

STRENGTH TRAINING EFFECTS ON LOWER LIMB EXPLOSIVE POWER IN ATHLETES



ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

EFEITOS DO TREINAMENTO DE FORÇA SOBRE O PODER EXPLOSIVO DO MEMBRO INFERIOR EM ATLETAS

EFFECTOS DEL ENTRENAMIENTO DE FUERZA SOBRE LA POTENCIA EXPLOSIVA DEL MIEMBRO INFERIOR EN LOS ATLETAS

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ABSTRACT

Introduction: In track and field events, the force generated by running, jumping, and throwing starts from the lower limbs and is transmitted from bottom to top, forming a complete dynamic chain. **Objective:** Study the effect of different combined strength training methods on the explosive strength of the lower limbs of track and field athletes. **Methods:** Twenty members of the track and field team were selected as research subjects and divided into two groups, A and B. Group A performed the maximum resistance training method, and group B performed the sub-maximal resistance training method and underwent 12 weeks of different combined strength training. **Results:** After 12 weeks of training, there was a significant difference in the results of the two groups of students in the approach run (male $P=0.034$, female $P=0.021$), and the results of experimental group B improved significantly. **Conclusion:** The maximum resistance training method can most effectively improve the explosive performance of the lower limbs of track and field practitioners. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Athletes; Strength Training; Lower Limbs.

RESUMO

Introdução: Em eventos de atletismo, a força gerada pela corrida, salto e arremesso parte dos membros inferiores é transmitida de baixo para cima, finalmente formando uma cadeia dinâmica completa. **Objetivo:** Estudar o efeito de diferentes métodos combinados de treinamento de força sobre a força explosiva dos membros inferiores dos esportistas de atletismo. **Métodos:** Foram selecionados 20 membros da equipe de atletismo como objetos de pesquisa e divididos em dois grupos, A e B. O grupo A realizou o método de treinamento de resistência máxima, e o grupo B realizou o método de treinamento de resistência submáxima, sendo submetidos a 12 semanas de diferentes treinamentos de força combinados. **Resultados:** Após 12 semanas de treinamento, houve uma diferença significativa nos resultados dos dois grupos de estudantes na corrida de aproximação (masculino $P=0,034$, feminino $P=0,021$), e os resultados do grupo experimental B melhoraram significativamente. **Conclusão:** O método de treinamento de resistência máxima pode melhorar de forma mais eficaz o desempenho explosivo dos membros inferiores dos praticantes de atletismo. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Atletas; Treinamento de Força; Membros Inferiores.

RESUMEN

Introducción: En las pruebas de atletismo, la fuerza generada por la carrera, el salto y el lanzamiento parte de las extremidades inferiores y se transmite de abajo a arriba, formando finalmente una cadena dinámica completa. **Objetivo:** Estudiar el efecto de diferentes métodos combinados de entrenamiento de la fuerza sobre la fuerza explosiva de los miembros inferiores de los atletas de atletismo. **Métodos:** Se seleccionaron veinte miembros del equipo de atletismo como sujetos de investigación y se dividieron en dos grupos, A y B. El grupo A realizó el método de entrenamiento de resistencia máxima, y el grupo B realizó el método de entrenamiento de resistencia submáxima, y se sometió a 12 semanas de diferentes entrenamientos de fuerza combinados. **Resultados:** Después de 12 semanas de entrenamiento, hubo una diferencia significativa en los resultados de los dos grupos de estudiantes en la carrera de aproximación (hombre $P=0,034$, mujer $P=0,021$), y los resultados del grupo experimental B mejoraron significativamente. **Conclusión:** El método de entrenamiento de resistencia máxima puede mejorar de forma más eficaz el rendimiento explosivo de los miembros inferiores de los practicantes de atletismo. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Atletas; Entrenamiento de Fuerza; Miembros Inferiores.



DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0592

Article received on 10/31/2022 accepted on 11/30/2022

INTRODUCTION

In track and field events, the force generated by running, jumping, and throwing starts from the lower limbs, and is transmitted from bottom to top, eventually forming a complete dynamic chain. According to relevant studies, in the process of force transmission, the lower limbs account

for about 51%, and the upper limbs account for about 46%.¹ Explosive power is a form of fast power, and it has also become a physical quality of special concern due to its important role in sports performance. There are various training methods for developing explosive power in modern sports training, according to the relationship with special projects, there

are general physical explosive power training and explosive power training of special physical fitness closely related to special projects; Other methods include weight-bearing and methods of overcoming one's own body weight, such as weight-bearing jumps, deep jumps and other exercises.²

Wong J M pointed out that the combination of different strength and technical training methods has stronger physical stimulation and faster recovery for athletes. At the same time, the combined strength training method consumes relatively less protein, and the body has strong adaptability and rapid recovery.³ Ruffault A conducted 26 football and basketball players through the combination of hyper isometric exercises and weight-bearing hyper isometric exercises, and concluded that these two training methods have an effect on the improvement of the athletes' lower body strength, however, the combination training method has better effect on the development of muscle power.⁴ Eetvelde B found through research on the explosive training combination of track and field, the explosive training of track and field athletes can no longer use a single training method, among the combined strength training methods, the training methods of maximum load and small load and fast speed can effectively improve the explosive power of track and field athletes.⁵

The author took 20 members of the track and field team as the research object, and observed the comparison of the effects of maximal resistance training and submaximal resistance training on the explosive power of the lower limbs, explore the effects of different combined strength training methods on the explosive power of the lower limbs of track and field athletes, and to provide a theoretical basis for the scientific development of track and field training.⁶

METHOD

Research object

This study took 20 members of a college track and field team (10 men and 10 women) as the research objects, and the subjects were divided into A and B2 groups (5 men and 5 women in each group). The average age is 18 years old, the average height of boys is 177CM, the average weight is 66kg, the average height of girls is 168CM, the average weight is 56kg, and they are in good health, all the subjects volunteered to participate in the experiment.

Documentation method

Through CNKI, Wanfang Database, etc., we searched and collected literature on lower body explosive strength training, analyze and organize the search information.

Mathematical Statistics

SPSS17.0 was used for data analysis.⁷

Experimental method

The research subjects underwent 12-week track and field training, 5 times a week, before the end of each track and field training, the two groups of players were given different combined strength training. Group A: Maximum resistance training method (85%-100% IRM half squat) + 30% quick squat take-off for 5 times; Group B: Perform sub-maximal resistance training (75% to 85% IRM half squat) + 30% fast straddling jumps 5 times.

Test indicators

Before the start of training, after 6 weeks of training and after 12 weeks of training, each group of players was tested to test the approach height, the height on the spot (SJ) and the height on the spot (CMJ). Note: SJ refers to the half-binding position on the spot, with both hands

stretched above the head, and then jump up to the one-handed touch board after binding; In-situ touch height CMJ refers to standing in place, with both hands stretched above the head, and quickly tied to jump, touch the board with one hand.⁸

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Nanjing Normal University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Analysis of test results before the experiment

The analysis of body shape index test results is shown in Table 1, before the experiment, there was no significant difference in age, height and weight among the body shape indexes of male and female players in group A and group B ($P > 0.05$).

Analysis of test results after the experiment

The results of the comparison of physical fitness indicators before the experiment and after 12 weeks of the experiment are shown in Table 2, before and after 12 weeks of training, the male and female team members of Group A and Group B had very significant differences in approaching height, SJ, and CMJ ($P < 0.01$), it shows that the two combined strength training methods can significantly improve the lower body explosive power of track and field athletes.

Before the experiment, after 6 weeks of the experiment and after 12 weeks of the experiment, the comparison results of the average scores of physical fitness indicators are shown in Figure 1, before the experiment, after 6 weeks of the experiment, and after 12 weeks of the experiment, the CMJ scores of men in group B and women in group B were significantly improved compared with those of men in group A and women in group A; However, the SJ scores of group A men and group A women were significantly higher than those of group B men and group B women.

Table 1. Test results of body shape indicators of players in Groups A and B2.

Group	Gender	Age	Height/cm	Weight/kg
Group A	male	18.1±1.2	177.1±1.0	65.3±5.5
Group B	male	18.4±1.1	176.9±1.1	66.2±4.9
P		P	0.6	0.9
Group A	Female	17.9±1.0	168.0±0.8	56.1±5.1
Group B	Female	18.0±0.9	168.4±1.2	56.6±2.1
P		0.3	0.3	0.6

Table 2. The results of the comparison of physical fitness indicators before and after the experiment of the team members of A and B2 groups.

Index	Group	Gender	Before experiment	After 12 weeks of experiment	P
Approach touch height/m	Group A	male	2.97±0.12	3.03±1.35	0.002
	Group B	male	2.97±1.23	3.06±0.89	0.001
	Group A	Female	2.64±2.87	2.69±1.17	0.000
	Group B	Female	2.64±1.06	2.72±0.99	0.001
In situ touch height SJ/m	Group A	male	2.77±0.35	2.82±0.77	0.000
	Group B	male	2.77±0.14	2.80±1.65	0.001
	Group A	Female	2.21±4.12	2.26±3.61	0.001
	Group B	Female	2.21±2.56	2.24±3.05	0.000
In situ touch height CMJ/m	Group A	male	2.78±0.42	0.81±0.09	0.000
	Group B	male	2.78±2.04	2.84±1.11	0.000
	Group A	Female	2.23±5.02	2.24±1.65	0.001
	Group B	Female	2.23±1.67	2.27±4.03	0.009

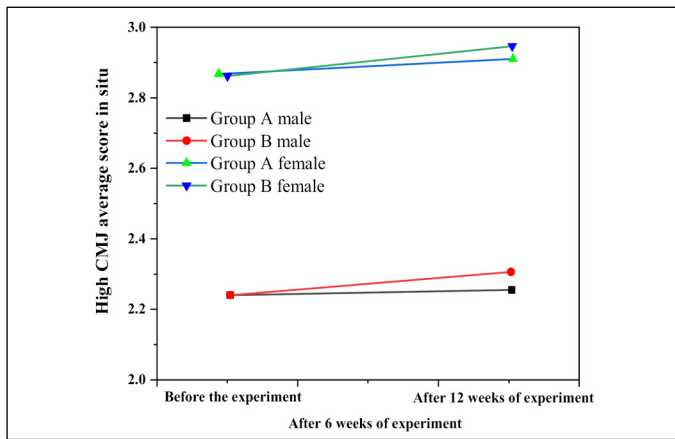


Figure 1. Changes in the average score of CMJ during the experiment.

As shown in Table 3, the men's run-up and touch-up performance in experimental group A increased by 1.3%, in the experiment group B, the men's run-up and touch-high performance increased by 1.7%, and there was a significant difference between the two groups ($P=0.034$ ($0.01 < P < 0.05$)); In experiment group A, the run-up and touch-up performance of females increased by 1.2%, while in experimental group B, the run-up touch-up score increased by 1.6%, there was a significant difference between the two groups ($P=0.021$ ($0.01 < P < 0.05$)). This shows that the combined training method of experimental group B, compared with the experimental group A combined training method, it is more effective for track and field athletes to improve their run-up and high performance. A run-up and touch-up requires a certain speed basis, the improvement of muscle rapid contraction ability can effectively improve the performance of approaching and reaching heights, which may be due to the fact that after 75% to 85% of IRM half-squat training, group B performed 30% of rapid straddling and jumping exercises, effectively stretch the leg muscles, thereby improving the rapid contraction of the muscles.⁹

This shows that, the combined training method of experimental group B is more effective than the combined training method of experimental group A in improving the CMJ performance of track and field athletes. The principle of running and touching height is the same,

Table 3. The test results of the single factor analysis of variance test for the improvement of the run-up touch height.

Group	Gender	Improve grades/m	Improve grade percentage/%	P
Group A	male	0.058±0.008	1.30	0.034
Group B	male	0.089±0.009	1.70	
Group A	Female	0.044±0.009	1.20	0.021
Group B	Female	0.077±0.010	1.60	

and they all belong to the projects that require higher eccentric strength of muscles. Therefore, in order to improve the performance of the CMJ, it is necessary not only to improve the maximum strength of the muscles, but also to improve the flexibility and coordination of the muscles.

DISCUSSION

12 weeks of training, the training method of "maximum resistance training method (85%~100% IRM half squat) + 30% quick squat and take-off for 5 times" is more effective in improving the SJ of track and field athletes; The "sub-maximal resistance training method (75%-85% IRM half squat) + 30% fast stride and jump for 5 times" is more effective in improving the CMJ of track and field athletes in squat jumping and approaching. Therefore, the maximum resistance training method has obvious promotion effect on the lower body explosive power of track and field athletes, can be used in track and field training.¹⁰

CONCLUSION

Different methods of strength training can develop athlete's lower body explosive power to different degrees, but a combination of strength training methods may be more effective. Limited by my own ability, there are not only four physical qualities used in the experiment to reflect the explosive power of the lower limbs of athletes, in the future, researchers can use more indicators to comprehensively reflect the explosive power of the lower limbs of athletes.

The author declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Kai Yang: writing and data analysis.

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