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The effectiveness of specific physical fitness exercises for female students in basketball courses at Saigon University

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Abstract
Background: Physical Education (PE) is crucial for students' holistic development. However, the general fitness of non-sports major students, especially females, often falls below required standards. While previous research at Saigon University developed a new basketball program for male students, the specific fitness needs of female students remain understudied. This study aimed to fill this gap.
Purpose: To assess the current general fitness status of female students in a Basketball 1 course and evaluate the effectiveness of a selected set of physical fitness exercises on their fitness development.
Methods: A total of 369 female students were randomly assigned to an experimental group (EG, n=180) and a control group (CG, n=189). An initial pool of 50 exercises was compiled from literature. Through structured interviews with 30 experts, 22 exercises achieving ≥80% agreement were selected. The EG followed a 15-week program integrating these exercises according to a detailed weekly schedule, while the CG followed the standard curriculum. Fitness was assessed pre- and post-intervention using six standardized tests (handgrip strength, sit-ups, standing long jump, 30m sprint, 4×10m shuttle run, 5-minute run) based on Vietnamese Ministry of Education and Training standards. Perceived exertion (RPE) was also measured.
Results: Pre-intervention, no significant differences existed between groups ($p>0.05$). Post-intervention, the EG showed significantly greater improvements in all six tests ($p<0.05$). The growth rate (W%) was substantially higher in the EG, with differences ranging from 0.26% to 2.65% across tests. RPE scores were significantly lower in the EG post-intervention (12.26 vs. 13.26, $p<0.05$).
Conclusion: The 22 specifically selected physical fitness exercises significantly improved the general physical fitness of female students more effectively than the standard curriculum, providing a scientific, practical exercise battery for enhancing PE programs.

Keywords: Physical fitness exercises, basketball, female university students, physical education, experimental research, Vietnam

Introduction

Physical Education (PE) is fundamental to comprehensive education, fostering students' health, physical development, and character formation. Within Vietnamese universities, PE programs aim to equip students with fundamental motor skills and promote lifelong physical activity habits. Basketball has emerged as a particularly popular elective sport, including at Saigon University, due to its comprehensive nature in developing various physical qualities such as speed, strength, endurance, agility, and coordination (Nguyen Huu Bang & Do Manh Hung, 2007) [10].

The Ministry of Education and Training has established clear standards for assessing student physical fitness through Decision No. 53/2008/ QD-BGDDT. Despite these standards, previous research indicates that the general physical fitness levels of non-sports major students frequently fall below expected benchmarks (Nguyen Thanh Nguyen, 2021) [12]. This concern is particularly pronounced among female students, who traditionally demonstrate lower participation rates in physical activities and face unique physiological considerations during exercise.

While the technical aspects of basketball are systematically taught within the curriculum at Saigon University, a notable gap exists: the absence of dedicated content specifically designed to enhance the foundational physical fitness required to perform these techniques effectively and sustainably. The Basketball 1 course currently lacks specialized exercises targeting power development, speed endurance, and agility—qualities crucial for optimal basketball performance. In a recent study, Tuan (2022) [18] introduced and assessed a novel 15-week basketball curriculum for male students, revealing marked enhancements in key fitness indicators. Crucially, Tuan (2022) [18] explicitly highlighted the necessity for subsequent research to investigate the program's effects on female students, given their distinct physiological profiles and potentially different baseline fitness levels.

This study was conducted with the following specific objectives: (i) to assess the current status of general physical fitness among female students enrolled in the Basketball 1 course at Saigon University; (ii) to systematically compile and select a set of effective physical fitness exercises suitable for these female students; and (iii) to experimentally evaluate the effectiveness of the selected exercises in improving their general physical fitness over a 15-week period.

Methods and Materials

A total of 369 healthy, non-sports major female students enrolled in the Basketball 1 course at Saigon University during the 2024-2025 academic year participated in this study. As presented in Table 2 participants had a mean age of 19.59±0.84 years, mean height of 157.69±5.18 cm, and mean weight of 49.47±6.34 kg. They were randomly assigned to either an experimental group (EG, n=180) or a

control group (CG, n=189). All participants were fully informed about the study's procedures and provided written informed consent. Exclusion criteria included serious injuries, medical conditions contraindicated for physical activity, or current use of medication affecting physical performance.

This study employed a 15-week quasi-experimental design with pre-test and post-test measurements for both groups. The EG followed a 15-week Basketball 1 program integrated with 22 selected physical fitness exercises according to a detailed weekly schedule, while the CG followed the standard curriculum without additional exercises. Both groups attended one 100-minute session per week under identical conditions.

Based on a comprehensive review of Vietnamese literature examining basketball training interventions and textbooks, an initial pool of 50 exercises was compiled targeting strength, power, speed, endurance, agility, and flexibility. To select the most suitable exercises, a structured questionnaire was administered to 30 experts in Physical Education and basketball coaching in Ho Chi Minh City. Exercises achieving an agreement rate of 80% or higher were selected for the intervention program. The complete exercise selection process is summarized in Table 1 Summarizes of Exercise Selection Process below.

Table 1: Summarizes of Exercise Selection Process

Stage	Number of Exercises	Selection Criteria
Initial compilation	50	Literature review
After expert interview	22	≥80% expert agreement
Final selected exercises	22	Categorized into 5 functional groups

The 22 selected exercises were systematically integrated into each 100-minute session for the EG, including: (1) Warm up with two-hand ball passing back and forth in front of the body (10 reps); (2) Warm up with ball circling around the body (10 reps); (3) Warm up with figure-8 ball circling around both legs (10 reps); (4) Warm up with stationary V-dribbling (20-30 reps); (5) Stationary one-hand overhead shooting (10 reps); (6) Two-step dribble drive with one-hand overhead shot (10 reps); (7) Stationary dribbling bouncing under knees (30 reps); (8) Continuous alternating right-left hand dribbling (30 reps); (9) Speed dribbling 30m × 2 times; (10) Two-hand chest pass (10 reps); (11) Combined passing, receiving, and two-step layup (10 reps); (12) Jump Squats (15 reps); (13) Bodyweight squats combined with passing (10 reps); (14) Endurance running (5 minutes); (15) Jump rope 2 minutes × 2 times; (16) Box jumps 30–50cm (15 reps); (17) Half-court 2v2 scrimmage 4 periods × 2 minutes; (18) Hamstring stretching 20–30 seconds each side; (19) Quadriceps stretching 20–30 seconds each side; (20) Calf stretching 20–30 seconds each side; (21) Groin stretching 20–30 seconds each side; (22) Shoulder stretching 20–30 seconds each side.

General physical fitness was assessed using six standardized tests prescribed by Decision No. 53/2008 [8]/QD-BGDDT: Handgrip Strength (kg) measured using a TKK 5001 dynamometer; Sit-ups (reps/30s); Standing Long Jump (cm); 30m Sprint (s); 4×10m Shuttle Run (s); and 5-minute Run (m). Rating of Perceived Exertion (RPE) was measured using the Borg scale (Borg, 1977) [1], ranging from 6 (no exertion) to 20 (maximal exertion).

All data were analyzed using SPSS for Windows (version 20.0). Descriptive statistics (mean ± standard deviation) were calculated. Independent Samples T-Test compared differences between EG and CG. Paired Samples T-Test compared within-group improvements. The growth rate (W%) was calculated using the Brody formula (Brody, 1927) [2]: $W\% = [(V_2 – V_1) / 0.5(V_2 + V_1)] \times 100$. Statistical significance was set at $p < 0.05$.

Results

Characteristics of Participants

Table 2 presents the demographic characteristics of the 369 female students who participated in this study. The experimental group (n=180) and control group (n=189) showed similar demographic profiles.

Table 2: Characteristics of Female Study Participants (N=369)

Variable	Experimental Female (n=180)	Control Female (n=189)
Age (years)	19.54 ± 0.78	19.64 ± 0.89
Height (cm)	157.24 ± 4.81	158.12 ± 5.49
Weight (kg)	49.31 ± 6.26	49.63 ± 6.42

Baseline Fitness Assessment

The pre-intervention fitness levels for both groups are displayed in Table 3. Independent samples t-tests were conducted to compare the baseline measurements between EG and CG.

Table 3: Baseline Characteristics and Pre-intervention Fitness Levels (n=369)

Variable	EG (n=180)	CG (n=189)	t	p
Handgrip strength (kg)	28.68 ± 2.02	28.81 ± 1.87	-0.623	0.534
Standing long jump (cm)	157.14 ± 6.20	156.67 ± 6.70	0.702	0.483
Sit-ups (reps/30s)	15.33 ± 1.51	15.54 ± 1.44	-1.379	0.169
4×10m shuttle run (s)	13.21 ± 0.78	13.23 ± 0.81	-0.331	0.741
30m sprint (s)	6.09 ± 0.89	6.15 ± 0.94	-0.678	0.498
5-minute run (m)	840.08 ± 23.78	839.13 ± 25.86	0.367	0.714

As shown in Table 3, no statistically significant differences were observed between EG and CG in age, height, weight, or any fitness tests ($p > 0.05$), confirming group homogeneity as shown in Tables 2 and 3. The initial fitness assessment revealed low baseline fitness levels among participants, with particular weaknesses in aerobic endurance as indicated by the 5-minute run test results (840.08 ± 23.78 m for EG and 839.13 ± 25.86 m for CG) and core strength as shown by sit-ups performance (15.33 ± 1.51 reps/30s for EG and 15.54 ± 1.44 reps/30s for CG). These findings suggest substantial room for improvement in these fitness components.

Post-Intervention Fitness Comparison

Following the 15-week intervention, significant differences emerged between EG and CG across all fitness measures, as detailed in Table 4.

Table 4: Post-Intervention Physical Fitness Comparison (n=369)

Test	Group	Mean ± SD	t	df	p
Handgrip strength (kg)	EG	32.07 ± 2.18	7.363	318.03	0.000
	CG	30.62 ± 1.52			
Standing long jump (cm)	EG	164.29 ± 5.39	2.161	360.29	0.031
	CG	162.95 ± 6.50			
Sit-ups (reps/30s)	EG	16.63 ± 1.06	2.178	348.56	0.032
	CG	16.34 ± 1.42			
4×10m shuttle run (s)	EG	12.16 ± 0.63	-9.282	357.55	0.000
	CG	12.84 ± 0.78			
30m sprint (s)	EG	5.58 ± 0.58	-2.068	326.29	0.039
	CG	5.74 ± 0.88			
5-minute run (m)	EG	932.72 ± 32.44	7.055	334.65	0.000
	CG	911.35 ± 25.47			

The data in Table 4 demonstrate that the EG demonstrated significantly superior performance compared to the CG across all six fitness tests ($p < 0.05$).

Paired samples t-test analysis revealed that both groups showed statistically significant improvements from pre-test to post-test ($p < 0.05$). However, the magnitude of improvement, reflected by the growth rate (W%), was consistently and substantially higher in the EG across all measures.

Within-Group Improvements and Growth Rates

To further analyze the effectiveness of the intervention, within-group improvements and growth rates were calculated and presented in Table 5.

Table 5: Within-Group Improvements and Growth Rates

Test	Group	Pre-test	Post-test	t	p	W%
Handgrip (kg)	EG	28.68±2.02	32.07±2.18	-16.78	.000	5.58
	CG	28.81±1.87	30.62±1.52	-10.32	.000	3.05
Standing long jump (cm)	EG	157.14±6.20	164.29±5.39	-12.14	.000	2.22
	CG	156.67±6.70	162.95±6.50	-9.50	.000	1.96
Sit-ups (reps/30s)	EG	15.33±1.51	16.63±1.06	-9.77	.000	4.07
	CG	15.54±1.44	16.34±1.42	-5.83	.000	2.51
4×10m shuttle (s)	EG	13.21±0.78	12.16±0.63	14.39	.000	4.14
	CG	13.23±0.81	12.84±0.78	4.53	.000	1.49
30m sprint (s)	EG	6.09±0.89	5.58±0.58	6.42	.000	4.37
	CG	6.15±0.94	5.74±0.88	4.95	.000	3.45
5-minute run (m)	EG	840.08±23.78	932.72±32.44	-31.75	.000	5.23
	CG	839.13±25.86	911.35±25.47	-30.03	.000	4.13

As illustrated in Table 5, Chart 1. The EG demonstrated markedly higher growth rates across all tests, with differences ranging from 0.26% (standing long jump) to 2.65% (4×10m shuttle run).

The most substantial differences were observed in tests measuring agility (shuttle run, +2.65%), upper body strength (handgrip, +2.53%), and abdominal endurance (sit-ups, +1.56%).

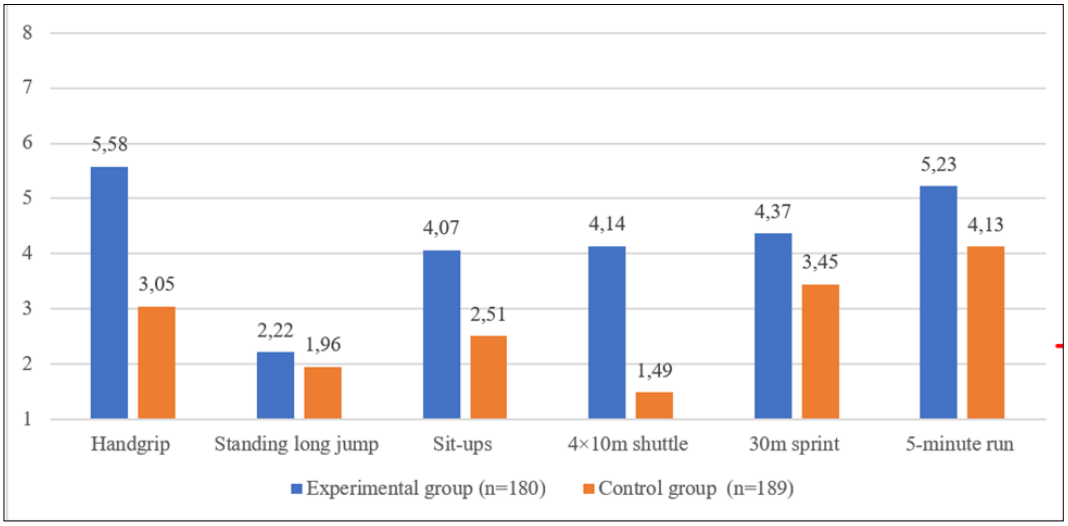

Chart 1: Evaluation of differences in general physical fitness after applying a set of general physical fitness development exercises for female students participating in the Basketball 1 course at Saigon University after the experiment

Rating of Perceived Exertion

Table 6 presents the RPE scores measured before and after the intervention for both groups.

Table 6: Rating of Perceived Exertion (RPE) Before and After Intervention

Time Point	EG (n=180)	CG (n=189)	t	df	p
Pre-intervention	14.28 ± 0.44	14.28 ± 0.45	-0.056	367	0.955
Post-intervention	12.26 ± 0.84	13.26 ± 1.22	-9.224	334.65	0.000

The results in Table 6 show that pre-intervention, no significant difference was observed between groups ($p > 0.05$). Post-intervention, the average RPE score for the EG was significantly lower than that of the CG (12.26 vs. 13.26, $p < 0.05$), with a substantially greater mean reduction in the EG (MD = -2.02) compared to the CG (MD = -1.02), confirming superior adaptation to exercise load.

Discussion

The findings from Tables 2-6 and Chart 1 provide compelling evidence for the effectiveness of a structured, targeted physical fitness program in improving the general fitness of female university students. As shown in Table 3, the initial assessment revealed low fitness levels among female students, with particular weaknesses in aerobic endurance (5-minute run: 840.08 ± 23.78 m for EG and 839.13 ± 25.86 m for CG) and core strength (sit-ups: 15.33 ± 1.51 reps/30s for EG and 15.54 ± 1.44 reps/30s for CG). These findings align with previous observations regarding non-sports major students in Vietnam (Nguyen Thanh Nguyen, 2021) [12] and underscore a significant public health concern, as adequate fitness during university years establishes foundations for lifelong physical activity habits.

The systematic selection of 22 exercises through expert consensus (≥80% agreement), as detailed in Table 1, represents a methodologically sound approach, ensuring comprehensive coverage of fitness components relevant to basketball performance. The intervention was carefully structured, with warm-up activities preparing the body and reinforcing ball handling, the main segment dedicated to targeted physical conditioning, and the cool-down phase prioritizing flexibility and recovery.

The most significant finding is the clear superiority of the experimental program over the standard curriculum in improving all measured fitness parameters. As presented in Tables 4 and 5, and visually confirmed in Chart 1, the growth rate differences were particularly notable for agility (shuttle run, +2.65%), upper body strength (handgrip, +2.53%), and abdominal endurance (sit-ups, +1.56%). These findings suggest that the targeted exercises effectively developed specific fitness components essential for basketball performance, including rapid directional changes, upper body strength for passing and shooting, and core stability for maintaining balance during dynamic movements.

The substantial improvements in the EG across all fitness measures, particularly in the 5-minute run (from 840.08 ± 23.78 m to 932.72 ± 32.44 m, with a growth rate of 5.23% as shown in Table 5), have significant practical implications, bringing the majority of EG students closer to national fitness benchmarks. The significantly lower RPE scores in the EG post-intervention (12.26 vs. 13.26, $p < 0.05$ from Table 6) provide important insights into physiological adaptations, suggesting that EG students not only achieved higher absolute fitness levels but also experienced physical demands as more manageable and less strenuous.

This research directly answers the call made by Tuan (2022) [18] for a focused investigation into the effects of basketball training on female students. Notably, while Tuan's work with male students did not find a significant improvement in core strength, our intervention resulted in significant gains in sit-up performance for the EG (4.07%, as detailed in Table 5). This disparity underscores the critical importance of tailoring exercise selection to the specific needs and baseline characteristics of the target population.

Several limitations should be acknowledged, including the 15-week intervention duration and the focus exclusively on general physical fitness outcomes without direct measurement of specific basketball skills. Future research should include follow-up measurements, incorporate sport-specific skill tests, and employ multi-site replication studies to enhance external validity.

Conclusion

This study successfully identified significant deficiencies in the general physical fitness of female students at Saigon University, particularly in aerobic endurance and core strength. Through systematic compilation and expert selection of 22 targeted physical fitness exercises, and their subsequent integration into the Basketball 1 curriculum, the research demonstrated a highly effective intervention approach. The experimental group showed significantly greater improvements across all measured fitness components—including upper body strength, lower body power, core endurance, speed, agility, and aerobic capacity compared to the control group. The magnitude of improvement, reflected in growth rates and national fitness classification changes, was substantially higher in the experimental group. Furthermore, EG students perceived the training as less strenuous post-intervention, indicating better physiological adaptation and potentially greater enjoyment of physical activity. By providing the first systematic evidence of a successful fitness intervention for female students at Saigon University, this study directly fills the research gap highlighted by previous research and provides a practical, scientifically grounded resource for enhancing Physical Education programs in Vietnamese universities.

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