SHORT REPORT

A study on the impact of functional physical training on college students' physical fitness test scores

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College students often perform poorly in physical fitness tests, and the traditional physical education teaching approaches are ineffective in improving physical fitness. Functional physical fitness training focuses on the comprehensive development of various physical qualities and can improve athletic performance. This study analyzed the effects of functional physical training to understand its role in college students' performance in physical fitness tests. A total of 40 non-sports major college students from Chongqing Chemical Industry Vocational College were recruited and randomly divided into two groups for an eight-week experiment. Experimental group underwent functional physical training, while the control group underwent traditional physical training. The results of the physical fitness test and functional movement screen (FMS) were compared between the two groups and showed that the experimental group demonstrated significant improvement in both physical fitness and FMS performances, achieving a total FMS score of 17.28 ± 1.78 points ($P < 0.05$), except for shoulder flexibility. The control group also showed significant improvement in physical fitness test performance. However, in the FMS test, only the score for the active straight leg raise showed a significant difference ($P < 0.05$). The results indicated that functional physical training was more effective in improving the physical fitness of college students than traditional physical training and could be applied in practice.

Keywords: functional physical training; physical fitness; college student; functional movement screen.

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Introduction

The physical fitness of college students has been declining due to factors such as diet structure and academic pressure [1, 2]. This issue has become a public health and education concern, attracting widespread attention because it not only relates to the personal development of college students but is also closely linked to the overall health and well-being of the entire nation. To address this challenge, college physical education courses bear the important responsibility of improving the physical health of college students. However, most colleges' physical education courses currently suffer from problems such as monotonous content and insufficient exercise. Most of these courses rely on traditional teaching methods, which makes it difficult to significantly improve students' physical fitness. Insufficient physical fitness can affect students' performance in specific sports, making it difficult for them to meet quality standards and increasing the risk of sports injuries [3], which can disrupt the balance between physical fitness development and skill development. Therefore, enhancing the physical fitness of college students is crucial given the

current situation [4].

Currently, several studies have been conducted to explore effective intervention measures. Zhai *et al*. analyzed the impact of the COVID-19 lockdown on body mass index (BMI) and physical fitness among college students through an analysis using the baseline-category logit regression model and found that men had higher odds for deterioration in BMI, muscle strength, and cardiopulmonary health, while showing lower odds of deterioration in flexibility [5]. Niu *et al*. compared the impact of two types of Tai Chi exercises on the physical fitness parameters of overweight college students and found that, after a 12-week training, both exercise types effectively improved physical fitness as evidenced by significant performance enhancements in wall squats, sitting and reaching, the 6-minute walk, and Y-balance tests, particularly in improving lower limb strength [6]. Hassan *et al*. analyzed the effects of kettlebell training on the physical fitness of sports college students and revealed that 12 weeks of kettlebell training led to significant changes in both strength and endurance among the athletes, suggesting that kettlebells might be a high-quality alternative to promote a healthy lifestyle [7]. Hlukhov *et al*. examined the effects of swimming training on the physical fitness of students aged 18 - 20 years old and found significant improvements in dynamic and static strength endurance of muscle groups, explosive power, flexibility, and speed [8]. Functional physical training that emphasizes exercises involving multiple joints and directions rather than focusing on a single type of motion can improve overall physical fitness [9], which simulates the basic human movement patterns in multiple planes and dimensions such as pushing, pulling, squatting, and standing up, effectively improves the working efficiency of the neuromuscular control system. Functional physical fitness training was initially applied in medical rehabilitation and has now been widely used in sports training [10, 11]. Compared to traditional physical fitness training, functional physical fitness training is more closely aligned with the demands of daily life and specific sports. However, the effectiveness of this training measure in the physical education teaching of ordinary colleges and its direct impact on the physical fitness test scores of college students still need to be verified by more empirical studies. Moreover, most existing studies have targeted specific athletes or physical education majors, resulting in a lack of representative samples.

To fill the research gap in this field, this study compared functional fitness training and traditional fitness training on 40 college students to explore the impact of functional fitness training on college students' physical fitness test scores. By comparing performance before and after training, this study verified the effectiveness of functional fitness training in improving physical fitness performance. The results of this study enriched the theoretical framework of functional fitness training and provided references and inspiration for colleges to innovate their physical education teaching modes and improve the physical health levels of college students.

Materials and methods

Research subjects

A total of 40 non-sports major college students from Chongqing Chemical Industry Vocational College were recruited for this study with the inclusion criteria as good health, no major surgical history within the past six months, no serious sports injuries within the past three months, no history of chronic diseases, understanding the purpose and process of the experiment, and signing the informed consent form. The participants were randomly divided into two groups with group A undergoing functional physical training and group B receiving traditional physical training. Group A included 20 students (10 females and 10 males) with the average age of 19.87 ± 1.16 years old, height of 177 ± 3 cm, and weight of 74.68 ± 4.46 kg. Group B also included 20 students (10 females and 10

males) with average age of 19.48 ± 1.57 years old, height of 178 ± 4 cm, and weight of 75.02 ± 3.68 kg. All procedures of this study were approved by the Ethics Committee of Chongqing Chemical Industry Vocational College (Chongqing, China).

Training methods and indicator determination

Physical fitness tests and functional movement screen (FMS) tests were conducted on all participants [12]. The general information of the participants was recorded. No warm-up or stretching exercises were done before the FMS test, which was conducted directly. All indicators were measured at one time with each indicator being measured three times, and the best results were recorded. Before the physical fitness test, the subjects warmed up thoroughly. The results of relevant indicators were recorded. After the pre-tests, the formal test began, which lasted for eight weeks with three times a week and 60 minutes for each time. There was a ten-min warm up/relax before or after training. After the eight-week experiment, the physical fitness test and FMS test were conducted again. The test indicators were measured according to the "National Student Physical Health Standard", which included 50-meter run, 1,000 m run, standing long jump, sit and reach, and pull-up. The FMS indicators were then measured, which included squat by holding the bar above the head with both hands, standing with feet shoulder-width apart, and slowly squatting down with heels not off the ground; stride by standing with the feet together, holding the bar behind the neck with both hands, slowly lifting the leg over the hurdle, and slowly pulling it back; split squat by standing on the test board, placing the tip of the left foot behind the zero mark and stepping the right foot forward, holding the bar behind the back with both hands so that the bar touched the head, shoulders, back, and hips, and slowly squatting down until the knees touch the test board; shoulder flexibility by making fists with both hands, raising one hand above the head and extending it down along the back and lifting the other hand upward along the back, measuring the shortest distance between the two fists; active straight knee lift by lying on the back with one leg straight up and the other resting on the ground; trunk-stable push-ups by lying face down with the hands shoulder-width apart and the entire body lifted up; rotational stability by kneeling at four points and touching the elbow with the knee on the same side, straightening again, straightening back up and returning to the kneeling position with the torso being kept in the horizontal position throughout the process [13].

The training program for group A

The training program for group A included that, from week 1 to 4, the upper limb training was performed with Y-position arm raise exercise (12 times × 3 sets), front dumbbell press (12 times × 3 sets), prone Swiss ball kettlebell press (8 times × 3 sets), bent over triceps extension (10 times × 2 sets), and seated dumbbell side raise (15 times × 3 sets). The trunk training involved kneeling ab wheel pull (5 times × 3 sets), straight-arm diagonal support (15 seconds × 3 times), and stable-support static plank (20 seconds/30 seconds/40 seconds). The lower limb training covered hip bridge (12 times × 3 sets), single-leg squat (8 times × 2 sets), lateral movement with a resistance band (10 times × 2 sets), and double-leg BOSU ball squat (10 times × 3 sets). From week 5 to 8, the upper limb training was suspended push-up (15 times × 5 sets), standing dumbbell side raise (10 times × 3 sets), standing dumbbell front raise (10 times × 3 sets), and Kettlebell shrug (8 times × 3 sets). The trunk training consisted of standing ab wheel push (3 times × 3 sets), bent-knee ball-support push up (15 times × 3 sets), instep-touching-ball push-up (15 times × 2 sets), and toe-touching-ball push-up (15 repetitions × 2 sets). The lower limb training included dumbbell single-leg squat (6 times × 3 sets), single-leg balance pad half squat (3 times ×3 sets), and Barbell Romanian deadlift (6 times ×3 sets). From week 9 to 12, the upper limb training included single-arm incline push-up (15 times × 3 sets), dumbbell supine press (12 times × 2 sets), single-foot support suspension push-up (15 times × 3 sets), and Swiss ball-leaned kettlebell lift (15 times × 3 sets). The trunk training involved toe-on-ball straight push-up (15 seconds × 3 times), straight-arm ball-support

push-up (15 times × 3 sets), and single-leg landing ab wheel push (2 times × 3 sets). The lower limb training consisted of Barbell balance-pad squat (5 times × 3 sets), standing balance-pad Bulgarian split squat (6 times × 2 sets), and standing balance-pad banded leg lift (5 times × 3 sets).

The training program for group B

The training program for group B was conducted on Monday, Wednesday, and Friday. On Monday, the training included push-ups (30 times × 2 sets), pull-up (10 times × 2 sets), sit-up (30 times × 2 sets), and half squat (40 kg/15 times × 2 sets). On Wednesday, the training included prone double raise (30 times × 2 sets), bench press (35 kg/15 times × 2 sets), power clean (40 kg/20 times × 2 sets), and comprehensive lower body strength training (20 times × 2 sets). On Friday, the training covered frog jump (30 meters × 2 sets), squat (45 kg/15 times × 2 sets), and full-body machine-based strength training (20 times × 2 sets).

Statistical analysis

The pre- and post-test results were recorded in Microsoft Excel (Microsoft, Redmond, Washington, USA) and statistically analyzed using SPSS 25.0 (IBM, Armonk, New York, USA) [14]. An independent samples t-test was employed for the comparison between groups before and after the training. A paired samples t-test was used for the comparison of each group before and after the training.

Results and discussion

The results showed that there were no statistically significant differences in the basic characteristics and pre-training physical fitness test and FMS test performances between the two groups. After the training, group A demonstrated significant improvements in speed, flexibility, and other qualities compared to that before the training ($P < 0.05$). In the FMS test, all performances were significantly different after training compared to that before the training ($P < 0.05$), except for shoulder flexibility. The total FMS score for group A reached 17.28 ± 1.78 points, indicating an overall improvement in the physical functions of the students. Similarly, group B showed significant improvements in physical fitness test performance after the experiment ($P < 0.05$). However, in the FMS test, only the score of the active straight knee lift showed a remarkable difference ($P < 0.05$). After the training, the physical fitness test performances of group A were better than those of group B ($P < 0.05$), indicating that functional physical training was more effective in improving physical fitness than traditional physical training. In the comparison of the FMS test score, there were significant differences between the two groups for all items ($P < 0.05$), except for trunk-stable push-ups. Group A performed better than group B, which also proved the advantage of functional fitness training. In the physical fitness test, the 50-meter run measured explosive power and speed. The sit and reach measured flexibility, the standing long jump reflects coordination and lower limb explosive power. The 1,000-meter run reflected endurance. Pull-ups were related to upper body strength and coordination. The results showed that, after eight weeks, both groups showed significant improvement in the physical fitness test performance, indicating that sustained physical training could improve college students' fitness levels. Further, group A was superior to group B ($P < 0.05$), indicating that functional physical training was more effective than traditional physical training, which was because functional physical training emphasized the training of the whole body's muscle groups including small and deep muscle groups and improve pelvic and spinal stability and enhance overall coordination. The FMS test could assess various physical qualities. After eight weeks of training, both groups showed improvement in FMS performances, but there were differences. Group A showed significant changes in FMS performances ($P < 0.05$), excluding shoulder flexibility, while group B only had a significant improvement in the active straight knee lift compared to the pre-training results ($P < 0.05$). After the training, group A outperformed group B in all six items except trunk-stable push-ups with

Table 1. Comparison of performance in the two groups before and after the training.

	Group A (n = 20)		Group B (n = 20)	
	Before the training	**After the training**	**Before the training**	**After the training**
50-meter run (s)	8.91 ± 0.56	8.12 ± 0.56[ab]	8.92 ± 0.54	8.64 ± 0.54[a]
Sit and reach (cm)	10.73 ± 4.31	15.12 ± 3.11[ab]	10.68 ± 3.68	12.77 ± 3.41[a]
Standing long jump (cm)	215.77 ± 15.64	242.37 ± 16.08[ab]	216.76 ± 12.37	223.46 ± 15.62[a]
1,000 m run (s)	267.46 ± 28.56	216.84 ± 20.16[ab]	265.87 ± 31.25	228.91 ± 18.68[a]
Pull-ups (times)	4.12 ± 2.33	14.77 ± 4.32[ab]	3.87 ± 2.64	11.16 ± 4.68[a]
Squat	2.12 ± 0.77	2.46 ± 0.56[ab]	2.08 ± 0.78	2.06 ± 0.55
Stride	1.97 ± 0.84	2.55 ± 0.57[ab]	1.97 ± 0.85	2.14 ± 0.66
Split squat	1.97 ± 0.83	2.54 ± 0.53[ab]	1.98 ± 0.84	2.15 ± 0.71
Shoulder flexibility	2.12 ± 0.87	2.38 ± 0.65[b]	2.08 ± 0.88	2.11 ± 0.78
Active straight knee lift	1.91 ± 0.68	2.55 ± 0.52[ab]	1.92 ± 0.66	2.21 ± 0.64a
Trunk-stable push-up	2.02 ± 0.84	2.34 ± 0.67[a]	2.01 ± 0.85	2.11 ± 0.49
Rotational stability	1.91 ± 0.77	2.46 ± 0.56[ab]	1.92 ± 0.78	2.04 ± 0.67
The total score of FMS	14.02 ± 1.94	17.28 ± 1.78[ab]	13.96 ± 2.01	14.49 ± 1.66

Note: a: $P < 0.05$ compared to that before the training. b: $P < 0.05$ compared to that of group B.

a total FMS score of 17.28 ± 1.78 points, which was also significantly higher than group B's score ($P < 0.05$) (Table 1). The results confirmed that the training effects for Group A were better, demonstrating the superior benefits of functional physical training. Therefore, functional fitness training should be included in college physical education courses to improve students' physical fitness and overall health.

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