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Application of an Exercise System to Develop General Physical Fitness for the Men's Volleyball Team Students at Ho Chi Minh City University of Technology

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ABSTRACT: Based on a two-round expert consensus filter, this study established 11 highly reliable pedagogical tests ($r > 0.8$, $P < 0.05$) to evaluate five core fitness dimensions of the HCMUT men's volleyball team: general strength, specialized strength, speed-agility, endurance, and flexibility. Concurrently, a structured system of 30 physical exercises was selected and systematically implemented over a 32-week experimental period, divided into Phase I (Adaptation & Stabilization, 16 weeks) and Phase II (Maximal Power Enhancement, 16 weeks), with a frequency of 3 sessions per week. Post-experiment results demonstrated statistically significant and synchronous improvements across all 11 evaluated physical indicators ($P < 0.05$). The most profound growth rates were recorded in upper-body and lower-body explosive power, validating the high efficacy of the proposed training system in optimizing the physical baseline of university-level volleyball athletes.

KEYWORDS: Volleyball, general physical fitness exercise system, students at Ho Chi Minh City University of Technology.

I. INTRODUCTION

Modern volleyball is characterized by a breakthrough trend shifting toward being "comprehensive, fast, high, and variable." It is an indirect confrontation sport with extremely high movement intensity and an acyclic exercise structure, requiring athletes to continuously execute rapid, powerful sequences of actions such as explosive acceleration, sudden stops, vertical jumps for spiking, and repetitive blocking at the net. Consequently, the functional foundation and energy metabolism capacity—particularly explosive power and specialized endurance—play a decisive role in technical-tactical efficiency and ultimate match outcomes.

At Ho Chi Minh City University of Technology (HCMUT), although the men's varsity volleyball team boasts a rich history of achievements within the Vietnam National University Ho Chi Minh City (VNU-HCM) system, practical observations indicate that the students' physical fitness remains weak. Physical deterioration becomes highly visible immediately following the opening sets, leading to an inability to maintain technical consistency and fail to meet the demands of high-intensity play. Furthermore, the current curricular physical education program is relatively brief (comprising only 3 modules totaling 90 periods), which is insufficient for building an advanced, specialized physical foundation. Therefore, the application of a scientifically grounded and structured exercise system to develop physical fitness for the varsity team is an urgently crucial requirement to enhance competitive performance.

Research Subjects: 12 male students (aged 19–23) from the university's varsity team, and 54 experts/coaches/lecturers participating in the interview panels.

II. RESEARCH RESULTS

2.1. Selection of Pedagogical Tests to Evaluate the General Physical Fitness Level of Male Students on the Volleyball Team at Ho Chi Minh City University of Technology

Out of 29 initial candidate tests gathered from domestic and international literature, through a two-round expert interview process (retaining tests that achieved a high consensus rate), the study identified **11 tests** that met or exceeded the conventional approval threshold (≥75%). These tests are categorized as follows:

General Strength (3 tests): Two-handed basketball chest pass (m), Bench press (3RM), Back squat (3RM).

Specialized Strength (2 tests): Approach vertical jump (cm), Standing vertical jump (cm).

Speed - Agility (2 tests): 20m sprint (s), 9-3-6-3-9m shuttle run (s).

Endurance (3 tests): 12-minute Cooper test (m), 1500m run (s), 92m "Pine Tree" (Agility) shuttle run (s).

Flexibility - Dexterity (1 test): Standing toe touch / Forward trunk flexion (cm).

Following the selection of tests with high approval ratings, the study conducted reliability testing using the correlation coefficient (r).

Table 1. Reliability Coefficients of the Selected Pedagogical Tests

No.	Test	Test 1 ($x^- \pm \delta$)	Test 2 ($x^- \pm \delta$)	r	P
1	Two-handed basketball chest pass (m)	17.67 ±1.826	17.67 ±1.826	0.96	< 0.05
2	Bench press (3RM) (kg)	44.08 ±2.843	44.08 ±2.843	0.97	< 0.05
3	Back squat (3RM) (kg)	81.42 ±2.275	81.42 ±2.274	0.95	< 0.05
4	Approach vertical jump (cm)	311.08 ±1.730	311.08 ±1.720	0.96	< 0.05
5	Standing vertical jump (cm)	307.75 ± 1.913	307.75 ±1.902	0.94	< 0.05
6	20m sprint (s)	2.60 ±0.49	2.6 ±0.38	0.86	< 0.05
7	1500m run (s)	377.42 ±26.387	377.42 ±26.239	0.94	< 0.05
8	9-3-6-3-9m shuttle run (s)	13.00 ±0.407	13.00 ±0.406	0.96	< 0.05
9	12-minute Cooper test (m)	2990.83 ±88.684	2990.83 ±88.576	0.94	< 0.05
10	92m "Pine Tree" shuttle run (s)	25.47 ±1.058	25.47 ±1.087	0.86	< 0.05
11	Forward trunk flexion (cm)	19.50 ±2.195	19.50 ±2.207	0.96	< 0.05

The data presented in Table 1 indicates that all selected tests possess sufficient statistical reliability for assessing the fitness levels of HCMUT male volleyball players ($r > 0.8$ and $P < 0.05$). Specifically, 09 tests demonstrated "excellent reliability" and 02 tests fell within the "acceptable and usable reliability" range.

2.2 Baseline Physical Fitness Status of the Men's Volleyball Team Students at Ho Chi Minh City University of Technology

Table 2: Baseline General Physical Fitness Status of the Target Subjects

No.	Test	Mean (x^-)	SD (δ)	Cv (%)
1	Two-handed basketball chest pass (m)	17.67	1.826	10.3
2	Bench press (3RM) (kg)	45.08	2.843	6.3
3	Back squat (3RM) (kg)	81.42	2.275	2.7
4	Approach vertical jump (cm)	311.08	1.730	0.5
5	Standing vertical jump (cm)	307.75	1.913	0.6
6	20m sprint (s)	2.60	0.049	1.8
7	1500m run (s)	377.42	26.387	6.9
8	9-3-6-3-9m shuttle run (s)	13.00	0.407	3.1
9	12-minute Cooper test (m)	2990.83	88.684	2.9
10	92m "Pine Tree" shuttle run (s)	25.47	1.058	4.1

No.	Test	Mean ($\bar{x}$)	SD (δ)	Cv (%)
11	Forward trunk flexion (cm)	19.50	2.195	11.2

The baseline evaluations in Table 2 reveal that prior to the experiment, the athletes' performances were relatively homogeneous (Cv < 10%). The only exceptions were in the basketball chest pass and forward trunk flexion tests, which showed a degree of heterogeneity (Cv > 10%).

2.3. Practical Application of the General Physical Fitness Exercise System for the Target Subjects

From an original pool of 44 compiled exercises, questionnaires collected from experts filtered out the final **30 general physical fitness exercises** that achieved over 70% of the maximum score and fit the profile of HCMUT students.

The experimental training curriculum spanned **32 weeks** (divided evenly across two semesters/academic phases).

Macrocycle I (16 weeks): Adaptation & Stabilization. Applied a low training volume and intensity using foundational movements.

Macrocycle II (16 weeks): Maximal Power Enhancement. Pushed volume and training intensity to their peak, focusing heavily on jumping mechanics, spiking drills, and both aerobic and anaerobic specialized endurance.

Table 3: Periodization Structure and Distribution of the Experimental Exercise System
Training Frequency: 3 sessions per week (Tuesday, Thursday, Saturday).
Session Duration: 90 minutes per session (including warm-up and cool-down protocols).

No.	Experimental Exercise Directory	Macrocycle I: Adaptation – Stabilization (Weeks 1 – 16)	Macrocycle II: Enhancement – Development (Weeks 17 – 32)
I	**Strength Exercise Group (Upper & Lower Body)**		
1	Two-handed basketball chest pass	Session beginning (W1–4, 9–12): 6–10 mins.	Warm-up maintenance: 5 mins/session at early cycle.
2	Bench press	Progressed from time-bound (10 mins) to sets: 13 x 3 → 15 times 3 sets.	Power output maintenance: 6 x 3 sets.
3	Back squat	Scaled workload from time-bound to sets: 10 x 3 → 15 x 3 sets.	High training workload push: From 10 x 3 → 12 x 3 sets.
4	Bodyweight squat at 30% load	Applied during second half of cycle: From 10 mins to 20 → 3 sets.	Thigh explosive speed development: 6 x 3 → 8 x 3 sets.
5	Light-load squats with bench jumps	First half of cycle based on time: 5–10 mins.	High-intensity circuit sets: Maintain 6 x 3 sets.
6	Rapid bodyweight squats	Continuous maintenance by time: 5–10 mins.	Maximize muscle contraction frequency: High push of 3 x 10 sets.
II	**Specialized Strength Exercise Group (Jumping Mechanics)**		
7	Cued runs with simulated spike jumps	Early cycle: Sets (10 x 3 → 13 x 3); Late cycle: 15 mins.	Combined with specialized variable-speed movement: 10 mins.
8	3-position net block jumps	Not yet applied in accumulation phase (joint deloading).	Applied across the entire cycle: 7–10 mins/session.
9	Approach vertical jump	Not yet applied in foundational phase.	Unleash max takeoff power: From 3 x 5 → 3 x 7 sets.
10	Continuous 3-step broad jumps	Applied in second half of cycle by time: 5–14 mins.	Leg explosive intensity training: Maintained at 5–12 mins.

No.	Experimental Exercise Directory	Macrocycle I: Adaptation – Stabilization (Weeks 1 – 16)	Macrocycle II: Enhancement – Development (Weeks 17 – 32)
11	Platform switch jumps	Transitioned from sets (10 x 3) to time-bound (8–12 mins).	Rapid local jumping frequency: From 3 x 5 → 3 x 7 sets.
12	Spiking suspended volleyballs	Not yet applied in general preparation phase.	Constant high-intensity application: From 6 x 3 -→ 12 x 3 sets.
13	Leapfrog (circular formation)	Ankle dexterity work by time: 5–12 mins.	Rapid explosive reflex sets: 6 x 3 → 12 x 3 sets.
14	Continuous double-leg vertical jumps	Applied in second half of cycle: Target sets from 13 x 3 → 15 times 3.	Anaerobic vertical endurance development: Maintain 8 x 3 –> 12 x 3 sets.
15	Continuous frog hops	Not yet applied in early cycle (prevents thigh overtraining).	Applied in second half of cycle for endurance: 7–15 mins/session.
16	Repetitive block jumps (coach feeds)	Set targets scaled progressively: From 5 x 3 → 15 →3 sets.	Advanced specialized jumping endurance: Continuous 10–15 mins.
III	**Speed – Agility Exercise Group (Velocity & Footwork)**		
17	30m sprints (4 sets)	Maintained regularly at session starts: 10–12 mins.	Shortened inter-set rest intervals: From 8 x 3 → 12 x 3 sets.
18	Multi-directional footwork (Forward, backward, lateral)	Stabilize foundational footwork mechanics: From 10 x 3 → 13 x 3 sets.	Focus on first half of cycle, high-velocity acceleration: 8–15 mins.
19	Fan-shaped agility runs	Applied in second half of cycle, volume scale: 8 x 3 → 20 x 3 sets.	Applied in second half of cycle, timed movement: 5–12 mins.
IV	**Endurance Exercise Group (Specialized Aerobic & Anaerobic)**		
20	Progressive variable-speed runs	Gradual push: From sets (5 x 3 → 10 x 3) to sustained time (10–15 mins).	Upgraded transition to 100m x4 interval sprint exercises.
21	100m interval sprints (4 repetitions)	Not yet applied during light aerobic accumulation.	High-speed anaerobic endurance development: Stabilized at 8–12 mins.
22	1500m run	Not yet applied during general preparation phase.	Baseline aerobic endurance monitoring: Fixed 1 repetition (x 1) on Thursdays.
23	92m "Pine Tree" shuttle run	Applied in second half of cycle for stamina accumulation: 14–20 mins.	Optimize high-density anaerobic movement speed: Reduced to 8–10 mins.
V	**Core Stability, Dexterity & Flexibility Supplementary Group**		
24	Wrist flexion/extension (bands/dumbbells)	Applied in second half of cycle for joint health: Maintained at 10 mins.	Develop rapid wrist snap power: Sustained from 5 x 3 → 10 x3 sets.

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No.	Experimental Exercise Directory	Macrocycle I: Adaptation – Stabilization (Weeks 1 – 16)	Macrocycle II: Enhancement – Development (Weeks 17 – 32)
25	Single-arm medicine ball overhead throws	Flexibly alternated between time (4–10 mins) and sets (5 x 3 → 10 x 3).	Applied in second half of cycle to increase power: From 8 x 3 → 12 x 3 sets.
26	Two-handed medicine ball overhead throws	Develop explosive anterior shoulder & core power: Maintained at 7–12 mins.	Not applied in this cycle to focus primarily on single-arm power outputs.
27	Supine crunches / Sit-ups	Reinforce central core muscle groups: Linear increase from 10–12 mins.	Maximize abdominal muscular endurance capacity: Pushed up to 10–18 mins.
28	Prone back extensions (hands behind head)	Develop posterior chain musculature to support trunk flexion: 10–12 mins.	Integrated into high-velocity targeted sets: From 3 x 7 → 3 x 10 sets.
29	Prone push-ups with hand walking	Applied in second half of cycle for shoulder & tricep strength: 13 x 3 → 15 x 3 sets.	Applied in second half of cycle for sustained shoulder load capacity: 8 x3 → 12 x 3 sets.
30	Partner-assisted passive stretching	Executed throughout entire cycle at session ends for recovery: 10–13 mins.	Maximize stabilization of joint range of motion: Fixed last 10 mins of sessions.

2.4. Evaluation of the Efficacy of the General Physical Fitness Exercise System

Following the 1-year experimental period, re-testing showed that **all 11 out of 11 physical fitness metrics experienced distinct, highly significant growth** that was statistically verified at the confidence threshold of $P < 0.05$.

Table 4: Comparative Physical Fitness Indicators Pre- and Post-Experiment (n=12)

No.	Evaluated Indicator	Pre-Experiment ($\bar{x} \pm \delta$)	Pre-Exp Cv (%)	Post-Experiment ($\bar{x} \pm \delta$)	Post-Exp Cv (%)	Growth Rate W (%)	t-value	P-value
1	Basketball chest pass (m)	17.67 ±1.826	10.30	21.50 ±1.567	7.28	19.55	9.931	< 0.05
2	Bench press (3RM) (kg)	45.08 ±2.843	6.30	68.83 ±2.250	3.26	41.69	24.883	< 0.05
3	Back squat (3RM) (kg)	81.42 ±2.275	2.70	115.75 ±6.107	5.27	34.82	18.030	< 0.05
4	Approach vertical jump (cm)	311.08 ±1.730	0.50	319.08 ±1.929	0.60	2.53	11.489	< 0.05
5	Standing vertical jump (cm)	307.75 ±1.913	0.60	311.08 ±1.730	0.55	1.076	14.832	< 0.05
6	20m sprint (s)	2.60 ±0.049	1.80	2.51 ±0.047	1.87	-3.52	10.183	< 0.05

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No.	Evaluated Indicator	Pre-Experiment ($x^- \pm \delta$)	Pre-Exp Cv (%)	Post-Experiment ($x^- \pm \delta$)	Post-Exp Cv (%)	Growth Rate W (%)	t-value	P-value
7	1500m run (s)	377.42 ±26.387	6.90	345.00 ±17.300	5.01	-8.97	10.940	< 0.05
8	9-3-6-3-9m shuttle run (s)	13.00 ±0.407	3.10	12.91 ±0.408	3.16	-0.67	19.432	< 0.05
9	12-minute Cooper test (m)	2990.83 ±88.684	2.90	3115.67 ±121.403	3.89	3.83	7.364	< 0.05
10	92m "Pine Tree" shuttle run (s)	25.47 ±1.058	4.10	24.78 ±0.939	3.78	-2.74	9.919	< 0.05
11	Forward trunk flexion (cm)	19.50 ±2.195	11.20	23.08 ±1.505	6.52	16.81	10.660	< 0.05

The findings in Table 5 demonstrate that physical baseline capacities across all squad members improved synchronously across all test categories. The most powerful acceleration in growth rates occurred within the explosive muscular strength groups targeting both upper and lower body mechanics.

CONCLUSION

Through systematic scientific methods, the study successfully selected 11 highly reliable pedagogical tests spanning 5 specialized fitness domains: general strength, specialized strength, speed-agility, endurance, and flexibility. A customized physical system of 30 exercises was structured across a 32-week periodized framework (consisting of two distinct phases: Adaptation-Stabilization and Maximal Power Enhancement), fully matching the physiological profiles of young adults aged 18–22. Following 1 year of experimental training, the physical capacities of the varsity male students improved in a highly synchronized manner across all 11 markers, with explosive muscular power demonstrating the most prominent statistical expansion.

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