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An Experimental Study on Strength Training of Sprinters

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Abstract: *Using literature, experiment, mathematical statistics and other methods, 16 male sprinters from the track and field team of Nanjing Xiaozhuang University were selected as the research objects, including 8 in the experimental group and 8 in the control group. The experimental group underwent 6 weeks of functional strength training, and the control group underwent 6 weeks of traditional strength training, and the training content was arranged according to the principle of gradual and orderly training. The test results before the experiment showed that in the 30-meter and 200-meter tests, there was no significant difference between the experimental group and the control group, but there were slight differences in the 60-meter and 100-meter tests, but none of them were significant. This indicated that the experimental and control groups had similar abilities in terms of initial speed and stamina. The test results after the experiment showed that the scores of the students in the control group improved significantly in the 30-meter and 60-meter tests, but not in the 100-meter and 200-meter tests. After functional strength training, students in the experimental group made significant progress in all tests, especially in the 100-meter and 200-meter tests, indicating that the impact of different strength training methods on speed quality varies with test distances. Comparing the results of the experimental group and the control group showed that the performance of the two groups of students in the initial speed test was similar, but in the later speed test, the performance of the experimental group was significantly better than that of the control group. This shows that functional strength training has a significant advantage in improving sprint ability. Conclusion: Both traditional strength training and functional strength training can improve students' speed quality to a certain extent, but have different effects on different test distances and stages.*

Keywords: *Speed Quality, Strength Training, Traditional Strength Training, Functional Strength Training*

1. Introduction

Sprinting is a physical fitness dominated speed event composed of strength and speed quality[1], which includes four basic technical movements such as starting, accelerating, running on the way, and sprinting running[2], and athletes need to increase the front swing hip amplitude high-speed running while controlling their own movement stability and coordination. It is one of the most ornamental and competitive events in athletics, and it is also one of the sports that require speed and strength the most in sports competition, which is characterized by fast speed, short endurance, and requires athletes to have high muscle strength and muscular endurance[3]. Strength training is the most important component of sprint training, effective special strength training is the prerequisite for athletes to create excellent results, but only develop a certain strength or incomplete development of strength quality, it is difficult to improve the athletic level of sprinters. At present, the training plan of China's college athletics team is too old and rigid, and has not been updated and improved in time; Strength training is overloaded and training methods are too old, resulting in physical injury problems that affect their training and competition performance[4]. As the level of competition of athletes becomes higher and higher, how to improve the performance of athletes has also become one of the hot issues in research. Therefore, this paper will explore the impact of comprehensive development of strength training on the performance of sprinters from the perspective of experimental research, the purpose of which is to improve the muscle strength and muscular endurance of sprinters, improve their starting and acceleration efficiency, thereby improving sprint performance, and provide some references for the practice of sprint training.

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2. Data sources

2.1. Documentation method

The study takes an inclusive approach by conducting an extensive literature review. This review is conducted through various reputable academic databases, including CNKI, Wanfang Database, Pubmed, and Web of Science. Upon gathering a wealth of relevant literature, the study employs a meticulous sorting and summarization process. This organized approach aids in distilling the wealth of information into coherent and manageable segments, facilitating a deeper understanding of the existing academic landscape surrounding strength training for sprinters.The purpose is to gather a wide array of scholarly sources that pertain to strength training for sprinters. This comprehensive search ensures that the latest advancements, research findings, and methodologies are accounted for in the study.

2.2. Experimental Method

A 2 (pre-test, post-test)×2 (experimental group, control group) mixed experimental design was adopted. The factors within the group will be divided into two levels of pretest and post-test, and the factors between groups will be divided into two levels of experiment and control. The experiment is divided into two parts: pre-test and post-test. First, pre-test the selected samples. The test indicators are: 30 meters, 60 meters, 100 meters and 200 meters. According to the pre-test data, they will be randomly divided into two groups, including 8 people in the experimental group and 8 people in the control group. Next, the samples will be trained for 6 weeks, 3 times a week, 60-90 minutes each time. Before each test, let the subjects make full preparations first, and ensure that the testers of each project remain the same before and after training to ensure the accuracy of the results. After 6 weeks of training, the samples were tested after the experiment. The test indicators were: 30 meters, 60 meters, 100 meters and 200 meters.

2.2.1. Experimental content

In this experiment, the athletes in the experimental group performed functional strength training, and the athletes in the control group performed traditional strength training. The pre-test data and post-test data of the experiment were statistically analyzed, and the intra-group and inter-group index data of the experimental group and the control group were compared. The training methods of the experimental group and the control group are interval training method/circulation training method, and the training intensity is from low to high intensity. The training time, training times, and training methods of the experimental group and the control group were the same, and there was no difference.

Table 1: Experimental group and control group training plan schedule.

	Intervention Stage	Training Content	Training Load
experimental group	Week 1-2	Hard pull	30kg *10 times * 2 groups, 40kg * 6 times * 2 groups, 50kg * 2 times * 1 group
		High flip	20kg * 10 times * 1 group, 30kg * 8 times * 1 group, 40kg * 4 times * 1 group
		Swiss ball Push-up	10 times * 4 sets
		Sled pusher	20 meters * 3 sets (40kg)
		Lateral elbow support	1 minute * 3 sets
		Single Leg Knee Lift	20 times * 3 sets
		Circled leg	15 times * 3 sets
		Swiss ball tuck in	10 times * 3 sets
		Supine hip straightener	15 times * 3 sets
	Week 3-4	Hard pull	40kg * 8 times * 2 groups, 50kg * 6 times * 2 groups, 60kg * 2 times * 1 group
		High flip	30kg * 8 times * 1 group, 40kg * 6 times * 1 group, 50kg * 2 times * 1 group
		Bosuball Push-up	15 times * 4 sets
		Sled pusher	20 meters * 3 sets (50kg)
		Lateral elbow support	1 minute * 3 sets(elastic band)
		Single Leg Knee Lift	20 times * 3 sets(elastic band)
		Circled leg	15 times * 3 sets
		Swiss ball tuck in	10 times * 3 sets
		Supine Step on Bosuball to Top Hip	15 times * 3 sets
		Hard pull	50kg*8 times*2 sets, 60kg*6 times*2 sets, 70kg*2

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	Week 5-6		times*1 group
		High flip	40kg*8 times*1 group, 50kg*6 times*1 group, 60kg*2 times*1 group
		Bosuball explosive Push-up	10 times * 4 sets
		Sled pusher	20m*3 sets (60kg)
		Lateral elbow support	1 minute * 3 sets
		Deep jump training	15 times * 3 sets
		High Leg Run (Elastic Band)	20 times * 3 sets
		TRX Climbing steps	20 times * 3 sets
		Nordic hamstring	10 times * 3 sets
control group	Week 1-2	Bench press	40kg*6 times*1 group, 45kg*4 times*1 group, 50kg*2 times*1 group, 55kg*1 time*1 group
		Squats	80kg*6 times*1 group, 90kg*4 times*1 group, 100kg*2 times*1 group, 110kg*1 time*1 group
		Sit-up	30 times * 4 sets
		Lie on your back	20 times * 4 sets
	Week 3-4	Bench press	45kg*6 times*1 group, 50kg*4 times*1 group, 55kg*2 times*1 group, 60kg*1 time*1 group
		Squats	90kg*6 times*1 group, 100kg*4 times*1 group, 110kg*2 times*1 group, 120kg*1 time*1 group
		Sit-up	30 times * 4 sets (weight-bearing)
		Lie on your back	20 times * 4 sets (weight-bearing)
	Week 5-6	Bench press	50kg*6 times*1 group, 55kg*4 times*1 group, 60kg*2 times*1 group, 65kg*1 time*1 group
		Squats	100kg*6 times*1 group, 110kg*4 times*1 group, 120kg*2 times*1 group, 130kg*1 time*1 group
		Sit-up	30 times * 4 sets (weight-bearing)
		Lie on your back	20 times * 4 sets (weight-bearing)

3. Results and Discussion

The difference between the experimental group and the control group in each test index before training. Before the experiment, the students in the experimental group and the control group were tested for 30 meters, 60 meters, 100 meters, and 200 meters. The basic descriptive statistics are shown in Table 2.

The students in the experimental group and the control group had the same performance in 30 meters and 200 meters, without significant difference ($p>0.05$). In the 60-meter test, the performance of the control group was better than that of the experimental group; in the 100-meter test, the experimental group's Results were better than those of the control group, but there was no significant difference ($p>0.05$). In the four indicators, there was no significant difference between the experimental group and the control group ($p>0.05$), suggesting that the speed quality and ability of the boys in the two groups were similar.

Table 2: Comparison of test index scores (pre-test) between the experimental group and the control group.

Test Indicators	Experimental Group	Control Group	P
30 m(s)	4.16±0.08	4.16±0.13	>0.05
60m(s)	7.41±0.15	7.40±0.12	>0.05
100m(s)	11.99±0.35	12.00±0.37	>0.05
200m(s)	25.07±1.33	25.07±1.83	>0.05

Note: $p>0.05$ means no significant difference, $p<0.05$ Significant difference, the same below

Table 3: Comparison of test index scores (before and after) in the control group.

Test Indicators	Before	After	P
30 m(s)	4.16±0.13	4.03±0.13	<0.05
60m(s)	7.40±0.12	7.16±0.18	<0.05
100m(s)	12.00±0.37	11.79±0.25	>0.05
200m(s)	25.07±1.83	24.28±0.76	>0.05

It is found from Table 3 that in the four indicators of 30 meters, 60 meters, 100 meters, and 200 meters, the students who use traditional strength training for training have better results after 6 weeks than the pre-test results. Among them, 30 meters increased by 0.13 seconds, and 60 meters increased by 0.24

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seconds. The paired sample t test showed that the difference between the pretest and the post-test was significant ($p<0.05$). 100 meters improved by 0.21 seconds, and 200 meters improved by 0.79 seconds, but the paired sample t-test showed that the difference between the pre-test and post-test was not significant ($p>0.05$).

From the results in Table 4, it is found that in the four indicators of 30 meters, 60 meters, 100 meters and 200 meters, the students' performance after 6 weeks is better than that of the pre-test. Among them, 30 meters increased by 0.08 seconds, but the paired sample t test showed that the difference between the pre-test and post-test of the students in the experimental group was not significant; 60 meters increased by 0.27 seconds, 100 meters increased by 0.42 seconds, and 200 meters It improved by 1.46 seconds, and the scores of 100 meters and 200 meters improved significantly. The paired sample t test showed that the differences between the pre-test and post-test of the students in the experimental group were significant ($p<0.05$).

Table 4: Comparison of test index scores (before and after) of the experimental group.

Test indicators	Before	After	P
30 m(s)	4.16±0.08	4.08±0.10	>0.05
60m(s)	7.41±0.15	7.14±0.16	<0.05
100m(s)	11.99±0.35	11.57±0.32	<0.05
200m(s)	25.07±1.33	23.61±0.79	<0.05

Table 5 shows that the experimental group and the control group have similar scores in the 30-meter and 60-meter tests. In the 30-meter score, the control group is 0.05 seconds faster than the experimental group; in the 60-meter score, the experimental group is 0.02 seconds faster than the control group, suggesting that 30 meters There is no significant difference between the scores of 60 meters and 60 meters ($p>0.05$). It can be inferred that traditional strength training or high-strength training can effectively improve the sprint ability. In the 100-meter and 200-meter test indicators, the 100-meter score of the experimental group is 0.22 seconds faster than the control group, and the 200-meter score of the experimental group is 0.67 seconds faster than the control group. In the paired sample t test, it is suggested that 100 meters, 200 meters The differences between the grades of m are significant ($p<0.05$). It can be inferred that functional strength training can effectively improve the ability of sprinting.

Table 5: Comparison of test index scores (post-test) between the experimental group and the control group.

Test indicators	experimental group	control group	p
30 m(s)	4.08±0.10	4.03±0.13	>0.05
60m(s)	7.14±0.16	7.16±0.18	>0.05
100m(s)	11.57±0.32	11.79±0.25	<0.05
200m(s)	23.61±0.79	24.28±0.66	<0.05

4. Conclusion and Recommendations

4.1. Conclusions

4.1.1. Pre-experimental tests

There was no significant difference in the 30-meter and 200-meter scores between the experimental group and the control group, indicating that the two groups of students had similar abilities in sprint acceleration and speed endurance.

4.1.2. Post-experimental tests

(1)Traditional strength training: For the control group, after 6 weeks of traditional strength training, the results of 30 meters and 60 meters were significantly improved, indicating that traditional strength training can help improve acceleration and sprint ability. However, in the 100-meter and 200-meter tests, the performance improvement was not obvious, possibly because traditional strength exercises are less effective at improving longer distances.

(2)Functional strength training: After 6 weeks of functional strength training, the students in the experimental group made significant progress in the 30-meter, 60-meter, 100-meter and 200-meter tests. Especially in the 100-meter and 200-meter tests, the students improved significantly, which shows that functional strength training has a more significant effect on improving sprinters' speed endurance in the second half.

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(3) Comparing the experimental group and the control group: In the 30-meter and 60-meter tests, the scores of the two groups of students are similar, indicating that traditional strength training and functional strength training have similar effects on improving initial speed. However, the experimental group was significantly better than the control group in the 100-meter and 200-meter tests, indicating that functional strength training has a more significant effect on improving sprinters' sprint speed in the second half of the race.

The above research results can reveal that the two strength training methods have similar effects in improving athletes' explosive power, but functional strength training can better improve sprinters' second-half acceleration speed. This shows that functional strength training has obvious advantages over traditional strength training in improving sprinters' specific abilities.

4.2. Recommendations

1) Sprinters should design training cycles reasonably, organically integrate functional strength training and traditional strength training, and comprehensively improve muscle explosive power.

2) Functional strength training should be based on the characteristics of sprinting, designing complex multi-dimensional movements to enhance the stability of the core area.

3) Future research can expand the sample size, extend the training time, and examine the pertinence of strength training at different training stages.

4) It can be studied in conjunction with technical training, psychological control and other factors to make the conclusions more instructive.

5) The intensity of strength training should be tailored to individual conditions and personalized based on the athletes' physical conditions. Personal characteristics and needs need to be considered when developing a training program[5].

The results of this study can help provide scientific basis for sprint physical training, and select appropriate strength training methods according to individual needs to improve students' performance and speed qualities. However, the cooperation between sprint speed quality training and technical and psychological training still needs to be studied in depth. It is believed that with the continuous deepening of research on sprint speed quality, the training effect of sprinters can be further improved [6].

This study fully proves that functional strength training can significantly improve the speed and speed endurance of sprinters, and has broad application prospects for improving the competitive level of sprinters. This study may still have some limitations, such as factors such as sample size and research time. Future research can further expand the sample size, extend the training time, and consider other factors that may affect the speed quality to obtain more comprehensive and accurate conclusions. It can also further explore the adaptability of different training programs to different populations and the sustainability of long-term training effects.

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