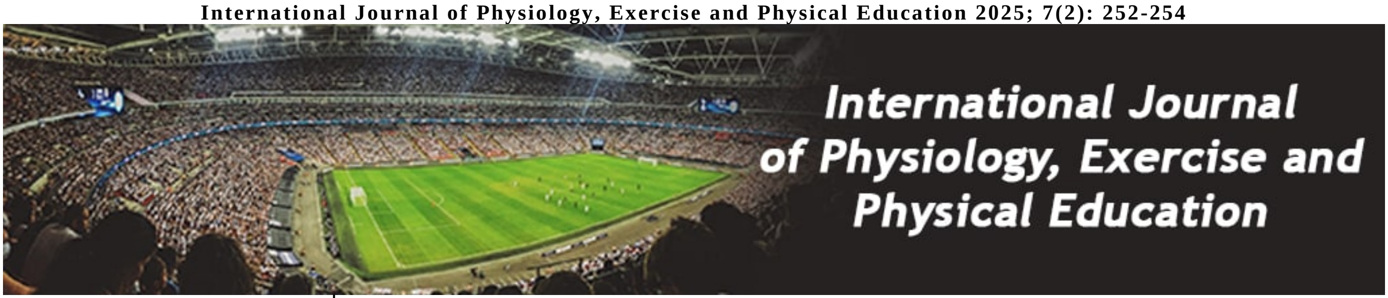
International Journal of Physiology, Exercise and Physical Education 2025; 7(2): 252-254



ISSN Print: 2664-7249
ISSN Online: 2664-7257
Impact Factor (RJIF): 8.3
IJPEPE 2025; 7(2): 252-254
www.physicaleducationjournals.com
Received: 19-07-2025
Accepted: 21-08-2025

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The impact of a 3-month strength regimen on male 100m sprinters at Tay Nguyen University

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DOI: https://www.doi.org/10.33545/26647249.2025.v7.i2d.224

Abstract
This study investigates the application of a structured system of strength exercises for male students in the 100m sprint group at Tay Nguyen University. The results demonstrate significant improvements across all 11 assessment criteria, which include 7 indicators of general strength and 4 indicators of specialized strength. Notably, two indicators showed the most substantial progress: the 30kg Barbell Lunge Jump (10 seconds), with a growth rate (W %) of 17.34%, and the Supine Bent-Knee Sit-up (30 seconds), with a growth rate (W %) of 14.14%. Therefore, the development and implementation of this strength training regimen are deemed appropriate, feasible, and highly applicable for enhancing performance in the 100m sprint.

Keywords: Strength training, Sprint performance, 100-Meter sprint, University athletes, Physical education

Introduction
Athletics, and specifically sprinting, constitutes a foundational component of the physical education curriculum in Vietnam. The 100m sprint is frequently employed as a key performance benchmark in both general and specialized university programs, underscoring a national focus on physical proficiency [1]. This educational approach aligns with a broader philosophy that recognizes the intrinsic link between physical health and the holistic development of students, a perspective consistently supported by the Ministry of Education and Training [2]. The physiological demands of the 100m dash are extraordinary, requiring athletes to produce maximal power output in an extremely short timeframe. Modern sports science has unequivocally established that success in this event is fundamentally determined by an athlete's muscular power, which is a function of both maximal strength and the speed at which that strength can be applied [3]. Consequently, a structured strength training program is no longer considered supplementary but is a core pillar of contemporary sprint training methodology [4]. A well-periodized regimen enhances neuromuscular efficiency, increases the rate of force development (RFD), and optimizes biomechanical patterns essential for achieving elite sprint speeds [5, 6]. Furthermore, the psychological fortitude and self-efficacy developed through rigorous physical preparation are critical contributors to competitive success [7]. Despite this clear consensus, the practical application of evidence-based strength protocols for non-specialized student-athletes in a university setting remains an area requiring further investigation [8]. At Tay Nguyen University, the 100m sprint is a formal assessment tool, creating a need for a training intervention that is not only effective but also feasible and safe for this demographic. This study, therefore, aims to implement and systematically evaluate a specialized strength exercise program designed to enhance the 100m sprint performance of male university students. The findings are intended to provide actionable, evidence-based insights for advancing the quality of physical education and sports coaching within the Vietnamese higher education system.

Materials and methods
Study design
This study utilized a pre-test/post-test design to assess the effects of a 12-week strength training intervention. All participants were evaluated on performance indicators before (pre-test) and after (post-test) the training period.

Participants

Thirty male non-specialized physical education students (age: 18-21 years) from Tay Nguyen University participated in the study. All subjects provided written informed consent and were free from musculoskeletal injuries prior to commencement.

Procedure

The study was conducted over 14 weeks at Tay Nguyen University. It included a pre-testing week, a 12-week training intervention, and a post-testing week. All testing protocols were identical for both pre- and post-assessments.

Assessment indicators

Performance was quantified using a battery of tests, including:

- General strength (7 tests): Standing long jump, hand grip strength, push-ups (60s), trunk extension, sit-and-reach, supine sit-ups (30s), and estimated 1RM back squat.
- Specialized strength (4 tests): 30m sprint, vertical jump, overhead medicine ball throw, and 30kg barbell lunge jumps (10s).
- Primary performance: 100m sprint time, measured with electronic timing gates.

Training intervention

The 12-week training program consisted of three 75-minute sessions per week on non-consecutive days. Sessions included a dynamic warm-up, a main workout, and a cool-down. The main workout focused on foundational strength (e.g., squats, deadlifts) and explosive power exercises (e.g., box jumps, kettlebell swings), adhering to the principle of progressive overload.

Statistical analysis

Data were analyzed using SPSS (Version 26.0). Paired-samples t-tests were used to compare pre-test and post-test means, with statistical significance set at $p < 0.05$. The percentage of improvement (W%) was calculated as:

$$W(\%) = \frac{(\text{Mean}_{\text{post-test}} - \text{Mean}_{\text{pre-test}})}{\text{Mean}_{\text{pre-test}}} \times 100$$

Results and discussion

General strength improvements

The 12-week strength training intervention yielded statistically significant improvements across all seven assessed general strength indicators ($p \leq 0.05$), as detailed in Table 1. These findings strongly suggest the program was effective in enhancing the overall physical capacity of the participants.

The most notable gains were observed in muscular power endurance and core strength. Specifically, the 30kg Barbell Lunge Jumps (10s) improved by a remarkable 17.34%, while the Supine Sit-ups (30s) increased by 14.14%. This substantial progress indicates the training was particularly effective at developing the ability to produce force repeatedly and maintain trunk stability. A strong, stable core is essential for efficient force transfer during sprinting, and enhanced power endurance is critical for resisting fatigue and maintaining technique throughout the 100m race[4, 7]. The rapid adaptation in these areas may suggest a lower initial baseline fitness level in the participants.

Table 1: Changes in general strength indicators of male students

No.	Indicator	Pre-test (X1)	SD	Post-test (X2)	SD	W(%)	p-value
1	Standing long jump (m)	2.48	2.05	2.51	3.08	1.20	0.05
2	Triple hop for distance (m)	6.74	2.18	6.85	2.32	1.62	0.05
3	Five-stride bound (m)	11.72	3.19	11.84	3.38	1.02	0.05
4	Supine sit-ups in 30s (reps)	20.70	1.34	23.85	2.35	14.14	0.05
5	30kg barbell lunge jumps in 10s (reps)	18.70	2.05	22.25	3.16	17.34	0.05
6	35kg barbell high knees in 10s (reps)	23.60	3.37	24.30	3.06	2.92	0.05
7	Half squat estimated 1rm (kg)	67.30	4.81	70.40	6.59	4.50	0.05

Furthermore, foundational strength and explosive power also developed positively. The Half squat estimated 1RM rose by 4.50%, providing a stronger base for all dynamic movements. This increase in maximal strength is a key prerequisite for enhancing explosive power, which is consistent with previous research demonstrating a direct positive transfer from lower-body strength to sprint performance[5]. Consequently, modest but significant gains were also seen in horizontal plyometric tests such as the Standing Long Jump (1.20% improvement).

In conclusion, the study provides robust evidence that a targeted 12-week strength program can significantly elevate the general strength profile of non-elite male university sprinters. The practical implication is clear: incorporating exercises that build foundational strength, core stability, and power endurance is a viable and effective strategy for physical education curricula aimed at improving student athletic performance. A primary limitation was the absence of a control group; therefore, future studies should include one to further validate these findings.

Others strength improvements

The training program yielded statistically significant improvements across all four others strength indicators ($p \leq 0.05$), confirming its effectiveness in developing attributes directly applicable to sprinting (Table 2). The most dramatic increase was in the 30kg barbell lunge jumps (17.34%), highlighting a rapid enhancement in muscular power endurance, which is crucial for sustaining force output during a race [4].

Table 2: Changes in others strength indicators

No.	Indicator (Unit)	Pre-test (X1)	SD	Post-test (X2)	SD	Improvement (%)
1	30m Sprint (s)	4.35	0.21	4.21	0.19	3.22*
2	Vertical jump (cm)	45.5	4.8	48.2	5.1	5.93*
3	Overhead medicine ball throw (m)	8.2	0.7	8.9	0.8	8.54*
4	30kg barbell lunge jumps in 10s (reps)	18.70	2.05	22.25	3.16	17.34**

The program successfully built the foundational explosive power necessary for sprinting. The gains in the Vertical jump (5.93%) and the Overhead medicine ball throw (8.54%) reflect an improved ability to generate vertical and total-body force, respectively. This demonstrates a stronger capacity to apply force to the ground and an enhanced ability to transfer energy through the kinetic chain, both of which are key mechanical determinants of sprint velocity [3]. Crucially, this enhanced power potential successfully transferred to on-track performance, as evidenced by the 3.22% improvement in the 30m Sprint. This validation of training transfer is the most important outcome, as it confirms that the strength gained in the gym directly resulted in faster acceleration [5]. The pattern of results is logical: the program first established a foundation of explosive strength and power, which in turn enabled a more effective and faster sprint execution. This aligns perfectly with modern training theory, which emphasizes building specific strength qualities as a prerequisite for improving complex athletic skills like sprinting [4, 6].

Improvements in sprint performance indicators

The training program culminated in statistically significant improvements across all four on-track sprint performance indicators ($p \leq 0.05$), as detailed in Table 3. This demonstrates a successful transfer of the foundational strength gains (Table 1) and specialized power gains into faster running times.

The results indicate that the program had a pronounced effect on the initial acceleration and maximum velocity phases of the sprint. The greatest percentage improvement was seen in the 30m flying start (3.78%), which is a key measure of maximum velocity. This suggests that the enhanced power and strength from the training allowed the students to achieve and maintain a higher top speed. Close behind was the 30m sprint from a block start (3.66%), indicating a significantly improved acceleration capacity. The ability to accelerate rapidly is fundamentally dependent on the explosive strength developed through exercises like squats and plyometric jumps, as previously discussed [5].

Table 3: Changes in sprint performance indicators

No.	Indicator (Unit)	Pre-test (X1)	SD	Post-test (X2)	SD	Improvement (%)
1	30m sprint - block start (s)	4.45	2.12	4.29	2.10	3.66
2	60m sprint - block start (s)	8.52	2.06	8.26	2.08	3.10
3	100m sprint - standing start (s)	12.94	2.17	12.71	2.19	1.79
4	30m flying start (s)	4.85	3.13	4.67	3.12	3.78

The improvement in the 60m sprint (3.10%) and the full 100m sprint (1.79%) further supports the program's overall effectiveness. The smaller percentage gain in the 100m distance is expected, as this event also involves factors like speed endurance and running economy, which may require more specific types of conditioning.

Conclusion

The discussion of these on-track results provides the ultimate validation for the study's training intervention. The strength and power developed in the gym were not isolated gains; they successfully translated into tangible, meaningful improvements in every key phase of the 100m sprint. This confirms that the selected system of exercises is a viable and highly effective method for enhancing the sprint performance of university students.

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