

INFLUENCE OF LOWER LIMB RESISTANCE TRAINING ON THE EXPLOSIVE QUALITY OF ATHLETES



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INFLUÊNCIA DO TREINAMENTO DE RESISTÊNCIA NOS MEMBROS INFERIORES SOB A QUALIDADE EXPLOSIVA DOS ATLETAS

INFLUENCIA DEL ENTRENAMIENTO DE RESISTENCIA EN LOS MIEMBROS INFERIORES SOBRE LA CALIDAD EXPLOSIVA DE LOS ATLETAS

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ABSTRACT

Introduction: Athletics demands high explosive strength from its athletes, and complementary techniques are constantly implemented to maintain the competitive level of its practitioners. And is believed that resistance training can benefit track and field athletes. **Objective:** Explore whether lower limb resistance exercise can effectively increase the explosive quality of track and field athletes. **Methods:** We randomly divided 88 professional track and field athletes into experimental and control groups, who underwent training for 12 weeks. The experimental group received lower limb-specific resistance training, while the control group underwent general training. **Results:** After the lower limb resistance training intervention, the athletes showed evolution in the standing triple jump, from $7.63 \pm 0.179\text{m}$ to $7.94 \pm 0.12\text{m}$. The average 30-meter running time also showed gains from $4.55 \pm 0.23\text{s}$ to $4.17 \pm 0.13\text{s}$, and the YOYO running distance increased from $979.48 \pm 134.11\text{m}$ to $1139.28 \pm 107.84\text{m}$. The sitting flexion distance increased from $16.91 \pm 4.86\text{cm}$ to $17.65 \pm 3.39\text{cm}$, and the solid ball throwing distance went from $20.03 \pm 2.05\text{m}$ to $21.24 \pm 2.35\text{m}$. **Conclusion:** Lower limb resistance training can effectively improve the explosive power of professional track and field athletes. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Track and Field; Lower Limbs; Muscle Strength; Training; Endurance.

RESUMO

Introdução: O atletismo exige muita força explosiva de seus atletas e técnicas complementares são constantemente implementadas para manter o nível competitivo de seus praticantes. Acredita-se que o treinamento de resistência possa beneficiar os praticantes de atletismo. **Objetivo:** Verificar se o exercício de resistência dos membros inferiores pode efetivamente aumentar a qualidade explosiva dos praticantes de atletismo. **Métodos:** Dividiu-se aleatoriamente 88 atletas profissionais de atletismo em grupo experimental e grupo de controle, submetidos a treinamento por 12 semanas. O grupo experimental recebeu um treinamento de resistência específico aos membros inferiores, enquanto o grupo controle passou por um treinamento geral. **Resultados:** Após a intervenção de treinamento de resistência nos membros inferiores, os atletas apresentaram evolução no salto triplo de pé, de $7,63 \pm 0,179\text{m}$ para $7,94 \pm 0,12\text{m}$. O tempo médio de corrida de 30 metros também apresentou ganhos de $4,55 \pm 0,23\text{s}$ para $4,17 \pm 0,13\text{s}$, e a distância de corrida YOYO elevou-se de $979,48 \pm 134,11\text{m}$ para $1139,28 \pm 107,84\text{m}$. A distância de flexão em posição sentada evoluiu de $16,91 \pm 4,86\text{cm}$ para $17,65 \pm 3,39\text{cm}$, e a distância de arremesso com bola sólida foi de $20,03 \pm 2,05\text{m}$ para $21,24 \pm 2,35\text{m}$. **Conclusão:** O treinamento de resistência nos membros inferiores pode efetivamente melhorar o poder explosivo dos profissionais de atletismo. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Atletismo; Membros Inferiores; Força Muscular; Treino de Resistência.

RESUMEN

Introducción: El atletismo exige mucha fuerza explosiva de sus atletas y técnicas complementarias son constantemente implementadas para mantener el nivel competitivo de sus practicantes. Se cree que el entrenamiento de resistencia puede beneficiar a los practicantes de atletismo. **Objetivo:** Explorar si el ejercicio de resistencia de las extremidades inferiores puede aumentar eficazmente la calidad explosiva de los practicantes de atletismo. **Métodos:** Se dividió aleatoriamente a 88 atletas profesionales de atletismo en un grupo experimental y un grupo de control, que se sometieron a entrenamiento durante 12 semanas. El grupo experimental recibió un entrenamiento de resistencia específico para las extremidades inferiores, mientras que el grupo de control se sometió a un entrenamiento general. **Resultados:** Tras la intervención de entrenamiento de resistencia de miembros inferiores, los atletas mostraron evolución en el triple salto de pie, de $7,63 \pm 0,179\text{m}$ a $7,94 \pm 0,12\text{m}$. El tiempo medio de carrera de 30 metros también presentó ganancias, de $4,55 \pm 0,23\text{s}$ a $4,17 \pm 0,13\text{s}$, y la distancia de carrera YOYO aumentó de $979,48 \pm 134,11\text{m}$ a $1139,28 \pm 107,84\text{m}$. La distancia de flexión en posición sentada evolucionó de $16,91 \pm 4,86\text{cm}$ a $17,65 \pm 3,39\text{cm}$, y la distancia de lanzamiento con balón sólido fue de $20,03 \pm 2,05\text{m}$ a $21,24 \pm 2,35\text{m}$. **Conclusión:**



Descriptores: Atletismo; Extremidades Inferiores; Fuerza Muscular; Entrenamiento de Resistencia.

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INTRODUCTION

Lower limb exercise is the most basic training of track and field events, and strength quality is gradually valued by all types of sports activities. In the process of track and field competitions, running, jumping and throwing are the main movements in track and field sports.¹ The generation of sports power is from bottom to top, which ultimately forms a complete power system. Explosive power is highly concerned in various sports activities, which is the main training content of athletes in sports training. Track and field competitions mainly include running, jumping and throwing. In the process of energy transfer, lower limb sports account for about 51%, and upper limb sports account for about 47%.² The explosive force of lower limbs is the key for track and field athletes to achieve good results. Therefore, we can improve the explosiveness of athletes in track and field competitions by training lower limb resistance exercises. In many forms of resistance exercise, resistance exercise is the most effective for stimulating muscles and bones.³ Its influence on muscle is mainly shown in four aspects: enhancing muscle strength, increasing muscle expansion, improving muscle resistance and increasing muscle explosive force. Among them, strengthening muscle strength and promoting muscle expansion are the two most widely used training methods in field sports training.⁴ Exercise resistance and supplements can improve protein synthesis in muscle and bone in a short time. Short term resistance training can prevent the reduction of muscle protein synthesis and loss of strength. The explosive training of athletes is very important, because athletes need strength, speed, endurance and other physical qualities to complete the project.⁵ These qualities have a great impact on the quality of athletes who have completed the project. Therefore, in order to improve the level of athletes, explosive force training must be carried out. In view of the above problems, the coach of track and field athletes should actively explore the direction of improving the explosive force of athletes to find the most effective training methods.⁶ This paper studies the relationship between the explosive ability of track and field athletes and lower limb resistance training, Try to find a way to stimulate athletes' sports ability and improve individual athletes' sports level. With the development of sports in China, we should pay more attention to sports and gradually cultivate some excellent athletes.⁷ Therefore, this article will start from the explosive force training of track and field athletes, explore the impact of lower limb resistance training on the explosive force of track and field athletes, in order to provide practical reference for track and field athletes.

METHOD

Experimental object

The subjects of this study are 88 professional track and field athletes, all of whom have been trained for more than 6 years and are national level 2 athletes. The experimental place is the track and field sports stadium. The study and all the participants were reviewed and approved by Ethics Committee of Hebei Sport University (NO.HBSU-PT20N018). These 88 professional track and field athletes are divided into two groups, one is the experimental group, and the other is the control group. The number of each group is 44, and there is no significant difference between the members of each group. The average height of 44 track and field athletes

in the experimental group was 176.704 ± 5.772 cm, the average age was 20.317 ± 0.798 years, and the average weight was 70.693 ± 7.942 kg. The average age of 44 track and field athletes in the control group was 20.451 ± 0.815 years old, the average height was 174.114 ± 5.622 cm, and the average weight was 68.448 ± 7.982 kg. The basic information of the two groups of track and field athletes is shown in Table 1.

Experimental methods

The experiment lasted for 12 weeks. The experimental group received lower limb resistance training intervention 4 times a week, and the control group received normal track and field training every week. Before the experiment, all subjects signed the Informed Consent for the experiment and were subject to the arrangement of the experiment.

RESULTS

Effect of lower limb resistance exercise on lower limb explosive force of track and field athletes

Table 2 shows the changes of all indicators of lower limb explosive force of 44 track and field athletes in the control group after 12 weeks of general training.

For track and field athletes, the explosive force of lower limbs is very important, and the strength of the explosive force of lower limbs directly affects the performance and play of track and field athletes. After general training, the indexes of lower limb explosive force of track and field athletes have not changed significantly, and each index has slightly improved, but the effect of improvement is very small, and the static squatting jump has the greatest effect. At the same time, it shows that general training can not effectively improve the explosive power of lower limbs of track and field athletes in a short time. If we want to improve the explosiveness of track and field athletes through traditional general training, the effect is very slow.

Table 3 shows the changes of indexes of lower limb explosive force of 44 track and field athletes after 12 weeks of general training in the experimental group.

After the resistance exercise of lower limbs, the indexes of standing long jump, reverse jump, fall jump and other explosive force of lower limbs of track and field athletes have not changed significantly, and each index has slightly improved. Although the effect of improvement is very

Table 1. Summary of basic information of two groups of subjects.

Group	Experience group	Control group
Age (y)	20.317 ± 0.798	20.451 ± 0.815
Height (cm)	176.704 ± 5.772	174.114 ± 5.622
Weight (kg)	70.693 ± 7.942	68.448 ± 7.982

Table 2. Influence of general training on explosive power of lower limbs of track and field athletes.

Option	Before experiment	After experiment	P value
Standing long jump (m)	2.596 ± 0.062	2.576 ± 0.076	$P < 0.01$
Vertical jump in situ (cm)	50.961 ± 3.043	51.923 ± 4.288	$P < 0.05$
Reverse jump (cm)	54.682 ± 3.544	55.078 ± 3.748	$P < 0.01$
Drop Jump (cm)	53.987 ± 2.978	55.823 ± 2.993	$P < 0.05$
Static squat jump (cm)	51.426 ± 4.931	56.025 ± 4.962	$P < 0.01$

small, it is significantly higher than the control group. The vertical jump and static squat jump can improve the effect obviously. The lower limb resistance exercise can effectively improve the falling jump, static squat jump and other indicators of track and field athletes, which shows that the lower limb resistance exercise can effectively improve the explosive power of the lower limbs of track and field athletes in a short time. We can add lower limb resistance training in daily track and field training, so as to improve the comprehensive indexes of standing long jump, vertical jump, reverse jump, fall jump, static squat jump, etc. of track and field athletes.

Influence of lower limb resistance exercise on comprehensive explosive power of track and field athletes

Table 4 shows the changes of lower limb comprehensive explosive force of 44 track and field athletes in the experimental group after 12 weeks of general exercise.

After general practice, the comprehensive indexes of 44 track and field athletes, such as standing triple jump, YOYO running, sitting forward bending, and throwing back solid ball, have been improved, but the effect is not significant. Only $P < 0.05$ for YOYO running, and $P < 0.01$ for other indexes, which shows that general training cannot effectively improve the explosive power of lower limbs of track and field athletes.

Table 5 shows the changes of lower limb comprehensive explosive force of 44 track and field athletes in the experimental group after 12 weeks of ordinary lower limb resistance training.

After the resistance training, the indexes of the explosive power of the lower limbs of the track and field athletes, such as standing triple jump, sitting forward bending, and throwing solid ball back, did not change significantly, and all the indexes were slightly improved. Although the improvement effect was very small, it was significantly higher than the YOYO running in the control group. At the same time, there was a decline in the 30 meter run. The lower limb resistance exercise can effectively improve the YOYO running and other indicators of track and field athletes, which shows that the lower limb resistance exercise can effectively improve

Table 3. The Influence of Lower Limb Resistance Training on the Lower Limb Explosive Force of Athletes.

Option	Before experiment	After experiment	P value
Standing long jump (m)	2.617 ±0.052	2.723 ±0.037	$P < 0.01$
Vertical jump in situ (cm)	51.661 ±3.512	55.249 ±2.893	$P < 0.01$
Reverse jump (cm)	55.188 ±3.139	57.373 ±2.860	$P < 0.05$
Drop Jump (cm)	53.987 ±3.107	55.823 ±3.053	$P < 0.01$
Static squat jump (cm)	51.625 ±3.353	57.552 ±3.240	$P < 0.01$

Table 4. Influence of general exercise on explosive power of lower limbs of track and field athletes.

Option	Before experiment	After experiment	P value
Standing triple jump (m)	7.569 ±0.197	7.751 ±0.188	$P < 0.01$
30 meter run (s)	4.555 ±0.222	4.362 ±0.231	$P < 0.01$
YOYO Run (m)	1004.800 ±134.112	1015.928 ±114.477	$P < 0.05$
Forward bending of sitting body (cm)	15.931 ±2.353	14.853 ±1.626	$P < 0.01$
Backthrow solid ball (m)	20.958 ±2.229	21.900 ±1.144	$P < 0.01$

Table 5. The Effect of Lower Limb Resistance Training on the Lower Limb Explosive Force of Athletes.

Option	Before experiment	After experiment	P value
Standing triple jump (m)	7.638 ±0.179	7.948 ±0.126	$P < 0.01$
30 meter run (s)	4.553 ±0.237	4.179 ±0.138	$P < 0.01$
YOYO Run (m)	979.485 ±134.112	1139.284 ±107.840	$P < 0.01$
Forward bending of sitting body (cm)	16.919 ±4.865	17.654 ±3.392	$P < 0.01$
Backthrow solid ball (m)	20.034 ±2.051	21.249 ±2.359	$P < 0.01$

the explosive power of the lower limbs of track and field athletes in a short time. The lower limb resistance training can be added in the daily track and field training, so as to improve the comprehensive indexes of the track and field athletes, such as standing triple jump, YOYO running, sitting forward bending, and throwing back solid balls.

DISCUSSION

Athletes need to have good physical fitness, especially in high-intensity long-distance running competitions, they need better physical fitness to provide sports support. In track and field competitions, athletes often feel tired or lack of physical endurance in long-distance competitions. Due to the physiological structure of the human body, physical strength will be rapidly consumed and decreased with a long period of exercise. After a long period of anaerobic exercise, lactic acid will be produced. Lactic acid will make athletes feel tired, and then affect the performance of athletes. Therefore, in order to enable athletes to play a good level, it is essential for track and field athletes to improve their explosive quality in a short time. Enhancing the explosive power of athletes can reduce fatigue in sports competitions, thus enhancing the muscle function in continuous sports, thus improving the physical fitness of athletes. One of the most important muscles in the lower limb muscle group is the quadriceps femoris. In order to develop the overall strength of the lower limb, special training will be added to the quadriceps femoris during strength training. The training of explosive force is one of the most important factors affecting sports performance. The explosive force regulated by the central nervous system includes speed, endurance, flexibility and balance. Lower limb resistance training can have a positive impact on the human body. In particular, the high-intensity anaerobic sports of track and field often determine the final direction of the competition in the final sprint stage. So the explosive force of lower limbs in a short time is the key to victory. Compared with the traditional anti resistance training, the study found that it can significantly improve the energy supply efficiency of ATP-CP, improve the oxygen tolerance and adaptability of the target muscle group, and improve the anti lactic acid ability, speed endurance ability and anaerobic exercise ability of the body.

If track and field athletes want to achieve good results in competitions, they also need track and field athletes to improve the quality of muscles in daily training. Because the muscle group strength of track and field athletes is the key to ensuring the core strength of track and field athletes, so strengthening the muscle group strength can help improve the core strength of track and field athletes, and can also effectively improve the sports performance of track and field athletes. In addition, we should pay more attention to the muscle strength training of track and field athletes, and should also focus on it. This is to train the strength of the athletes' arm muscles, so that the core muscles of track and field athletes can be strengthened. In order to enhance the muscle strength of track and field athletes, effective resistance training can be carried out for the lower limbs to improve the muscle strength. Similarly, track and field athletes can carry out effective training for the shoulder muscle group strength to improve the shoulder strength. Therefore, track and field athletes should pay full attention to the muscle group strength training. If they want to give full play to their personal strength in future competitions, and then win in the competition, Then we should often carry out reasonable training for our own muscle groups, and an important way to improve the explosiveness of track and field athletes is the lower limb resistance training.

CONCLUSION

In this paper, 88 track and field athletes were trained in lower limb resistance training and general training to explore the impact of lower limb resistance training on the explosive quality of track and field athletes.

The explosive power of the athletes in the control group of general training has been improved, but the improvement effect is very small, and the extent of improvement is significantly less than that of the athletes in the lower limb resistance training. The indexes of explosive force of track and field athletes who have undergone lower limb resistance training after the experiment are better than those of track and field athletes who have undergone general training. The lower limb resistance training can be added to the daily training of track and field athletes. At the same time, professional coaches are required to guide the training process to prevent injuries to track and field athletes caused by improper training. Lower limb resistance training can effectively improve the explosive power of track and field athletes, so as to improve all aspects of the comprehensive quality of track and field athletes, promote track and

field athletes to achieve better results in the competition, improve the overall level of China's track and field sports, and promote the further development of China's track and field sports.

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