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Development of Functional Training Program to Improve Sprinting Ability in University Students

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Abstract

Background and Aim: This study was to develop and evaluate a functional training program to enhance sprinting ability among university students. The research objectives included: 1) to compare the mean of sprinting ability between experimental and control groups, 2) to compare the mean of sprinting ability within experimental groups, pretest, midtest, and posttest, and 3) to develop a functional training program to improve sprinting ability in university students.

Materials and Methods: The study employed a quasi-experimental design involving 30 track and field students with simple random sampling and divided them into experimental and control groups. Research instruments included a functional training program developed and validated through expert consultation (CVI = 0.82), an infrared laser timer for measuring sprinting ability, and a standing long jump test. The experiment was conducted over 8 weeks, 4 days per week; the functional training program was used for the experimental group, and a conditioning training program for the control group. Data were analyzed using mean and standard deviation, independent t-tests, repeated measures ANOVA, and Bonferroni post hoc pairwise comparisons between pretest, midtest, and posttest, with significance set at $p < .05$.

Results: The results found that the experimental group demonstrated significant improvements in sprinting ability compared to the control group, including reduced sprint times and enhanced explosive power. Within the experimental group, significant progressive improvements were observed across pretest, midtest, and posttest evaluations. The functional training program was of excellent quality, with a content validity index (CVI = 0.82), and the tryout with sample results was adequate in terms of exercise drills, training volume, and recovery times.

Conclusion: Highlighting the effectiveness of the training program in enhancing sprinting performance metrics such as acceleration and maximum speed. The functional training program can improve sprinting ability in university students.

Keywords: Functional Training Program; Sprinting Ability; University Students

Introduction

The sprint ability of sprinters, as the core indicator to measure their competitive level, directly determines the result in the competition. This ability not only reflects the speed and strength of the athletes but is also closely linked with their technical mastery, psychological quality, endurance, and other qualities, which constitute an important part of the comprehensive quality of the sprinters. The studies of many scholars have discussed this in depth. For example, Wang (2015) pointed out in the article "The Importance of Sprint Technology in the Race" that sprint ability was the key for sprinters to decide the outcome in the final stage of the race. Whether the athlete can keep high speed and complete the sprint effectively at the critical moment has a direct impact on his results. Zhao (2018) further pointed out in his strategy on improving sprint ability that athletes with strong sprint ability often perform well in other aspects, such as quick starting response and stable running skills on the way. These performances are not only derived from the physical quality of the athletes but are also inseparable from the excellent technical habits and psychological quality formed by the long-term training.

Functional training programs play a crucial role in improving sprints. The goal of functional training was to enhance athletes' performance. It focuses on improving athletes' special skills and motor efficiency by combining the coordinated movement of many muscle groups and joints in a situation that feels like real life. The characteristic of this training method lies in its multi-joint and multi-plane movement mode, which can simulate the complex movement mode in the real movement, so that the athletes can better adapt to the

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needs of the competition in the training. At the same time, the functional training also focuses on the improvement of core stability, providing strength and stability support for the core muscle group and helping the athletes to better complete the technical movements. Moreover, functional training also helps to reduce the risk of injury during competition and training by enhancing muscle strength and improving joint flexibility and stability. Specifically, the key elements of a functional training program include speed endurance training, coordination training, strength training, technical training, and psychological training. Speed endurance was an important part of sprinters' sprint ability (Marzouki et al., 2023). Through scientific and reasonable speed endurance training, such as intermittent main and close main distance running training, which can effectively improve the energy utilization efficiency of athletes to enhance their sprint ability. Wei (2019) pointed out in Sprinters: Energy Metabolism Characteristics and Training Strategies that speed endurance training was crucial to improving athletes' sprint ability. Coordination is one of the important factors affecting the performance of sprinting. The training methods, such as high-leg running, can effectively improve the physical coordination of athletes through one-leg rope skipping. Zhang (2016) looked at how coordination affects sprint speed to improve and optimize sprint technical details, and suggested training plans that would work best for that. Strength training is the basis of improving sprinters' sprint ability, which should pay attention to the improvement of explosive power and core stability. Guo (2014) mentioned in a study of "Physiological Analysis of 400m Running Speed Rules and Training Methods" that strength training can enhance the muscle strength of athletes, thus improving their explosive power in the sprint stage. Correct technical movements are the key to improving sprint ability. Coaches and athletes should pay attention to the standardization and optimization of technical movements in daily training. In 2020, a study on the optimization of sprint technology based on biomechanical analysis, Sun (2020), used the biomechanical principle and found that the key to improving sprint speed is to specify and optimize technical movements. Finally, the psychological factors can also not be ignored in the sprint competition; psychological training can help the athletes to keep calm and confident in the sprint stage to play at the best level. The necessity for this research stems from the critical role sprinting ability plays in both athletic performance and the comprehensive development of an athlete’s physical and mental capabilities. Sprinting was not merely a test of speed but a multifaceted skill requiring integration of strength, endurance, coordination, technical precision, and psychological resilience.

These factors underscore the urgent need to explore innovative training programs tailored to meet the demands of sprinting. The key reasons for research necessity: comprehensive development of sprinting ability, sprinting performance directly impacts competitive outcomes, particularly in the crucial final stages of races. Research by Wang (2015) highlights that maintaining peak speed during critical moments is pivotal for success. However, achieving this requires a holistic approach that addresses various components of sprinting ability. Gaps in Current Training Methods: Traditional training methods often focus narrowly on specific aspects, such as speed or endurance. Functional training offers a broader framework by integrating multi-joint, multi-plane exercises that simulate real-world scenarios. This innovative approach addresses the limitations of traditional training and provides a more effective way to develop sprinting skills (Zhao, 2018). Enhanced Adaptability and Injury Prevention: Functional training emphasizes core stability, joint flexibility, and muscle strength, which are crucial for reducing the risk of injuries. This focus on injury prevention is especially relevant for university students, who often engage in intensive physical activities without adequate preparation. Practical Relevance for University Students: University students, as developing athletes, represent a critical population for implementing advanced training programs. Enhancing their sprinting ability not only benefits their athletic performance but also contributes to their overall physical fitness and mental well-being. Scientific Validation of Functional Training: While functional training is widely recognized for its benefits, empirical evidence supporting its application in improving sprinting ability, particularly in university students, remains limited. This research seeks to fill that gap by providing scientifically validated methodologies. Holistic Approach to Athletic Development: This study follows current trends in sports science that stress combining different factors for the best performance (Sun H., 2020) by looking at physical, technical, and psychological aspects.

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In conclusion, this research is essential for advancing our understanding of how functional training can be tailored to improve sprinting ability in university students. Its findings have the potential to influence training practices, enhance athletic performance, and promote the overall health and resilience of student-athletes.

Objectives

The objectives of this study were as follows:

1. To compare the mean of sprinting ability between experimental and control groups.
2. To compare the mean of sprinting ability within experimental groups, pretest, midtest, and posttest
3. To develop a functional training program to improve sprinting ability in university students.

Literature review

Functional Training: Functional training refers to exercise programs that are meticulously designed to enhance an individual's ability to perform real-life activities and sport-specific movements with efficiency and safety. Unlike traditional training methodologies that often isolate specific muscle groups, functional training focuses on integrated movement patterns that mimic the complex demands of daily life or athletic performance. According to Siff (2002), functional training emphasizes the coordinated synergy of multiple muscle groups, aiming to optimize overall movement efficiency while adhering to the principle that "form follows function." This principle underscores the concept that physical training should prepare the body for specific functional tasks, whether athletic or occupational. Research demonstrates that functional training improves sport-specific skills across various disciplines. For instance, Wu et al (2023) found that incorporating functional training into athletic programs significantly enhanced explosive power, stability, and endurance in competitive settings. These improvements are achieved by targeting energy systems relevant to specific sports, such as the aerobic system for endurance or the anaerobic system for short, high-intensity efforts. Additionally, functional training fosters greater neuromuscular coordination, enabling athletes to execute complex movements with precision. Functional training also addresses core strength and stability, which are vital for transferring energy through the kinetic chain during athletic activities. Exercises such as plank variations, medicine ball throws, and rotational movements strengthen the core, ensuring that the athlete can generate power efficiently while maintaining stability. For example, sprinters benefit from a strong core by improving the efficiency of force transfer from the lower to the upper body during sprints (Boyle, 2003).In the 1980s, functional training began gaining recognition within strength and conditioning communities. Early adopters emphasized the importance of multi-joint and multi-planar exercises for enhancing athletic performance. By the early 2000s, functional training had emerged as a mainstream methodology, with a focus on preventing injuries and optimizing performance in competitive sports (Hu, 2011). Today, functional training is widely applied across various sports disciplines, including soccer, basketball, and track and field. Coaches and trainers have developed tailored programs that address the specific demands of each sport. For example, soccer players benefit from exercises that improve agility and quick changes of direction, while basketball players focus on vertical jumps and explosive lateral movements (Santana, 2016). Technological advancements have further refined the application of functional training. Motion analysis systems, wearable devices, and biomechanical sensors allow coaches to monitor an athlete's performance in real-time, providing valuable insights into movement patterns and areas for improvement (Wu et al, 2023). Additionally, virtual reality and augmented reality tools are being integrated into functional training programs, offering immersive environments for skill development and assessment.

Biomechanics of Sprinting: Sprinting performance is fundamentally rooted in the principles of biomechanics, which analyze how the human body generates and optimizes force during motion. Efficient sprinting requires the interplay of force production, stride mechanics, and body posture. During the acceleration phase, the body produces high levels of horizontal force, which directly influences sprint speed (Mero et al., 1992). Effective force application, especially in the initial steps, determines the sprinter's

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ability to overcome inertia and achieve acceleration. The sprinting process can be divided into key phases: the start, acceleration, and maximum velocity. At the start, biomechanical factors such as reaction time, block clearance, and initial step length are critical. Studies show that a well-coordinated "set" position with optimal hip extension and propulsive forces during the push-off phase enhances early acceleration (Valamatos et al., 2022). Additionally, sprinting at maximum velocity involves minimizing braking forces during ground contact and maximizing propulsive force (Moura et al., 2023). Proper stride length and frequency coordination are essential, requiring optimal joint angles at the hip, knee, and ankle to maintain efficiency. Recent research highlights the importance of ground reaction forces (GRFs) during sprinting, especially vertical and horizontal forces. GRFs enable efficient force transfer from the ground to the sprinter's body, resulting in forward propulsion (Morin & Willwacher, 2016). The balance between braking and propulsive GRFs significantly impacts running efficiency and speed maintenance during the constant velocity phase.

Factors Influencing Sprint Performance: Sprint performance is influenced by several physiological and biomechanical factors, including acceleration, maximum speed, and endurance. Each factor plays a unique role in determining an athlete's ability to perform at a high level. Acceleration Phase The acceleration phase requires the generation of large horizontal forces in a short time frame. Athletes with high levels of lower-body strength and explosive power often excel in this phase. Research by Moura et al. (2023) emphasizes that step frequency and length transitions during acceleration are critical determinants of performance. Moreover, a sprinter's ability to maintain forward body lean and optimize joint angles during push-off enhances the efficiency of force application. Maximum Speed: Reaching and maintaining maximum speed involves precise coordination of stride frequency and length. Athletes generate peak power by optimizing neuromuscular activation patterns, allowing for rapid force production. Studies have shown that elite sprinters achieve higher velocities by minimizing ground contact time and maximizing the force applied during each step (Lin & Pandy, 2022). Additionally, muscle-tendon properties, such as stiffness and compliance, contribute significantly to an athlete's ability to sustain high speeds. Speed Endurance. While speed endurance was less emphasized in shorter sprints, it plays a crucial role in events like the 200m and 400m. This factor was influenced by the athlete's ability to sustain near-maximal efforts while managing fatigue. Efficient energy utilization through the aerobic and anaerobic pathways was critical. Sprint-specific endurance training focuses on improving the capacity to resist fatigue while maintaining proper biomechanics (Zwaard et al., 2017). Role of Neuromuscular Coordination in Sprinting**.** Neuromuscular coordination was vital for optimizing sprinting performance. It involves the precise activation of muscle groups to produce force, maintain balance, and execute efficient movement patterns. Proper neuromuscular coordination ensures seamless transitions between the different sprinting phases and minimizes energy wastage. Interplay Between Muscle Groups Sprinting involves the coordinated activation of multiple muscle groups, particularly the hamstrings, quadriceps, glutes, and calves. Effective muscle sequencing reduces the risk of imbalances, which can lead to inefficiencies or injuries. For example, during the swing phase, the hamstrings decelerate the lower leg while preparing for ground contact, ensuring a smooth and powerful transition (Hunter et al., 2004). Motor Unit Recruitment: High levels of motor unit recruitment are required to generate the explosive forces needed for sprinting. Elite sprinters exhibit greater recruitment of type II muscle fibers, which are optimized for power and speed. Training programs that include plyometrics and heavy resistance exercises enhance motor unit synchronization and firing rates, leading to improved performance (Mero et al., 1992). Proprioception and balance play a critical role in maintaining stability during high-speed movements. Sprint-specific drills that challenge dynamic balance, such as single-leg hops and agility ladder exercises, improve proprioceptive feedback and reduce ground contact time. This enhances overall efficiency and helps athletes maintain proper sprint mechanics under fatigue (Valamatos et al., 2022).

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Conceptual Framework

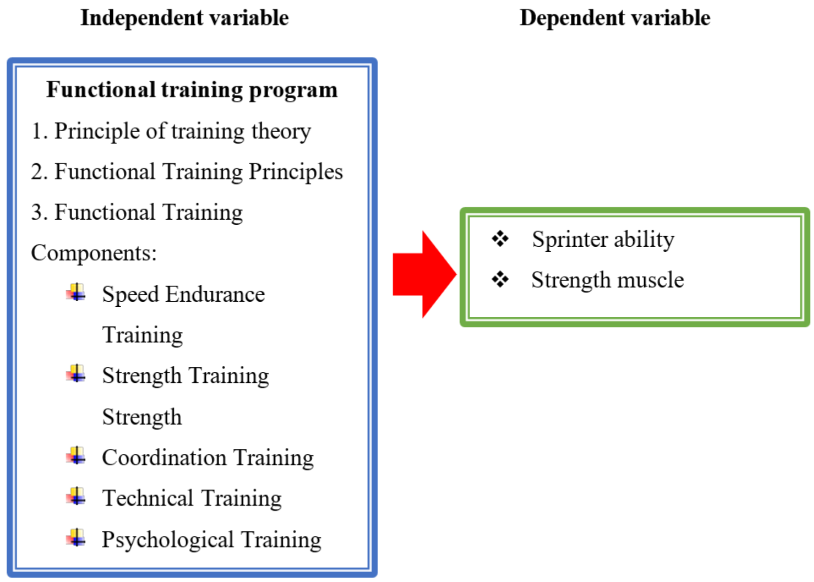

Figure 1 Conceptual Framework

Methodology

This research study is a quasi-experimental design with a two-group pretest-posttest design. The research has been reviewed by the Human Research Ethics Committee of Bangkok Thonburi University, research ethics code BTUIRB No. 2567/202(14), with the following details.

Population and sample

The research will involve 100 track and field students from the Department of Physical Education at Sichuan University of Commerce, selected from the sophomore, junior, and senior year levels. Participants will be evenly distributed across the 2024 academic year to ensure a representative sample.

The sample was a simple random sample of 30 track and field students, who were divided into two groups, each comprising 15 students. To ensure balance in performance levels between the groups, a matched-pairs method was used. And systematic sampling was conducted within the group, 15 each, then divided to be the experimental group and the control group.

Research Design

This study was a quasi-experimental research with control and experimental groups that repeated measurements, a pre-test, an after 6 weeks, and a post-test.

Experimental group	O_1	T_1	O_3	T_1	O_5
Control group	O_2	T_2	O_4	T_2	O_6

Note: O_1 refer to pretest of experimental group, O_2 refer to pretest of control group, O_3 refer to mid-test of experimental group, O_4 refer to mid-test of control group, O_5 refer to post-test of experimental group, and O_6 refer to post-test of control group, T_1 refer to training program of experimental group, and T_2 refer to training program of control group.

Research Instrument

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The research instruments of this study were as follows;

1. Functional training program: The training duration was 8 weeks, which combined speed endurance, strength training, coordination, technical training, and psychological training. Weeks 1-2 were trained 4 days/week, 60 minutes each day; weeks 3-4 were trained 5 days/week, 60-70 minutes each day; weeks 5-6 were trained 5 days/week, 70-75 minutes each day; weeks 7-8 were trained 5 days/week, 75-90 minutes each day.

The validity of the training program was through expert consultation (CVI = 0.82), and then a tryout with 5, 9 samples found that the training drill, intensity, and recovery time were appropriate for training.

2. Sprinting ability test was used, Infrared Laser Timer (manufacturer: Jiangsu, China), which tests assesses a sprinter's speed in different phases of a 100m sprint, including the drive phase, acceleration phase, maximum speed phase, and flying phase. The test involves running at maximum speed for 80 meters, with times recorded for the following segments: start-10m, 10-20m, 20-40m, and 40-80m.

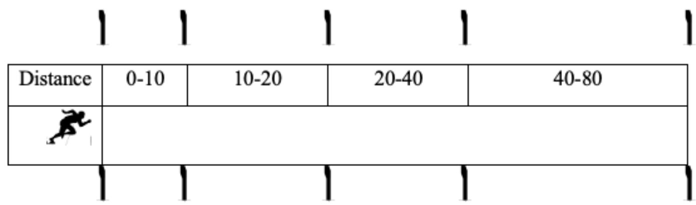

Figure 2 The sprinting ability test diagram with 5 infrared laser timers

3. Standing Long Jump Test: The Standing Long Jump Test measures the explosive power of the legs. The athlete stands behind a line with feet slightly apart, swings their arms, bends their knees, and jumps as far as possible, landing on both feet. The distance from the takeoff line to the nearest point of contact on landing is measured. The longest of three attempts was recorded. (Hemara, 2018).

Data collection

The researchers had conducted the data collection process as follows:

1. Record the jump distance for each test (pretest, midtest, posttest).
2. Organize the data by participant and test phase (pretest, midtest, posttest) for analysis.
3. Compare results to evaluate progress in strength.

Data Analysis

The researchers conducted the data analysis process as follows:

1. Mean and standard deviation analysis of data.
2. The independent sample t-test was used to compare data between groups.
3. Comparison within experimental groups with one-way ANOVA repeated measurement and post hoc Bonferroni between pretest, midtest, and posttest.
4. The significant difference was set at 05.

Results

The research results support the hypothesis that the sprinting ability on the post-test of the experimental group was better than in the control group.

Table 1 The characteristics of the experimental and the control group.

Variables	**Experimental G (n=15)**	**Control G (n=15)**
	M +SD	**M +SD**
Ages (years)	20.87+0.74	19.73+0.70

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Variables	Experimental G (n=15)	Control G (n=15)
	M +SD	M +SD
Weight (kg)	64.80+8.74	64.13+8.53
Height (cm)	173.60+5.91	172.00+5.84
BMI	21.40+1.48	21.58+1.83

From table 1, it was found that the means and standard deviations of age, weight, height, and BMI in the experimental group were 20.87+0.74 years, 64.80+8.74 kg, 173.60+5.91 cm, and 21.40+1.41, respectively. The same as the control group were 19.73+0.70, 64.13+8.53 kg, 172.00+5.84 cm, and 1.58+1.83, respectively.

Table 2 Mean compared between the experiment and control groups with the pretest of the sprint ability with an independent t-test.

Variables	Expert. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+SD	M+SD	lower	Upper		
Start 0-10 meters (sec)	1.92+0.16	1.98+0.16	-0.06	0.06	-.99	.33
10-20 meters (sec)	1.68+0.14	1.78+0.17	-0.22	0.01	-1.87	.07
20-40 meters (sec)	2.99+0.19	3.04+0.15	-0.18	0.08	-.82	.41
40-80 meters (sec)	5.57+0.48	5.73+0.48	-0.52	0.20	-.91	.37

*P<.05

From Table 2 found that all variables were pairwise, and the sprint ability and was no statistically significant difference.

Table 3 Mean compared between the experiment and control groups with the pretest of the standing long jump with an independent t-test.

Variables	Expert. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+SD	M+SD	lower	Upper		
Standing long jump (cm)	233.33+25.84	228.80+25.29	-14.59	23.66	.49	.63

*P<.05

From Table 3, it was found that the standing long jump did not show a statistically significant difference.

Table 4 Mean compared between the experiment and control groups with the posttest of sprinting ability by t-test independent.

Variables	Expert. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+SD	M+SD	lower	Upper		
Start 0-10 meters (sec)	1.70+0.15	1.90+0.11	-0.30	-0.10	-4.04	.01*
10-20 meters (sec)	1.51+0.09	1.71+0.16	-0.30	-0.10	-4.19	.01*
20-40 meters (sec)	2.68+0.16	2.91+0.14	-0.34	-0.12	-4.35	.01*

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Variables	Expert. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+SD	M+SD	lower	Upper		
40-80 meters (sec)	5.18+0.50	5.57+0.45	-0.75	-0.03	-2.23	.01*

*P<.05

From Table 4, it was found that all sprinting ability pairs were statistically significantly different (*p<.05).

Table 5: Mean compared between the experiment and control groups with the posttest of the standing long jump by t-test independent.

Variables	Expert. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+SD	M+SD	lower	Upper		
Standing long jump (cm)	262.80+34.77	240.33+24.84	-0.13	45.07	2.04	.05*

*P<.05

From table 5, it was found that the standing long jump was statistically significantly different (*p<.05).

Table 6 Mean comparison of sprint ability within experimental group by using one-way ANOVA repeated measurement and Bonferroni post hoc.

Variables	Test		Bonferroni Mean Difference	Std. Error	p	M+SD	F	p
Start 0-10 meters	Pre test	Mid test	0.09	0.02	.01*	1.92+0.16	124.79	.01*
		Post test	0.23	0.02	.01*			
	Mid test	Pre test	-0.09	0.02	.01*	1.83+0.13		
		Post test	0.14	0.01	.01*			
	Post test	Pre test	-0.23	0.02	.01*	1.70+0.15		
		Mid test	-0.14	0.01	.01*			
10-20 meters	Pre test	Mid test	0.08	0.01	.01*	1.68+0.14	113.75	.01*
		Post test	0.17	0.02	.01*			
	Mid test	Pre test	-0.08	0.01	.01*	1.60+0.11		
		Post test	0.09	0.01	.01*			
	Post test	Pre test	-0.17	0.02	.01*	1.51+0.10		
		Mid test	-0.09	0.01	.01*			
20-40 meters	Pre test	Mid test	0.13	0.01	.01*	2.99+0.19	201.47	.01*
		Post test	0.31	0.02	.01*			
	Mid test	Pre test	-0.13	0.01	.01*	2.86+0.19		
		Post test	0.18	0.02	.01*			
	Post test	Pre test	-0.31	0.02	.01*	2.68+0.16		
		Mid test	-0.18	0.02	.01*			

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Variables	Test		Bonferroni Mean Difference	Std. Error	p	M+SD	F	p
40-80 meters	Pre test	Mid test	0.16	0.01	.01*	5.57+0.48	845.50	.01*
		Post test	0.38	0.01	.01*			
	Mid test	Pre test	-0.16	0.01	.01*	5.40+0.51		
		Post test	0.22	0.01	.01*			
	Post test	Pre test	-0.38	0.01	.01*	5.18+0.50		
		Mid test	-0.22	0.01	.01*			

*P<.05

From Table 6, it was found that all of the sprint ability pairwise comparisons showed statistically significant differences (*P<.05).

Table 7 Mean comparison of standing long jump within experimental group by using one-way ANOVA repeated measurement and Bonferroni post hoc.

Variables	Test		Bonferroni Mean Difference	Std. Error	p	M+SD	F	p
Standing long jump	Pre test	Mid test	-7.33	1.16	.01*	233.33+25.84	121.68	.01*
		Post test	-29.47	2.66	.01*			
	Mid test	Pre test	7.33	1.16	.01*	240.67+28.61		
		Post test	-22.13	1.79	.01*			
	Post test	Pre test	29.47	2.66	.01*	262.80+34.77		
		Mid test	22.13	1.79	.01*			

From Table 7, it was found that all of the standing long jump pairwise comparisons showed statistically significant differences (*P<.05).

Discussion

The study developed a comprehensive functional training program that integrated multiple components, including speed, strength, coordination, technical, and psychological training, to enhance sprinting performance among university students. This program was designed to improve multi-joint movement efficiency, core stability, and muscle endurance, allowing athletes to simulate real-world competitive sprinting scenarios. By addressing these critical elements, the program provides a holistic approach to optimizing sprinting ability, aligning with key principles of sports science and recent research findings.

Key Components of the Training Program: The speed training component focused on enhancing acceleration and maintaining maximum velocity, both of which are critical for short-distance sprinting. High-intensity interval training and repeated sprints were utilized to develop speed endurance, a factor that Wei (2019) emphasized as crucial for optimizing energy utilization during high-intensity efforts. Strength training targets key muscle groups, particularly the hamstrings, quadriceps, glutes, and core, through exercises such as squats, deadlifts, and plyometric drills. These exercises improved explosive power, enabling faster starts and sustained speed, as highlighted by Guo (2014) in his study on strength training for sprinters. in another way Ma & Thongdecharoen (2023) found functional training can develop the strength, explosive force, agility, anaerobic ability, punching speed, and punching strength of amateur boxers, and it was more effective than traditional strength training in developing the explosive force,

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punching speed and punching strength of amateur boxers. Coordination training emphasized improving neuromuscular efficiency and body control, with exercises such as agility ladder drills and single-leg balance activities. This component addressed Zhang's (2016) insights into the importance of coordination for optimizing sprint mechanics, particularly in achieving fluid and efficient movements. Technical training focused on refining key aspects of sprinting form, including stride length, stride frequency, and arm mechanics, using biomechanical feedback and video analysis for precision. The Role of Psychological Training: The program also integrated psychological training to build mental resilience, confidence, and focus under competitive pressure. Techniques such as visualization and goal-setting were employed to help athletes mentally prepare for high-stress situations, which are often critical in competitive sprinting. This approach aligns with Lu & Xu's (2023) findings on the role of psychological readiness in sprinting performance, emphasizing that mental fortitude is as important as physical preparation.

Program Implementation and Results: The program was structured into an 8-week cycle, divided into foundation and performance phases. Each phase progressively increased intensity and complexity, allowing participants to adapt and improve their capabilities incrementally. Training sessions were conducted three to five times a week, with a focus on alternating between speed, strength, coordination, and technical components to ensure balanced development. The effectiveness of the program was evaluated through pretest, midtest, and posttest assessments, which demonstrated significant improvements in sprint performance metrics among participants. Validation Through Research: The program's design and implementation align with recent findings in sports science. For instance, Zhao (2018) highlighted that functional training, which combines physical and technical conditioning, effectively enhances athletic performance. Additionally, the emphasis on coordination and technical refinement is consistent with Zhang's (2016) research, which underlined the critical role of biomechanics in sprinting. The inclusion of psychological training further strengthens the program’s holistic approach, addressing both physical and mental aspects of athletic preparation. By combining these multifaceted components, the functional training program provides a scientifically validated and practical approach to improving sprinting ability. The integration of speed, strength, coordination, technical, and psychological elements ensures that athletes are well-prepared for the multifactorial demands of competitive sprinting. These findings not only validate the effectiveness of functional training but also highlight its potential for broader applications in athletic training programs. This holistic approach represents a significant advancement in training methodologies, offering athletes and coaches a robust framework for achieving peak performance.

The experimental group showed remarkable advancements in sprinting performance metrics compared to the control group, confirming the effectiveness of the functional training program in addressing specific aspects of sprinting ability. The observed improvements spanned all intervals, including start-to-10m, 10-20m, and 20-40m sprints, highlighting the comprehensive benefits of the program. These findings provide a detailed understanding of how targeted, scientifically grounded training can enhance key elements of sprinting performance.

Key Improvements in Sprint Metrics, the faster times recorded by the experimental group in the start-to-10m interval indicate an increase in explosive power, which is critical for achieving rapid acceleration from a stationary position. Guo's (2014) findings corroborate this, showing that strength and core stability training are essential for generating the initial burst of power required in sprint starts. Strength training exercises such as weighted squats, deadlifts, and plyometric drills likely contributed to this improvement, as these activities specifically target the muscles responsible for explosive movement. The reduction in times for the 10-20m interval reflects advancements in stride frequency and efficiency, crucial elements in building momentum during the acceleration phase. Markovic and Mikulic (2010) emphasized the importance of plyometric and dynamic strength training in improving the mechanical efficiency of sprinting. By focusing on exercises that promote neuromuscular coordination, such as agility ladder drills and high-knee runs, the program effectively enhanced the participants’ ability to maintain optimal stride patterns. Similarly, the improvements in the 20-40m interval suggest better speed endurance, allowing athletes to sustain high velocities over a longer distance. This aligns with Wei's (2019) research, which

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highlighted the role of speed endurance training in maximizing energy utilization during prolonged sprint efforts. The functional training program's incorporation of interval sprints and fartlek runs likely played a pivotal role in these advancements, as these exercises are designed to enhance the anaerobic energy system critical for sustaining speed.

The control group saw minimal improvements, highlighting the limitations of traditional training. In contrast, the experimental group, using a functional training program, showed significant gains in sprinting performance, emphasizing the importance of a holistic, scientifically backed approach. This program not only improved physical attributes but also enhanced movement efficiency and adaptability, providing athletes with the tools to refine their technique and maximize their potential.

Conclusion

The research successfully developed and validated a functional training program that significantly enhanced sprinting ability among university students. The program's multi-component approach addressed key performance determinants, demonstrating its applicability and effectiveness. The mean sprinting ability of the experimental group was better than that of the control group. The mean comparison of sprinting ability within experimental groups, posttest, was better than pretest and midtest.

Recommendation

1. The results indicate that functional training significantly improves sprint ability and lower-body power. Therefore, it is recommended that coaches and trainers incorporate structured functional training programs to optimize sprint performance.
2. The training program should follow a progressive overload principle, gradually increasing intensity and complexity to maximize performance improvements while minimizing injury risks.
3. A well-rounded training program should integrate strength, coordination, endurance, and sprint mechanics to ensure holistic athletic development.
4. Regular assessments, such as pretest, midtest, and posttest evaluations, should be maintained in training programs to track progress and make necessary adjustments.
5. While the study focused on a general training program, individualized modifications should be considered based on an athlete's specific needs, fitness levels, and performance goals.

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