

International Journal Of Multi Research

Online ISSN: 3107 - 7676

IJMR 2026; 2(3): 07-12

2026 May - June

www.allmultiresearchjournal.com

Received: 05-03-2026

Accepted: 07-04-2026

Published: 05-05-2026

Study on The Development of Physical Fitness During A Training Cycle of Female Athletes in the Ho Chi Minh City Basketball Team, Vietnam

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Abstract

Basketball is a high-paced contact sport that requires a comprehensive combination of technique and speed. Physical fitness is the core foundation that helps athletes maintain competition intensity, optimize tactical performance, prevent injuries, and directly determine top-level competition results. The research uses methods of document synthesis and analysis, interviews, pedagogical testing, and statistical mathematics. The subjects observed were 16 female athletes from the Ho Chi Minh City basketball team and 20 individuals who are experts, managers, coaches, and basketball lecturers in Ho Chi Minh City, Can Tho, and Soc Trang. The research results have developed a 5-month training cycle for the female athletes of the Ho Chi Minh City basketball team, Vietnam, including the Transition and Preparation phases. The results of monitoring the development of 14 physical fitness indicators show a systematic development and outstanding growth ($p < 0.01$). Specifically, the rate of physical fitness development reached its highest level during the general preparation period. This foundation helps performance values, technical skills, and physiological parameters (VO₂max) reach optimal levels by the end of the specialized preparation phase, providing a solid basis for athletes to stabilize their technical and tactical performance.

Keyword: Physical activity, in Competitions, Female athletes, Basketball, Ho Chi Minh City, Vietnam

1. Introduction

In the modern sports training system, basketball is defined as a sport with mixed intensity, requiring sophisticated coordination between energy systems and complex physical qualities. The nature of the competition requires athletes not only to possess explosive strength and acceleration but also to have specialized endurance to maintain technical and tactical performance under the harsh pressures of time and space (McInnes *et al.*, 1995; Montgomery *et al.*, 2010) ^[1, 2]. For women's basketball, the requirements for flexibility, jumping ability to contest the ball, and recovery speed between high-intensity plays are the core variables that determine competitive performance (Scanlan *et al.*, 2012; Reina *et al.*, 2020) ^[3, 4].

However, fitness levels are not a static state but a biological process directly influenced by the structure of training volume during training phases. According to Drinkwater *et al.* (2008) ^[5], understanding the fluctuations of physical fitness

indicators throughout an average training cycle (Mesocycle) is key for coaches to optimize performance peaks. Recent studies by Wang and Wang (2023) ^[6] and Ge *et al.* (2022) ^[7] also affirm that controlling the "dynamics" of indicators such as VO₂max, speed strength, and agility helps quantify the body's adaptation process, thereby preventing overtraining and injuries.

In Vietnam, Ho Chi Minh City is currently the leading unit in the women's basketball movement with a systematic training, competition, and coaching program. However, the city's women's team is facing a major challenge with the dense competition schedule and the increasing demands for professionalism in physical training. Based on a review of domestic research works, it can be observed that authors such as Dang Ha Viet (2007) ^[8], Nguyen Thi Minh Cam (2010) ^[9], and Huynh Long Bao (2015) ^[10] mostly focus on developing exercise systems or assessing physical fitness levels at cross-

sectional points (beginning or end of the phase) to serve selection and evaluation tasks.

The main issue currently is the lack of empirical data on the progression (continuous changes) of physical qualities throughout a specific training cycle. The evaluation of "static" results at the two ends of the training period does not yet reflect the adaptation rules and the accumulation of physical fitness of female athletes under the pressure of major tournaments such as the National Championship or the National Sports Congress. This leads to difficulties in adjusting the immediate amount of movement, causing training work to sometimes be based on experience rather than scientific foundations in terms of biological dynamics.

Furthermore, the distinct physiological characteristics of female basketball players require specialized analyses of their ability to maintain explosive strength and cardiovascular stability during different preparation phases (Gómez-Carmona *et al.*, 2021) [11]. If the coach does not thoroughly understand this fluctuation rule, it will be difficult to establish a personalized training plan and ensure that the athlete reaches their peak condition at the time of the official competition. Based on the urgent theoretical and practical demands mentioned above, the implementation of the topic:

“Study on the development of physical fitness during a training cycle of female athletes in the Ho Chi Minh City basketball team, Vietnam”

This study not only evaluates the current level of physical fitness but also aims to clarify the laws of physical fitness changes, providing a reliable scientific basis to optimize training programs and enhance the competition performance of the Ho Chi Minh City basketball team in the future.

2. Methodology

2.1 Research Methods

2.1.1 Documentary research method

This method aims to read, analyze, and synthesize to systematize knowledge related to the research field, helping to build the theoretical foundation for the study; select research methods; formulate scientific hypotheses, determine the research content, and discuss research results during the research process. In addition, this is a method that helps researchers compare with the data obtained during the research process.

2.1.2 Interview method

Used in the research process to consult experts both domestically and internationally who are currently directly involved in managing and coaching basketball in our country, such as districts in Ho Chi Minh City, provinces and cities nationwide, and clubs, to collect information related to the physical development of the research subjects via various training stages.

2.1.3 Pedagogical testing methods

This method aims to assist researchers in evaluating the physical fitness tests of the study subjects at different stages of the annual training cycle of the female basketball team of Ho Chi Minh City, Vietnam.

2.1.4 Statistical methods

The study uses this method to process and analyze the data obtained from testing the physical fitness assessment tests of the research subjects after each training phase. In data processing, we use SPSS 22.0 software to calculate the mean, standard deviation, conduct ANOVA tests, and calculate growth.

Research subjects:

- 16 female athletes from the Ho Chi Minh City basketball team were selected using convenience and judgment sampling methods.

Average age: 23.5 ± 3.54 years old (The maximum age is 30 years old and the minimum age is 20 years old)

Average height: 169.25 ± 4.77 cm

Average weight: 64.75 ± 5.56 kg.

Interview subjects: 20 people, including 04 experts, management staff; 10 coaches, and 06 basketball lecturers in Ho Chi Minh City, Can Tho, and Soc Trang.

3. Results and Discussion

3.1. Plan for a training cycle for the female athletes of the Ho Chi Minh City basketball team, Vietnam

Study of physical fitness changes during a training cycle of female athletes on the Ho Chi Minh City basketball team, Vietnam; the study monitors physical fitness changes according to the training cycle as follows:

Duration: 1st June 2020 – 31st October 2020, divided into 02 phases:

Phase 1: Transition period (T): 1st June 2020 to 1st August 2020

Phase 2: Preparation period (P): 3rd August 2020 to 31st October 2020, divided into 02 phases:

- General preparation (GP): 03/08/2020 – 30/09/2020.

- Specialized preparation (SP): 1st October 2020 to 31st October 2020.

3.2 Places

- Every week, the team trains with physical exercises on Mondays and Fridays from 6:00 PM to 8:00 PM at Phu Tho Training Center, Ho Chi Minh City, Vietnam.
- Every week, the team practices on Tuesday, Wednesday, Thursday, and Saturday from 7:30 PM to 9:30 PM at the University of Physical Education and Sports in Ho Chi Minh City, Vietnam.
- Every week, the team practices additional position-specific skills and tactics on Tuesday, Thursday, and Saturday from 11:00 AM to 1:00 PM at Lãnh Binh Thăng Sports Hall, Ho Chi Minh City, Vietnam.

3.3 Coaches

03 coaches (01 head coach and 02 assistant coaches) agreed on the training plan and exercises.

The physical training time is strictly managed according to the provided lesson plan, excluding external factors that affect the training, leaving only the impact of the exercises on the research subjects.

3.4 Athletes

- 16 female athletes from the Ho Chi Minh City basketball team

3.5 Physical fitness test

The study uses physical fitness assessment tests according to the research of Le Minh Chi, *et.al.* (2024) [12], including:

Speed [Run 20m from a standing start (seconds), Defensive slide (seconds), Dribbling (seconds)], **Strenght** [Vertical jump (cm), Hexagonal jump (seconds)], **Flexibility** [Sitting flexibility (cm)], **Skillful** [Run in a T-shape (seconds), Move and pass the ball as much as possible in 30 seconds (points), Move and shoot 2-point baskets from 5 positions in 1 minute (points), Move and shoot 3-pointers from 5 positions in 1 minute (points)],

Endurance [Drill test (seconds), VO2max (ml/kg/minute), Relative Peak Power (RPP) (w/kg), Relative Mean Power (w/kg)].

3.2. The progression of physical fitness during a training cycle of a female athlete from the Ho Chi Minh City basketball team, Vietnam

The study conducted an assessment of the physical condition over a training cycle of the female athletes of the Ho Chi Minh City basketball team according to the following steps:

Step 1: The study conducts a performance evaluation of the physical fitness tests of the female athletes of the Ho Chi Minh City Basketball team according to each training period: Pre-experiment (PE), transition (T), preparation (P), general preparation (GP), and specialized preparation (SP). Compare the average performance values of the physical fitness assessment tests of the research subjects between the different training periods with each other.

Step 2: Conduct an assessment of the physical development of the research subjects via each training period according to the growth rhythm and evaluation standards (section 3.1).

Step 3: Compare the physical development of the research subjects between different training periods.

3.2.1. Compare the average performance values of the specialized physical fitness assessment tests of the research subjects between different periods

The study conducted an assessment of the physical fitness test results of the female athletes of the Ho Chi Minh City Basketball Team according to different training periods: Pre-experiment (PE), Transition period (TP), Preparation period (P), General preparation (GP), and Specialized preparation (SP). Calculate the mean value and standard deviation; the results are shown in Table 3. 1.

Table 1: Statistics of physical fitness test results of female athletes of the Ho Chi Minh City Basketball Team by training periods

	Test	Pre-experiment		Transition		General preparation		Specialized preparation	
		\bar{X}_{PE}	SD	\bar{X}_T	SD	\bar{X}_{GP}	SD	\bar{X}_{SP}	SD
1	Run 20m from a high start (s)	3.73	0.20	3.67	0.20	3.53	0.21	3.47	0.21
2	Standing high jump (cm)	48.56	4.41	51.06	4.09	55.19	3.95	56.63	4.18
3	Hexagonal jump (s)	15.91	0.27	15.73	0.26	15.45	0.26	15.27	0.27
4	Sitting flexibly, bending the body (cm)	20.88	3.90	21.94	3.68	23.69	3.55	24.25	3.49
5	Run in a T-shape (s)	11.55	0.27	11.46	0.26	11.21	0.26	11.11	0.25
6	Drill test (s)	33.19	1.84	33.12	1.83	31.21	1.78	31.12	1.78
7	Move and pass the ball as much as possible in 30 seconds (points)	50.50	2.03	52.31	1.99	57.38	1.96	59.13	1.78
8	Move and shoot 2-point baskets from 5 positions in 1 minute (points)	16.00	2.31	17.00	2.22	18.75	2.02	19.56	1.93
9	Move and shoot 3-pointers from 5 positions in 1 minute (points)	9.63	1.63	10.19	1.87	12.63	1.67	13.56	1.67
10	Defensive slide (s)	11.69	0.45	11.63	0.46	10.42	0.45	10.34	0.44
11	Dribbling (s)	8.67	0.39	8.58	0.37	8.46	0.37	8.39	0.36
12	VO2max/kg (ml/minute/kg)	45.01	2.90	45.36	2.75	47.29	2.78	48.25	2.99
13	Relative Peak Power (RPP) (w/kg)	9.31	0.98	9.44	0.99	9.84	1.07	10.04	1.04
14	Anaerobic Capacity Power (ACP) (w/kg)	7.45	0.87	7.56	0.85	7.96	0.86	8.18	0.88

The data in Table 3.1 show that the average performance values of the physical fitness assessment tests for the research subjects differ across training periods; performance in the later period tends to be better than in the earlier period. To evaluate accurately and scientifically the research, conduct a

comparison of the average performance values of the physical fitness assessment tests of the research subjects between different periods through a one-way ANOVA, with the results presented in Table 1.

Table 2: Comparison of the average performance values of physical fitness tests for female athletes of the Ho Chi Minh City Basketball Team across different training periods.

TT	Test	Mean1	Mean2	Mean3	Mean4	F	Sig	Post - hoc (Scheff)
1	Run 20m from a high start (s)	3.73	3.67	3.53	3.47	5.48	.002	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
2	Standing high jump (cm)	48.56	51.06	55.19	56.63	12.72	.000	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
3	Hexagonal jump (s)	15.91	15.73	15.45	15.27	5.58	.002	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
4	Sitting flexibly, bending the body (cm)	20.88	21.94	23.69	24.25	2.90	.042	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
5	Run in a T-shape (s)	11.55	11.46	11.21	11.11	9.93	.000	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
6	Drill test (s)	33.19	33.12	31.21	31.12	6.49	.001	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
7	Move and pass the ball as much as possible in 30 seconds (points)	50.50	52.31	57.38	59.13	10.37	.000	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$
8	Move and shoot 2-point baskets from 5 positions in 1 minute (points)	16.00	17.00	18.75	19.56	9.31	.000	$\mu_1 \approx \mu_2, \mu_3 \approx \mu_4$ $\mu_1, \mu_2 < \mu_3, \mu_4$

9	Move and shoot 3-pointers from 5 positions in 1 minute (points)	9.63	10.19	12.63	13.56	19.57	.000	$\mu 1 \approx \mu 2, \mu 3 \approx \mu 4$ $\mu 1, \mu 2 < \mu 3, \mu 4$
10	Defensive slide (s)	11.69	11.63	10.42	10.34	43.25	.000	$\mu 1 \approx \mu 2, \mu 3 \approx \mu 4$ $\mu 1, \mu 2 < \mu 3, \mu 4$
11	Dribbling (s)	8.67	8.58	8.46	8.39	1.74	.168	$\mu 1 \approx \mu 2 \approx \mu 3, \mu 2 \approx \mu 3 \approx \mu 4$ $\mu 1 < \mu 4$
12	VO2max/kg (ml/minute/kg)	45.01	45.36	47.29	48.25	4.71	.005	$\mu 1 \approx \mu 2 \approx \mu 3, \mu 2 \approx \mu 3 \approx \mu 4$ $\mu 1 < \mu 4$
13	Relative Peak Power (RPP) (w/kg)	9.31	9.44	9.84	10.04	1.80	.157	$\mu 1 \approx \mu 2 \approx \mu 3, \mu 2 \approx \mu 3 \approx \mu 4$ $\mu 1 < \mu 4$
14	Anaerobic Capacity Power (ACP) (w/kg)	7.45	7.56	7.96	8.18	2.47	.071	$\mu 1 \approx \mu 2 \approx \mu 3, \mu 3 \approx \mu 4$ $\mu 1, \mu 2 < \mu 4$

$\mu 1$: Pre-experiment, $\mu 2$: Transition period, $\mu 3$: General preparation, $\mu 4$: Specialized preparation

The data in Table 3.2 show that most of the average performance values of the physical fitness assessment tests of the research subjects between the initial phase and the transition period, the general preparation phase, and the specialized preparation phase are equivalent (sig > 0.05); the preparation period (general, specialized) has better performance than the initial phase and the transition period, and this difference is statistically significant (sig < 0.05).

The above results show that during the transition period, the average performance values of the physical fitness assessment tests of the research subjects, although differing from the initial stage, the differences are very small and not statistically significant (sig > 0.05) and can be considered equivalent. In reality, during the transition period, the coaching staff only used a few game-based exercises with low volume and intensity to maintain the athletes' fitness, so the development of their physical fitness was limited.

During the preparation period, the coaching staff used exercises with gradually increasing volume and intensity to best prepare the athletes' physical fitness for competition. Therefore, the average performance values of the physical fitness assessment tests of the research subjects showed significant improvement compared to the transition period, with a statistically significant difference (sig < 0.05).

3.2.2. Evaluate the physical development of the research subjects during each training period according to the growth rhythm (section 3.1).

The study evaluates the development of the research subjects' physical fitness during each training period according to the growth rhythm of performance in physical fitness assessment tests during each training phase; the differences between the training phases were tested using ANOVA, with results presented in Table 3.

Table 3: Comparison of the average growth rate of physical fitness test results of the female athletes of the Ho Chi Minh City Basketball Team during different training periods.

	Test	W1	W2	W3	W4	F	Sig	Post - hoc (Scheff)
1	Run 20m from a high start (s)	0.84	1.96	0.81	2.77	71.76	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
2	Standing high jump (cm)	2.55	3.91	1.28	5.19	59.43	.000	$\mu 3 < \mu 1 < \mu 2 < \mu 4$
3	Hexagonal jump (s)	0.61	1.65	0.65	2.30	55.89	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
4	Sitting flexibly, bending the body (cm)	2.64	3.96	1.22	5.18	10.87	.000	$\mu 3 < \mu 1 < \mu 2 < \mu 4$
5	Run in a T-shape (s)	0.39	1.09	0.45	1.53	200.32	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
6	Drill test (s)	0.11	2.97	0.14	3.12	1680.9	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
7	Move and pass the ball as much as possible in 30 seconds (points)	3.90	8.54	1.47	9.99	23.31	.000	$\mu 3 < \mu 1 < \mu 2 < \mu 4$
8	Move and shoot 2-point baskets from 5 positions in 1 minute (points)	3.12	5.02	2.16	7.16	19.41	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
9	Move and shoot 3-pointers from 5 positions in 1 minute (points)	2.73	11.01	3.64	14.58	50.64	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
10	Defensive slide (s)	0.29	5.47	0.42	5.89	4255.7	.000	$\mu 1 \approx \mu 3$ $\mu 1, \mu 3 < \mu 2 < \mu 4$
11	Dribbling (s)	0.56	0.65	0.43	1.08	39.62	.000	$\mu 1 \approx \mu 2 \approx \mu 3$ $\mu 1, \mu 2, \mu 3 < \mu 4$
12	VO2max/kg (ml/minute/kg)	0.40	2.09	0.99	3.08	90.75	.000	$\mu 1 < \mu 3 < \mu 2 < \mu 4$
13	Relative Peak Power (RPP) (w/kg)	0.67	2.09	1.03	3.12	48.23	.000	$\mu 1 < \mu 3 < \mu 2 < \mu 4$
14	Anaerobic Capacity Power (ACP) (w/kg)	0.72	2.60	1.36	3.96	63.19	.000	$\mu 1 < \mu 3 < \mu 2 < \mu 4$

$\mu 1$: Transition period, $\mu 2$: General Preparation, $\mu 3$: Specialized preparation, $\mu 4$: Preparation period

The data in Table 3.3 shows that the average growth rate of performance in physical fitness tests of the research subjects between the transition period and the specialized preparation phase is equivalent ($\text{sig} > 0.05$); the preparation period has a better average growth rate than the transition phase, this difference is statistically significant ($\text{sig} < 0.05$); During the preparation period, the average growth rate of the general preparation phase is better than that of the specialized preparation phase, and the difference is statistically significant ($\text{sig} < 0.05$).

The above results indicate that during the transition period and the specialized preparation phase, the average growth rate of the subjects' performance in specialized physical fitness tests is equivalent ($\text{sig} > 0.05$). In reality, during the transition period, the coaching staff only used a few game-based exercises with low volume and intensity to maintain the athletes' fitness, so the development of specialized fitness for the athletes was not high. In the specialized preparation phase, the coaching staff used high-level physical maintenance exercises to prepare for competitions, so the development of physical fitness was also not high.

During the preparation period, the coaching staff used exercises with gradually increasing volume and intensity to best prepare the athletes' physical fitness for competition. As a result, the average growth rate of the performance in the physical fitness assessment tests of the research subjects showed significant improvement compared to the transition period, with a statistically significant difference ($\text{sig} < 0.05$).

4. Discussion

The research results show that the training plan for the female athletes of the Ho Chi Minh City basketball team is structured in cycles, including transition, general preparation, and specialized preparation periods, in accordance with modern sports training principles. According to Bompa, T. O., & Buzzichelli, C. (2019) [13], the division of training cycles helps enhance adaptability and develop specialized physical fitness for athletes.

The results of the physical fitness tests show that the athletes' performance tends to improve with each training phase. The indicators of speed, strength, endurance, and agility all develop better during the preparation period compared to the initial phase and the transition period. Especially, the performance in the 20m run, defensive slide, and standing high jump improved significantly, reflecting the effectiveness of speed and explosive strength development exercises. According to Delextrat và Cohen (2009) [14], Speed and jumping power are important factors that determine the effectiveness of women's basketball performance.

Specialized tests such as ball movement, 2-point shooting, and 3-point shooting have all shown significant improvement. This shows that the athletes' coordination and technical skills have improved through simulated competition exercises. Hoffman (2014) [15] argues that technical effectiveness in basketball largely depends on the coordination between physical fitness and the ability to control specialized movements.

In the endurance group, both VO₂max and anaerobic power increased throughout the training phases. This result reflects the improved ability to supply energy and maintain exercise intensity of the athletes. According to Castagna *et al.* (2008) [16], basketball requires the coordination of the aerobic and anaerobic energy systems to maintain performance throughout the game.

The ANOVA results show that most tests have statistically significant differences between the preparation period and the

initial and transition phases ($\text{Sig} < 0.05$). Meanwhile, the transition period has a lower level of development due to primarily using low-volume and low-intensity fitness maintenance exercises. The general preparation phase has the highest rate of physical fitness growth, consistent with Platonov's (2015) [17] view that this is the most important phase for developing the foundational physical fitness in the training cycle.

Overall, the training cycle has had a positive impact on the professional physical development of the female athletes of the Ho Chi Minh City basketball team, especially during the general preparation phase.

5. Conclusion

The study successfully established and implemented a 5-month training cycle (06/2020 – 10/2020) for female basketball players in Ho Chi Minh City, clearly distinguishing between the Transition phase (maintained at low intensity) and the Preparation phase (enhanced differentiation through two periods: general preparation and specialized preparation). The training management process at the three specialized locations has ensured the objectivity of the exercises' impact on the research subjects.

1. Experimental results show the systematic development of 14 specialized physical fitness indicators:

Regarding performance value: There is a significant growth throughout each phase, in which the Preparation phase has a much better performance than the Transition and Pre-experimental phases ($p < 0.01$). The technical indicators combining physical fitness and physiology (VO₂max) reached optimal levels by the end of the cycle.

Regarding the growth rhythm: The development speed reaches its peak during the general preparation phase, laying a solid physical foundation before entering the specialized preparation phase to stabilize technical and tactical performance.

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How to Cite This Article

Le Minh C, Nguyen TME, Ho HTA. Study on The Development of Physical Fitness During A Training Cycle of Female Athletes in the Ho Chi Minh City Basketball Team, Vietnam. *International Journal of Multi Research*. 2026; 2(3): 07-12.

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