolism and blood flow to the heart. Participants engage in frequent shuttlecock training, which enhances physical coordination and flexibility by exercising each body's flexibility and developing a feeling of three-dimensional space and time. Additionally, there are different shuttlecock kicks. You may compare the frequency, duration between kicks, and pattern of kicks. Therefore, the shuttlecock has emerged as the top choice for exercise among individuals of all ages due to its ease.

Playing shuttlecock can boost an aged person's antioxidant capacity (Li, 2006). The study by Cui et al. (2004) revealed that older women with poor cardio-pulmonary function might benefit from five-animal workouts. As a type of traditional folk sport, in Vietnam, playing shuttlecocks is a popular sport and is taught as part of physical education in schools. The shuttlecock-playing technology, Tang (2010) noted, had its philosophical roots in the "body of knowledge" philosophy of the ancients, the balance of yin and yang, and the harmony between man and nature, yet there aren't many domestic studies on this topic that support cultural growth.

The current study investigates how the traditional sport of shuttlecock affects physical fitness and bodily functions, and it offers a more objective evaluation of the training benefits of the

shuttlecock. It serves as the foundation for assisting everyone, but particularly female students, in selecting the best type of education.

2. METHODS

2.1. Participants

This study was conducted on 60 female students divided into two groups (30 CG and 30 EG) from AGU (mean age, 19.6±2.2 years; mean height, 163.3±5.1cm; average body weight, 49.2±4.2kg) in the EG group, 30 students were participating in the shuttlecock training program studied and tested. The participating students did not smoke, drink alcohol, or use prescription drugs and none of them got sick.

Each student undertakes a 15-week course (equivalent to one semester). 30 students from the control group participated in the PE program's Normal shuttlecock at Agu. The experimental group was randomly selected 30 students, selected to participate in a brand new shuttlecock program modeled after the club. Before giving written consent, they were informed of the test's protocols. The Agu-VNU-HCM Board of Directors approved the use of people in this study (students). All participants were advised to maintain a regular diet and exercise regimen throughout the trial.

2.2. Procedures and Measurements

Each participant answered a quick baseline questionnaire about their personal information and previous sports injuries two weeks before practice (in case of any problems, contestants will be disqualified). Before starting the fitness program, a week later, all participants were assessed for fitness (first test).

In this study, 5 physical fitness tests were performed: the standing long jump test to assess leg strength, the sit-up test to assess core strength, and the water running test. 30-meter sprint to assess speed, a 4 x 10-meter shuttle test to assess agility, and a 5-minute field run test to assess maximum aerobic speed (MAS) (Dao, 2021). According to the Ministry of Education and Training (2008) Vietnam, and 10 functional tests of the body (BMI; Body fat %; Chest skinfold (mm); Waist skinfold (mm); Thigh skinfold (mm); Diastolic pressure; Flexion angle of the hip joint; Resting heart rate; Systolic pressure; VO2max). According to Zhang & Luo (2015), these tests are suitable for assessing the fitness of amateur athletes like our Agu-VNU-HCM students and are suitable for assessing the fitness of those participating in the annual PE course as part of the PE program at Agu-VNU-HCM (Thuc, 2019; Dao, 2021).

Both groups then participated in a 15-week training program under identical conditions in terms of hours of study, facility use, weather, and surroundings. Every Monday, the training class is held from 7:00 a.m. to 8:30 a.m. (once a week, same as in the PE program). The second fitness test was performed on the two groups after 15 weeks (same as the first test). Four elements make up the new 15-week SMC: fitness, skill, tactics, and additional training (described in Table 1). As a result, the volume of training increases continuously. The training methods used by SMC include training exercises that incorporate and focus on technique and fitness. In addition, SMC provides mental preparation for competitions and introduces participants to the regulations. In contrast, the current program (PE course) emphasizes only physical training and two methods for determining a student's final grade.

Body composition: A Body Composition Analyzer was used to measure body density and body fat percentage (Korean in body 3.0); Skinfold: Using a skinfold tester, the skinfold of the chest, waist, and thighs was assessed; Heart rate: The heart rate at rest was recorded. On the day of the shuttlecock game, the Japan Casio HEM605 was used to measure the individuals' 60-second resting heart rates while they were lying down; Blood pressure: A Japan Casio HEM605 sphygmomanometer was used to monitor resting blood pressure after 15 minutes of calm sitting; Exercise oxygen consumption: Participants used a Sweden cycle ergometer to perform an aerobic fitness test. The exercise load started at 80W and increased by 25W every two minutes.

Table 1. 15-week training plan playing shuttlecock

Weeks	H	T	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	T
1. Fitness training																		
Agility							v	v	v	v	v							
Cooperation										v	v	v	v	v	v	v	v	
Endurance			v	v	v	v	v	v										
Flexibility						v	v	v	v									
Mixed training										v	v	v	v	v	v			
Reaction time									v	v	v							
Speed			v	v	v	v	v											
Strength					v	v	v											
2. Skill																		
Dribble-pass control			v	v	v	v	v	v	v									
Jump-shot															v	v	v	
Lay-up and block												v	v	v	v	v		
Mixed training															v	v	v	

Personalization				v	v	v	v	v	v	v	v							
3. Tactic																		
Defensive									v	v	v	v						
Individuals						v	v	v	v									
Mixed training																		
Offensive											v	v	v	v	v			
4. Other training																		
Rules			v	v	v	v												
Mental training	V	v	v															v

Notes: The presence of an v indicates that participants are being tested; the presence of a gray area indicates that participants are being instructed. H: Day of the physical. T: Day of testing

2.3. Statistical Analysis

Descriptive analyses and paired sample T-tests were performed using the Statistical Package for the Social Sciences (SPSS) 20.0 and Microsoft excel 2016. The threshold for statistical significance was established at p=0.05.

3. RESULTS

The study involved 60 female students with respective mean age (19.6±2.2 years), mean height (163.3±5.1 cm), and average body weight (49.2±4.2 kg). During the experimental practice, no student was excluded from the 2 groups.

Before starting the 15-week club-based Shuttlecock training program at Agu-VNU-HCM, the mean differences in students' physical fitness and functional factors between CG and EG are shown in Table 2. There was a marked difference between CG and EG in any of the fitness tests, (including 30-m sprint(s); 30-s sit-up (times); 4 × 10 m shuttle run (s); 5-min running (m); standing long jump (cm), and functional tests [Body weight (kg); BMI; Body fat %; Chest skinfold (mm); Waist skinfold (mm); Thigh skinfold (mm)]. This result demonstrates that the fitness levels of the two groups are comparable. As a result, it is possible to continue using the 15-week training plan for each of the different groups.

Female students participating in the PE program who underwent all Shuttlecock physical fitness and functional tests at Agu-VNU-HCM before and after implementing the two training programs showed improvement in both EG and CG. Studies by several authors, including Nguyen et al., (2022); Zhang & Luo (2015), confirm this increase.

Table 2. Body composition, function, and physical fitness levels before and after the experiment

Tests	EG						CG					
	Pre-test		Post-test		t	W%	Pre-test		Post-test		t	W%
	M	SD	M	SD			M	SD	M	SD		
BMI	20.49	1.78	19.9	2	1.21	**-2.92**	20.5	1.38	20.89	1.49	-1.05	**1.88**
Body fat (%)	15.29	2.18	13.5	2.4	3.02	**-12.43**	15.8	2.58	16.29	3.09	-0.67	**3.05**
Chest skinfold mm)	10.49	4.28	8.78	4	1.60	**-17.75**	7.8	4.18	7.89	2.99	-0.10	**1.15**
Waist skinfold mm)	14.19	5.98	11.8	5.6	1.60	**-18.39**	9.7	4.08	10.89	4.29	-1.10	**11.56**
Thigh skinfold mm)	11.09	2.68	9.48	3	2.19	**-15.65**	11.4	3.98	12.39	4.89	-0.86	**8.32**
Diastolic pressure (mmHg)	67.35	11.3	65.00	6.7	0.98	**-3.55**	66.07	4.12	65.9	5.12	0.14	**-0.26**
Flexion angle of hip joint (dominant)	102.24	9.86	115	12.9	-4.3	**11.75**	109.7	13.6	110	7.8	-0.1	**0.27**
Resting heart rate (bpm)	68.7	6.7	68.9	8.4	-0.1	**0.29**	74.01	6.3	72.4	7.3	0.91	**-2.20**
Systolic pressure (mmHg)	113.21	4.23	111	15.7	0.74	**-1.97**	114.3	3.45	111	7.2	2.26	**-2.93**
VO2max (ml/kg/min)	39.54	7.5	41.2	9.09	-0.77	**4.11**	39.78	7.2	36.2	6.8	1.98	**-9.42**

Mean (M); Standard Deviation (SD); W% (percentage of change).

In both CG and EG, the mean differences between the students' fitness levels before and after the test are shown in Table 2 (before and after the implementation of the 15-week training program). The results showed a significant change between the pre-and post-trial periods in all physical fitness and functional indices for (CG and EG). This shows that both of these physical fitness training courses are suitable for female students at Agu - VNU-HCM. Also, while speed, endurance, and MAS increase in EG at a higher rate than in CG, speed, endurance, and MAS increase at the highest achievable speeds.

At the same time, Tables 2 and 3 show the difference in fitness between EG and CG students after a 15-week training course at Agu-VNU-HCM. Explosive leg strength and core strength (30-second sit-up test) were not significantly different between EG and CG, but agility *4 × 10 m shuttle run*, speed *30-m sprint* and MAS (*5-min running*) were performed (standing long jump test).

Regarding the functional test of the body, the EG group had a more significant improvement than the CG group. Details are shown in Table 2, specifically, test body fat %, which increased by 12.43%, Chest skinfold increased by 17.75%, Waist skinfold increased by 18.39%, Thigh skinfold increased by 15.65%, outperforming CG.

Table 3. Comparison of physical fitness improvement before and after the experiment

	Tests	Pre-test		Post-test		t	p	W%
		M	SD	M	SD			
CG	30-m sprint (s)	5.75	0.63	5.94	0.26	-1.53	0.02	3.25
	30-s sit-up (times)	15.58	1.54	15.55	0.78	0.10	0.03	-0.19
	4 × 10 m shuttle run (s)	12.03	0.57	12.15	0.2	-1.09	0.00	0.99
	5-min running (m)	772.46	37.52	827.45	40.51	-5.45	0.04	6.87
	standing long jump (cm)	169.55	14.99	175.24	9.72	-1.74	0.00	3.30
EG	30-m sprint (s)	5.88	0.46	5.82	0.26	0.62	0.01	-1.03
	30-s sit-up (times)	15.71	15.29	15.41	0.78	0.11	0.00	-1.93
	4 × 10 m shuttle run (s)	12.16	11.74	11.86	0.2	0.14	0.02	-2.50
	5-min running (m)	772.59	42.17	979.29	40.29	-19.41	0.00	23.60
	standing long jump (cm)	169.68	19.26	189.38	9.72	-5.00	0.00	10.97

Mean (M); Standard Deviation (SD); W% (percentage of change).

According to the results of Tables 2 and 3, EG was superior to CG in body function indexes, especially in physical fitness tests, significantly outperforming the following tests of speed, agility, and MAS. when managing SMC. One of the sports that requires the highest agility is Shuttlecock. Therefore, Shuttlecock players must match their speed and agility to improve their footwork in tournaments. In addition, it is important to reduce the number of player injuries (Hulteen et al., 2015). In addition, Shuttlecock players must be able to change direction quickly based on the circumstances of the game while maintaining a constant focus on their opponent or ball Al-wahid et al. (2022). Therefore, increasing speed and agility is a must for every training program shuttlecock (Wang, 2021). SMC responded to the growing exercise needs of female students at Agu-VNU-HCM and achieved results in speed and agility that were superior to the current program in this study. The test group's participants were encouraged to run and move more when the training program was put into practice, which showed their superior performance in terms of speed, agility, and MAS compared to individuals of the control group.

4. DISCUSSION

4.1. Analysis of changes in body composition

Table 2 showed that before the trial, there was little to no variation in any of the indices between the EG and the CG, proving that the participants in both groups had similar body compositions. There was no discernible difference in body weight, BMI, or body density between participants in the EG or the CG before and after the trial, which lasted 15 weeks. The findings showed that playing shuttlecocks had no discernible impact on the patient's body weight, which had been affected by aerobic exercise performed for eight to twelve weeks at an intensity of 60 to 80 percent Kieres (1991). The BMI of the participants in the control group and the shuttlecock-playing group were within the normal range before training, and none of the subjects were on a diet during the duration of the trial, which may be the cause of the subtle change in body weight. According to Hoeger et al. (2015), those with normal BMIs have a harder time losing weight and lowering their body fat percentage than those who are overweight. Gwinup (1987) believed that the exercise weight loss intervention experiment's most important component was food management. Subjects in a shuttlecock-playing group showed substantial variations in body fat percentage, and chest, waist, and thigh skinfold before and after the trial. According to Siri (1993), body weight is the result of adding the weight of fat and subtracting it. The removal of fat would increase weight if body weight remained constant and fat weight decreased. In general, the removal of fat weight might indicate the development of muscle. Playing with a shuttlecock was a type of low- to moderate-intensity exercise. The body fat percentage found in this study was in line with Zhang Meili's 12-week study on the effects of aerobic exercise on body composition, indicating that aerobic exercise's method for lowering body fat was the same as that of shuttlecock play.

According to Powers et al. (2014), sports only slightly and slowly alter body composition. Participants can lower their body fat percentage by 92% by engaging in aerobic activity more than three times for a total of more than 20 minutes a week for three months (Davis & Turner, 2001). Unger (2003) showed that people who are prone to high cholesterol, high blood pressure, diabetes, and high uric acid tend to have more fat around the waist and other metabolic syndrome conditions in people who have a lot of fat in their buttocks and legs. Therefore, even in people who are not on a strict diet plan, shuttlecock activity can enhance body composition and support overall health.

4.2. Analysis of body function changes

Before the experiment, the EG and CG had similar levels of aerobic capacity in Table 2. Systolic pressure, pedaling duration, bilateral hip joint flexion angles, the physical fitness tests were significantly different before and after the experiment for students in EG, and other evaluation indices also improved. Resting heart rates, systolic pressures, VO2 max, and other function indicators were all within the normal range before the trial. However, following the experiment, the systolic pressure was lower in the EG participants, although the CG patients' other cardio-pulmonary function indicators did not alter much. According to Saltin (1969), students' VO2max consumption increased as a result of an increase in stroke volume and an increase in the arteriovenous oxygen difference. Peripheral vascular resistance, which can lower blood pressure and increase peripheral blood flow after exercise, is the main factor generating an increase in stroke volume. A study by Klausen et al. (1982) showed that riding a cycle ergometer with one foot while engaging in moderate-intensity exercise can lower peripheral vascular resistance, which has a stronger impact on boosting stroke volume than the sports model with two legs.

Continuous shuttlecock play may also raise the maximum oxygen uptake by increasing the arteriovenous oxygen difference in the lower extremities. Wang et al. (2004) found that single-foot support can improve lower-body muscular control and balance. Standing on one foot for a lengthy amount of time can engage the deep muscles in the waist, claim (Stefanyshyn et al., 2000). Ebbeling et al. (1994) showed that elevating the leg to the inner of the thigh can work the iliopsoas and abdominal muscles.

4.3. Analysis of physical fitness changes

Due to differences in gender, age, fitness level (athletes who are semi-professional, professional, amateur, or elite), assessment types, weekly training sessions, political and cultural diversity, as well as differences in testing procedures, among other factors, the results of many earlier studies cannot be directly compared (Nguyen et al., 2022). The objective of our study was to identify a more workable strategy to enhance students' fitness while they are enrolled in a full-time major. The next semester, they were able to join the basketball club more quickly because they were already prepared to start practicing for the game. The research's two training programs were advantageous for the female students at Agu-VNU-HCM.

However, the adoption of the SMC at Agu-VNU-HCM met the expanding training needs of basketball players. In other words, the SMC adoption at Agu-VNU-HCM was more beneficial to the PE course there than the current curriculum was. According to Thuc (2019), female students at Agu-

VNU-HCM who took elective sports courses expressed poor satisfaction with their physical education lessons. If they did not see the value in physical education classes, female students would leave when given the opportunity (i.e., increased fitness, made new friends, or had greater excitement in training) (Gibbons, 2009).

5. CONCLUSIONS

Students who play shuttlecock can improve their cardio-pulmonary function, reduce their body fat, drop their systolic blood pressure, and improve their physical fitness by SMC. Students can become more physically fit through SMC. Whether or not shuttlecock training may increase agility and coordination is still up for debate because of the limitations of the experimental setup. Further research is required to determine the effects of shuttlecock training on exercise volume and physical fitness in middle-aged adults, children, young adults, or other populations.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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