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The effectiveness of the sports training environment on the physical development of female students at Thai Nguyen university of education in Vietnam

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Abstract

This study aims to evaluate the impact of the sports training environment on the physical development of female students at Thai Nguyen University of Education in Vietnam after a 12-week intervention. Seventy-four healthy female students were randomly selected and divided into two groups: an experimental group, which participated in a structured physical training environment, and a control group, which engaged in self-directed training. Five fitness criteria were used to assess physical development: the 30-meter sprint test (to measure speed), the standing long jump test (to measure explosive leg power), the 30-second sit-up test (to assess core strength), the 4×10-meter shuttle run test (to evaluate agility), and a 5-minute endurance run test (to assess endurance). After 12 weeks of physical training in an enhanced environment, the experimental group demonstrated higher improvements across all five fitness tests compared to the control group. In the experimental group, the most significant improvements were observed in the 30-second sit-up test (31.35%), standing long jump (12.85%), 5-minute endurance run (11.21%), 30-meter sprint (6.69%), and 4×10-meter shuttle run (6.33%). This study has shown that the sports training environment has a strong influence on the physical development of female students. Universities should consider and recommend enhancing training environments as a measure to improve both the academic performance and physical development of students.

Keywords: Physical fitness, Sports training environment; Students, Thai Nguyen University of Education, Vietnam.

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Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Institutional Review Board Statement: The study was conducted following the principles of the Declaration of Helsinki. All participants were informed about the study procedures and provided written consent. This research was approved by the Scientific Research & Education Council at Thai Nguyen University of Education (TNUE) according to Decision No. 1356/QD-DHSP, dated May 29, 2024 of the Rector of TNUE. Participants were encouraged to maintain consistent physical activity, diet, and daily routines throughout the study.

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1. Introduction

The environment is the primary factor influencing the level of daily physical activity and exercise participation among children and adolescents [1, 2]. Ecological models propose that physical and social environments, such as economic conditions, social norms, urbanization, and industrialization, are key determinants of physical activity engagement [3]. Moreover, a dynamic community environment fosters increased physical activity through better urban planning and infrastructure design [4]. In China, built environments have shown a positive correlation with youth physical activity [5].

Sports are essential not only for individual health protection but also for enhancing social interaction and fostering intercultural integration. Moreover, sports contribute significantly to both physical and mental well-being, regulate social behaviors positively, and improve both physical and psychological attributes to a certain extent [6, 7]. Therefore, it is crucial to recognize the important role of sports in improving individuals' health and overall well-being [8].

University life represents a crucial transitional stage during which students gain greater autonomy in decision-making. At this phase, students tend to join various communities, sports teams, dance groups, or musical ensembles to fulfill social interaction needs and personal interests. However, individual responses to these opportunities vary depending on personal characteristics [9]. The university sports environment, comprising fields, facilities, equipment, coaching staff, management, educational programming, and sports organizations, is foundational to a nation's healthy sports development. The absence of any of these components hinders progress [10]. Engaging in diverse sports environments fosters a healthy lifestyle and supports the development of social values. Sports are thus acknowledged as a powerful tool for promoting a healthy, happy, and productive society [11]. Moreover, a positive university sports environment significantly impacts students' academic motivation [8].

Universities serve as institutions committed to the scientific development of students and the provision of education for diverse professional fields. Accordingly, extracurricular and athletic activities play a pivotal role in fostering traits such as self-confidence, autonomy, quick decision-making, and precision [12]. Furthermore, sports also contribute to students' intellectual, physical, and emotional development within the university setting. Participation in sports has been shown to reduce stress, boost self-esteem, enhance academic performance, and facilitate social integration [13]. Institutions with robust sports infrastructure provide richer teaching resources, stimulate student interest and participation, and improve academic efficacy, physical fitness, and skill proficiency [14, 15].

Physical fitness encompasses a range of health-related attributes, including aerobic capacity, muscular endurance, strength, body composition, flexibility, balance, agility, and reaction time [16, 17]. Numerous studies have demonstrated that physical activity exerts a substantial influence on the development of physical fitness among students, producing positive effects that contribute to significant improvements in participants' physical capabilities [18-21].

Identifying the key determinants of physical activity and mental health outcomes is essential to improving educational and developmental outcomes for students. Recent research has emphasized the profound influence of environmental factors, including perceptions of sport policies, school infrastructure, family, and community environments on young individuals' participation in physical activity [22-25]. In addition, a study in Singapore confirmed the importance of school-based physical education programs in enhancing students' fitness [26]. A UK-based study developed an innovative and collaborative physical training model that integrated PE curriculum, school sports, and local sports clubs to support student development [27]. In Vietnam, several authors have examined the impact of sports training environments, such as extracurricular sports movements among students at the Medical College and sports club models for 11th-grade students, as well as the physical fitness of students [28, 29]. However, no research to date has focused specifically on how the sports training environment affects the physical development of students at pedagogical universities.

TNUE, a major institution in northern mountainous Vietnam, has recently invested in creating a supportive environment for academic and physical development. However, due to various internal and external factors, student participation in sports remains limited. The number of students engaging in regular training is still low, the overall quality of sports

activities is suboptimal, and students' physical fitness remains underdeveloped. Furthermore, interest in sports activities is declining, and student participation in athletic competitions has not met expectations. One of the potential causes may be the absence of a structured sports training environment. We hypothesize that students in the enhanced training environment would show greater improvements in physical fitness than those in unstructured training. Therefore, this study aims to evaluate the impact of the sports training environment on the physical development of female students at TNUE in Vietnam after a 12-week intervention.

2. Materials and Methods

2.1. Participants

The study involved 74 healthy female students enrolled at TNUE during the 2024-2025 academic year. All participants were randomly selected and confirmed to be in good physical health, with no smoking or alcohol consumption habits, and not under the influence of any medication. The participants were divided into two groups: the experimental group ($n = 37$) and the control group ($n = 37$). The baseline characteristics of the participants are presented in Table 1.

Table 1.
Participant Characteristics ($n = 74$).

Group	Gender	Age (Years)	Height (cm)	Weight (kg)
Experimental ($n=37$)	Female	20.28 ± 0.79	160.05 ± 4.57	53.40 ± 5.76
Control ($n=37$)	Female	20.19 ± 0.82	160.11 ± 4.48	53.41 ± 5.74

- The experimental group, consisting of 37 female students, participated in training within an environment implementing measures to promote sports activities over a 12-week period. The sports utilized included football, volleyball, badminton, and various movement-based games.
- The control group, comprising 37 students, engaged in physical activity according to personal preferences or in self-organized groups. Students trained independently or in informal groups according to personal preferences, without any formal training structure.

The study was conducted following the principles of the Declaration of Helsinki. All participants were informed about the study procedures and provided written consent. This research was approved by the Scientific Research & Education Council at TNUE according to Decision No. 1356/QĐ-DHSP, dated May 29, 2024, by the Rector of TNUE. Participants were encouraged to maintain consistent physical activity, diet, and daily routines throughout the study.

2.1.1. Procedure

Before the experiment began, all participants completed a brief questionnaire regarding personal information and prior injury or health history. Individuals with relevant health issues were excluded. Subsequently, all students in both the experimental and control groups underwent an initial physical fitness assessment prior to the intervention. The assessments were conducted in accordance with Decision No. 53/2008/QĐ-BGDĐT, issued on September 18, 2008, by the Ministry of Education and Training, which stipulates the regulations for evaluating and classifying students' physical fitness by age and gender, thereby ensuring high reliability [30]. Five physical fitness tests were conducted, including the 30-meter sprint test (to measure speed), the standing long jump test (to measure explosive leg power), the 30-second sit-up test (to assess core strength), the 4×10-meter shuttle run test (to evaluate agility), and the 5-minute endurance run test (to assess endurance). After baseline testing, the experimental group participated in a structured physical training program within an enhanced sports environment over 12 weeks. Meanwhile, the control group continued with self-directed or casual exercise routines. After the 12-week intervention, both groups underwent a second physical fitness assessment using the same five fitness tests as in the initial evaluation.

2.2. Training Program and Sport Activities

Students in the experimental group engaged in regular training sessions within a structured and stimulating sports environment. The program included group training sessions and friendly competitions with internal and external clubs associated with TNUE. All participants completed a 12-week training program, with training sessions held three times per week. Each session lasted 90 minutes and included a warm-up, main training phase, and cool-down. Each warm-up and cool-down phase lasted 15 minutes and was performed at a light intensity (50% HR_{max}). The training intensity during the sessions was maintained at a moderate level (70–80% HR_{max}), and heart rate was monitored before, during, and after the training using a Polar H10 heart rate monitor (as in Table 2). The training program was structured to develop key physical qualities, including speed, strength, endurance, coordination, and flexibility. The sports incorporated in the program included football, volleyball, basketball, and badminton. Students participated in training sessions based on a pre-arranged schedule. The training methodology emphasized active engagement, combining collective and sequential practice in a balanced manner to maximize training time and ensure an appropriate volume of physical activity. A variety of game-based and competitive methods were employed to create engaging and stimulating experiences, thereby encouraging active student participation.

In contrast, students in the control group engaged in unsupervised training without a formal structure or guided program.

Table 2.

Weekly Sports and Training Activities of the Experimental Group (12 weeks).

Weeks	1	2	3	4	5	6	7	8	9	10	11	12
Basic technical skills												
Football	x	x	x	x		x	x		x		x	
Volleyball			x		x		x	x		x		
Basket ball	x				x	x			x	x	x	
Badminton		x	x	x		x		x		x		
Game-based exercises and fitness												
Speed		x		x			x		x		x	
Strength	x				x	x		x		x		x
Endurance			x				x		x			x
Coordination	x		x	x		x		x		x	x	
Flexibility		x			x				x	x		
Competitive performance												
Football	x		x	x		x				x		x
Volleyball		x			x		x	x			x	
Basket ball	x			x			x			x	x	
Badminton			x		x	x		x	x			x

2.3. Statistical Analysis

Data were analyzed using SPSS for Windows, version 20.0. An independent-sample t-test was used to examine differences between the experimental and control groups. A paired-sample t-test was used to assess within-group differences before and after the intervention. Statistical significance was set at $p < 0.05$. The effect size was evaluated using Cohen's d. Data are presented as mean (M) \pm standard deviation (SD).

3. Results

To establish a basis for assessing students' physical fitness development, both the experimental and control groups underwent baseline fitness testing before the intervention. The results of the independent samples t-test comparing the two groups are presented in Table 3.

Table 3.

Pre-Test Independent Samples t-Test Comparing Physical Fitness of Experimental and Control Groups.

Test	Groups	n	M \pm SD	t- value	p- value
Standing long jump (cm)	Control Group	37	151,21 \pm 3,41	0,965	,341
	Experimental Group	37	150,48 \pm 3,65		
30-m sprint (s)	Control Group	37	6,88 \pm 0,16	-0,947	,350
	Experimental Group	37	6,92 \pm 0,25		
30-s sit-up (times)	Control Group	37	14,70 \pm 1,22	0,818	,419
	Experimental Group	37	14,43 \pm 1,28		
5-min running field (m)	Control Group	37	847,70 \pm 19,60	0,194	,847
	Experimental Group	37	846,89 \pm 21,42		
4 \times 10-m shuttle run (s)	Control Group	37	13,12 \pm 0,13	0,782	,440
	Experimental Group	37	13,10 \pm 0,16		

Note: M: Mean; SD: Standard Deviation

The results in Table 3 indicate no statistically significant differences in baseline fitness levels between the control and experimental groups across all five tests ($p > 0.05$). This suggests that both groups were equivalent in physical fitness prior to the intervention, thereby ensuring the objectivity and validity of the experimental setup.

After the 12-week training intervention, a post-test evaluation was conducted to compare fitness levels between the groups. The results of the independent-sample t-test are presented in Table 4.

Table 4.

Post-Test Independent Samples t-Test Comparing Physical Fitness of Experimental and Control Groups.

Test	Groups	n	M \pm SD	t- value	p- value
Standing long jump (cm)	Control Group	37	156,40 \pm 3,47	-19,823	,000
	Experimental Group	37	172,67 \pm 2,21		
30-m sprint (s)	Control Group	37	6,90 \pm 0,15	5,121	,000
	Experimental Group	37	6,47 \pm 0,46		
30-s sit-up (times)	Control Group	37	15,94 \pm 0,97	-15,743	,000
	Experimental Group	37	21,02 \pm 1,86		
5-min running field (m)	Control Group	37	871,08 \pm 31,93	-6,765	,000
	Experimental Group	37	953,78 \pm 54,63		
4 \times 10-m shuttle run (s)	Control Group	37	12,89 \pm 0,31	7,306	,000
	Experimental Group	37	12,32 \pm 0,32		

Note: M: Mean; SD: Standard Deviation.

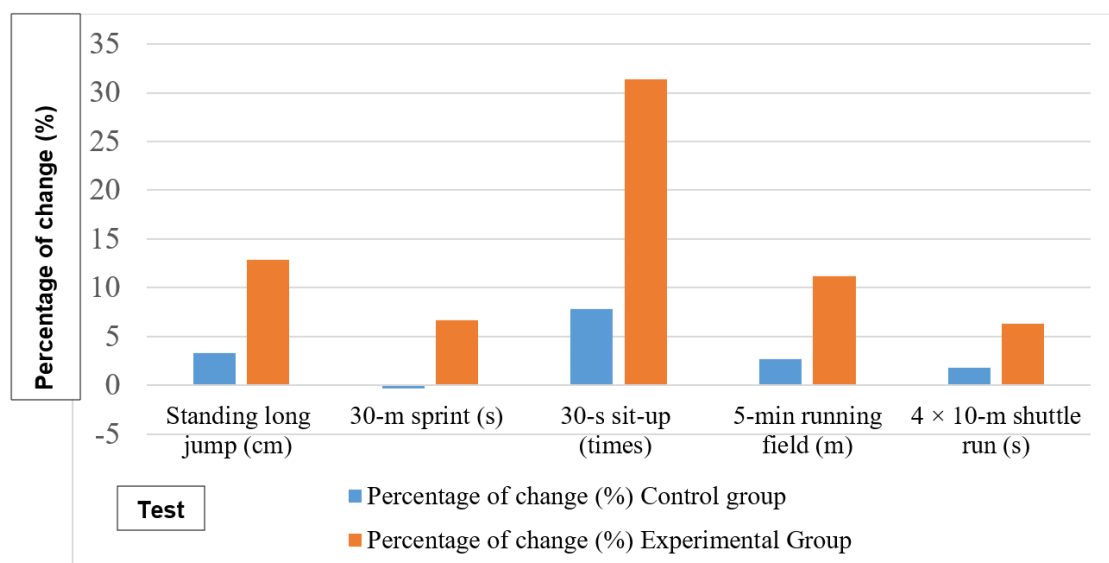
The results presented in Table 4 indicate a significant difference in the physical fitness of female students in the control and experimental groups following the implementation of an enhanced sports training environment over a 12-week period. Post-intervention, the mean scores in all five physical fitness tests measuring explosive leg power (standing long jump test), speed (30-m sprint test), core strength (30-s sit-up test), agility (4 \times 10-m shuttle run test), and endurance (5-min running field test) were higher in the experimental group compared to the control group, with $p < 0.001$. These findings suggest that participation in an enhanced sports training environment positively influenced all five components of physical fitness, fostering balanced, harmonious, and comprehensive development among students.

Table 5.

Paired Sample t-Test Results for the Experimental and Control Groups Before and After the Intervention.

Test	Pre-test (M \pm SD)	Post-test (M \pm SD)	t- value	p- value	Percentage of change (%)
Control group					
Standing long jump (cm)	151.21 \pm 3.41	156.40 \pm 3.47	-6.490	0.000	3.32
30-m sprint (s)	6.88 \pm 0.16	6.90 \pm 0.15	-0.970	0.339	-0.29
30-s sit-up (times)	14.70 \pm 1.22	15.94 \pm 0.97	-4.475	0.000	7.78
5-min running field (m)	847.70 \pm 19.59	871.08 \pm 31.93	-3.703	0.001	2.68
4 \times 10-m shuttle run (s)	13.12 \pm 0.13	12.89 \pm 0.31	4.092	0.000	1.78
Experimental Group					
Standing long jump (cm)	150.48 \pm 3.65	172.67 \pm 2.21	-35.871	0.000	12.85
30-m sprint (s)	6.92 \pm 0.25	6.47 \pm 0.46	5.318	0.000	6.69
30-s sit-up test (times)	14.43 \pm 1.28	21.02 \pm 1.86	-17.796	0.000	31.35
5-min running field (m)	846.89 \pm 21.42	953.78 \pm 54.63	-11.328	0.001	11.21
4 \times 10-m shuttle run (s)	13.10 \pm 0.16	12.32 \pm 0.31	12.405	0.000	6.33

Note: M: Mean; SD: Standard Deviation.

**Figure 1.**

Percentage Improvement in Fitness Scores - Experimental vs. Control Group.

The data in Table 5 and Figure 1 reveal that, after the 12-week intervention, the experimental group demonstrated growth across all physical fitness tests, with higher improvement rates compared to the control group. The post-intervention test results of the experimental group reached a “good” level according to the physical fitness evaluation standards for students outlined in Decision No. 53/2008 of the Ministry of Education and Training. Among these, the greatest improvement was observed in the assessed core strength (30-s sit-up test), with an increase of 31.35%, followed by the measure of explosive leg power (standing long jump test) with a 12.85% increase. The lowest improvement was recorded in endurance (5-minute running test) at 11.21%, while the measure of speed (30-m sprint test) increased by 6.69%, and the evaluated agility (4 × 10-m shuttle run test) showed the smallest increase at 6.33%.

In the control group, differences in physical fitness were also observed between the pre-test and post-test; however, only four assessments the standing long jump test (to measure explosive leg power), the 30-s sit-up test (to assess core strength), the 4×10-meter shuttle run test (to evaluate agility), and the 5-minute endurance run test (to assess endurance) showed statistically significant improvements ($p < 0.05$). The remaining assessment, the 30-meter sprint test (to measure speed), exhibited no significant difference ($p > 0.05$). While the control group experienced some improvements in physical fitness after the intervention, the overall improvement level was relatively low. The highest increase was recorded in the 30-s sit-up test at 7.78%, followed by the standing long jump test at 3.32%, the 5-minute running field test at 2.68%, and the 4×10-m shuttle run test at 1.78%. Notably, the 30-m sprint test performance slightly declined compared to baseline, with an improvement rate of −0.29%.

These findings indicate that both the control and experimental groups showed improvements in students’ physical fitness after the 12-week training period. However, participation in the enhanced sports training environment yielded greater overall effectiveness in the experimental group, with more substantial and uniform improvements across all five fitness assessments (Figure 1). In contrast, the control group’s unstructured, preference-based training also contributed to fitness gains among female students but resulted in less consistent improvements across the five tests, thereby limiting overall effectiveness.

4. Discussion

Our study demonstrates that implementing an enhanced sports training environment has a substantial impact on female students’ physical fitness. After 12 weeks of intervention, the mean values achieved in all five physical fitness tests for the experimental group were significantly higher than those of the control group ($p < 0.001$, independent t-test and paired sample t-test). These findings suggest that engaging students in a structured training environment featuring four sports (soccer, volleyball, badminton, basketball) combined with fitness-oriented games and competitive activities offers diverse and stimulating training experiences. Such an environment significantly improves physical fitness compared to unstructured or informal group training based on personal preference.

Universities are ideal settings for promoting physical activities and enhancing students’ fitness levels. At TNUE, where female students account for approximately 80% of enrollment, our study examined both baseline fitness levels and changes after a 12-week intervention using the method “Enhancing Sport Competitions and Collaboration to Develop Physical Education and Sports Activities for Students of Thai Nguyen University.” Baseline results indicated that female students at TNUE had average physical fitness levels. This aligns with findings by Irēna et al. [19] who reported relatively balanced physical fitness among students in social sciences [19].

Our findings align with several intervention studies that have shown that participation in sports clubs leads to improved physical fitness. This improvement is particularly notable in endurance and strength, as evidenced in Tahira’s research [31]. Participation in sports clubs is also associated with higher physical fitness in terms of endurance, strength, power, and agility, as highlighted in the research by Drenowatz et al. [32]. Some previous studies share similar views with our research. They demonstrate a positive relationship between sports participation and the physical development of students [33-36].

Found that women performed better than men in flexibility tests, consistent with studies on adolescent health status by Wiecezorek et al, which revealed gender differences in fitness test performance, supporting similar findings by other researchers Wiecezorek and Adrian [37].

Sallis et al. [38] demonstrated that environment design in neighborhoods and socioeconomic status influence adolescents’ physical activities, sedentary behavior, and weight status. Selecting appropriate strength-training methods can help female university students comprehensively develop motor fitness components, thereby improving health, physique, and self-confidence [38].

Moreover, leveraging available sports facilities can further enhance students’ physical fitness. Physical fitness activities engage the whole body, developing coordination, strength, flexibility, and balance [39].

A study by Aoyagi et al. [25] and colleagues in Japan, through qualitative analysis of interview data, revealed that internal individual factors including the attractiveness of the sport, sense of responsibility, and diligence in training among students and external factors including training space, facilities, policies, and the content of sports activities—are considered key to promoting physical activities among adolescents. Factors supporting adolescent sports participation, such as training grounds, equipment, sports clubs, and annually organized sporting events, all contribute to influencing their physical fitness [25].

Research by Tu et al. [28] analyzed the impact of sports training environments, such as sport movements, student sport clubs, on physical development, fitness, and academic performance among students at Thai Nguyen University. Results showed that a favorable sports environment enhances motivation and enjoyment in training, with better fitness and

academic outcomes compared to institutions lacking adequate training conditions. The analysis confirmed the positive effects of high-quality training environments on female students' health and physical fitness [28, 29].

A related study evaluated sports facilities and physical education programs at public colleges in Chitwan, Nepal. It assessed intramural and extracurricular sports, budgets, infrastructure, and participation barriers. Many institutions lacked adequate facilities, regular coaching, and financial incentives for student-athletes. Gender disparities in participation were evident, with female students facing more barriers. Academic workload also negatively affected participation. Providing suitable and sufficient physical activity facilities in universities can improve students' attitudes toward physical activities during their studies. Since student needs vary, these must be considered when improving programs and facilities [40].

Overall, our study confirms that implementing the "Enhancing sport competitions and collaboration to develop physical education and sports activities for students" initiative for 12 weeks significantly improved speed, core strength, explosive leg power, and endurance among students at TNUE.

5. Conclusion

At TNUE, engaging in regular physical activities remains a challenge, particularly among female students. This study has demonstrated that implementing the intervention titled "*Enhancing sport competitions and collaboration to develop physical education and sports activities for students*" had a positive and significant impact on the physical fitness of the participants. Before the intervention, both the experimental and control groups had comparable fitness levels. However, after a 12-week program implementing "sport competitions and collaboration to develop physical education and sports activities for students," the students of TNUE in the experimental group showed substantial improvements in all five tested fitness components: running speed, core endurance, leg power, overall endurance, and motor coordination.

In conclusion, the implementation of the measure "Enhancing sport competitions and collaboration to develop physical education and sports activities for students of TNUE" over a 12-week period has yielded significant improvements and greater benefits compared to when no measures were applied to develop the training environment. Specifically, after applying this measure, a diverse and healthy learning and physical training environment was created, meeting the needs of students at TNUE. Furthermore, participants in this study had more opportunities to engage in recreational activities, explore their own abilities, improve their health, and exchange knowledge with one another. These experiences not only contribute to their personal growth but also expand their social networks, which can support their future professional endeavors.

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